ENLARGED 2nd AUTUMN SPECIAL with TABLOID RADIO COURSE

Amateur Wireless

and Radiovision

3d Every Wednesday

CHEAPEST WAYS OF GETTING HIGH TENSION

WHAT THE IDEAL FOUR WILL DO

TELEVISION

CIGAR-BOX SET

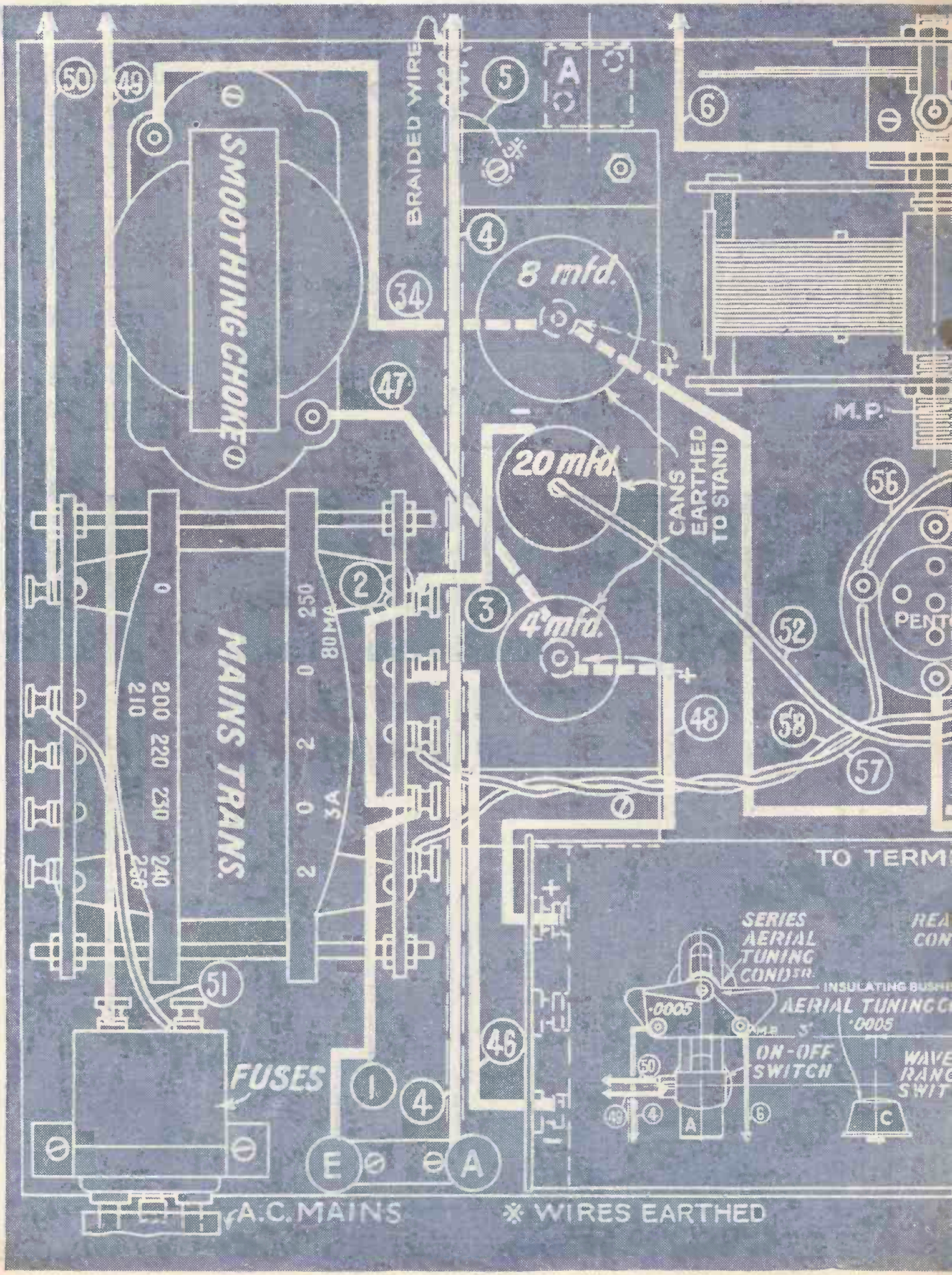
The BEGINNER'S HOW and WHY of the NEW RADIO

"LIVE" COMPONENTS TELL THEIR OWN STORIES!

Full-size Blueprint for Building Amazing A.C. Two!

Vol. XXIII. No. 589. Registered at G.P.O. as a newspaper September 23, 1933

FULL-SIZE LAYOUT AND WIRING GUIDE FOR THE CONSOLECTRIC TWO (see pages 496-497)



No. 589. Vol. XXIII. SEPTEMBER 23, 1933

Amateur Wireless & RADIOVISION

Britain's Leading Radio Weekly for Constructor, Listener and Experimenter

Editor: D. SISSON RELPH | Radiovision Editor: H. CORBISHLEY | Editor-in-Chief: BERNARD E. JONES | Technical Editor: J. H. REYNER, B.Sc.(Hons.), A.M.I.E.E. | Assistant Editor: ALAN HUNTER

Research Consultants: W. JAMES and PERCY W. HARRIS M.Inst.Rad.E.

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

Radio Gossip of the Week

Our Second "Special"

HERE we are with a second bumper autumn number of AMATEUR WIRELESS! We introduce to you in our centre pages a *tabloid radio course* conceived on entirely novel lines. An essentially "live" feature every newcomer to radio will welcome.

You must not miss our *Consolectric Two*—fully described in this issue—a novel mains set with a high-frequency pentode as detector.

Our *guide to power*, from batteries and mains, is another special feature we should specially like you to read.

We've worked hard on this number; and hope you like it!

◆ ◆ ◆

German Television Enterprise

THOSE Germans are very keen on ultra-short-wave television. We hear that they propose to erect a chain of twenty ultra-short-wave transmitters in the most important towns in Germany, and to send out 180-line pictures on the cathode-ray system. A high-power central medium-wave station would supply the equivalent sound. Whether the vision stations are to be synchronised or whether they will take it in turns to accompany the central sound station is not yet clear. Anyway, it shows which way the television wind is blowing, doesn't it?

◆ ◆ ◆

New Boon of Short Waves

DOCTORS have recently discovered that short waves, particularly ultra-short waves, can effect remarkable cures of deep-seated complaints. This news follows the well-known effect at wireless generating stations, where workers sometimes experience a rise of their temperatures to as much as 103 degrees, though they appear to suffer no ill effects. Short waves look like having a real medical value in future, when fevers may be induced by ultra-short-wave radiation.

◆ ◆ ◆

Wireless in the Army "war." An "enemy" scout in a light car equipped with radio, sending out messages while speeding across a field

Look out for something special from "The Experimenters" next week!

At the French Exhibition

PERHAPS the most striking feature of the tenth wireless exhibition that opened at the Grand Palais in Paris recently was the wholesale swing-over to the super-het type of set, straight sets being almost entirely absent. Quota restrictions have practically wiped out American competition in France, and the only sign of British influence was seen in one set that embodied Catkin valves!

◆ ◆ ◆

What About Photo-electric Cells?

IT appears that trains passing through Box Hill tunnel on the Dorking line do so in complete darkness, the reason being given that to light up the lamps at the stations on each side of the tunnel would cause too much delay.

Well, if that is so, why on earth don't the railway engineers adopt the photo-electric-cell idea, so that the lamps would automatically light up and switch off as the train went in and came out of the tunnel. The Americans and Germans do it—why not us?

DON'T MISS THESE!

	Page
My Test of the Ideal Four	482
Your Guide to Economical Power	487
Using the Relay Stations ...	495
The Consolectric Two ...	496
Solving the All-wave Tuning Problem	498
Tabloid Radio Course ...	500
Television Section	504

Mühlacker Closing Down

IN October the high-power Mühlacker station will be closed down for about two months in order that the power may be increased to 100 kilowatts. Meanwhile the old 1.5-kilowatt transmitter will carry on. London Regional listeners should notice a distinct decrease in interference, because the German is on the next wavelength to the London station, and often causes a "background."

◆ ◆ ◆

"Battle" Over Noisy Loud-speaker

ON receiving a neighbour's complaint about a nearby noisy loud-speaker, a police constable of Brockley, London, went to the offending house and remonstrated with the owners. The sequel was something like a "battle," in which kicks and punches were freely exchanged. One man was sent to prison for a week and a second was fined as a result, not of using a too loud loud-speaker, but for unduly resenting the constable's intrusion!

◆ ◆ ◆

Learning the B.B.C. Organ

WHAT a lot of fuss that organ at Broadcasting House seems to be causing. The latest *canard* is that only three organists—C. H. Trevor, Berkeley Mason and Thalben-Ball—are to be allowed to broadcast on it. The truth is that the B.B.C. wants as many first-class organists to play on it as possible. It will take time to get used to the quaint disposition of the stops, apparently, and even the best of organists have gone pale with fright on being shown the organ for the first time. As soon as possible the B.B.C. wants to get together a large rota of good organists and then the expense of this new organ can be justified by more frequent broadcasts.

News from Broadcasting House

By Our Special Commissioner

Hallo, Everybody!

I AM now taking you over to the B.B.C.; this week, next week, and for many weeks to come, I hope. Taking you over to Portland Place—to the headquarters of British broadcasting. I am taking you, rather than suggesting that you go yourself, just because they will not welcome you; will not let you past those ample commissionaires who so zealously guard the sacred portals of the B.B.C.'s "H.Q."

So come with me, and let us learn together how our ten-bob licence fees are spent.

Wireless Terms Travestied

Home-made Models

More Power to Droitwich?

FORGIVE me bringing up the subject of Droitwich again. It is rather in the news these days. Already, fantastic stories are being written of a station that is so far only at the concrete foundation stage. The latest is that Droitwich, although scheduled to be a 100-kilowatt station, really had another 100 of the best up its 700-foot aerial masts.

Don't you believe it! The utmost they could get out of that plant would be 150 kilowatts, but you can take it from me that the Post Office licence is for only 100 kilowatts, and the rest, such as it is, will be kept in reserve.

Your Modest Regionals

DID you know, by the way, that every one of the B.B.C.'s regional stations, in spite of its advertised 50 kilowatts, really has a potential power of over 60 kilowatts? The engineering boys of the B.B.C. don't believe in running a station at full blast, hence the unsuspected reserve I mention.

◆ ◆ ◆

Swap That Het!

HEARD that perfectly poisonous heterodyne whistle on London National? Excruciating! I had to switch over to the long-wave National, it was so bad. Down at Tatsfield, B.B.C. engineers are feverishly twiddling the knobs of their wavemeters trying to track down the offending foreigner causing all the bother.

So far they have failed, and so have the Brussels checkers. Meanwhile, as I write, that 3,000-cycle note continues to make a mockery of London National's 50 kilowatts. Oh, for Droitwich!

◆ ◆ ◆

Time, Gentlemen, 16 Times!

THOSE Empire listeners certainly do like our Big Ben. Sentimental reasons, I suppose. The B.B.C. has been so swamped with requests for more of Big Ben that it has decided to put the old fellow over really big. In future the Empire will get Big Ben no less than 16 times in every twenty-four hours. And that is not to mention the Greenwich pips.

With so much time by the clock no one in the Empire with a short-wave set need worry about getting the pip.

Cleaning Up Our Time Signals

TIME is under review at Broadcasting House. There is a feeling that we, of the British Isles, get too much of it over the wireless. Certainly you must have noticed the tendency to cut down the number of pips and chimes in the programmes lately.

Give them time signals, but keep them clean; that is the edict that has gone forth. By clean they mean free from the programmes; free from being superimposed on the tag-end of concerts, plays, and whatnot.

◆ ◆ ◆

Passing Portland Place

DO you ever? Pass by Portland Place, I mean? Because if you do, and it happens to be around lunchtime, listen carefully. Precisely at 1 p.m. you will be surprised—or would be if I hadn't told you this—to hear the sound of Big Ben very clearly chiming out the hour. The mystery is solved when I tell you that, high up on the roof of Broadcasting House, they have now finally fixed up a bank of powerful moving-coil loudspeakers, which relay by land-line the chimes of Big Ben once a day. A quaint custom, but the Director General likes it.

◆ ◆ ◆

Lining Them Up for Lucerne

DOES the Lucerne Plan keep you awake at night? Nor me, but, remote though it may seem, I think we ought to begin to sit up and take notice of it. This Lucerne Plan may make a lot of difference—after January 15, 1934—to our foreign-station reception.

What a mess-up if those seven stubborn countries refuse to sign on the dotted line; they have certainly refused up to the present. Finland, Greece, Holland, Hungary, Lithuania, Poland, and Sweden: a fairly formidable opposition they make, don't they?

Evidently the International Broadcasting Union think so, too, because a special meeting has been fixed for Amsterdam next month to try to bring the die-hards into the European wavelength share-out.

Let's hope everyone agrees to give the plan a trial. Otherwise . . . but I am no good at making flesh creep!

◆ ◆ ◆

Step on It, Sisters!

THOSE Eight Step Sisters have created a minor crisis among the studio officials at Broadcasting House. You see, when that noble pile was designed nobody imagined dancing girls would be needed for *sound* broadcasting, and so the Sisters, poor dears, cannot find anywhere to titivate themselves. Something will have to be done about this; we cannot listen to them if their make-up is the slightest little bit makeshift, can we now?

◆ ◆ ◆

Governors Must Advertise!

MOST of you know what a man of mystery is Montagu Norman, the Governor of the Bank of England; his brother, R. C. Norman, seems to share the family habit of reticence. Did you, for example, realise that "R. C." was vice-chairman of the board of governors of the B.B.C.?

No, nor apparently do a good many people. Why, when he paid a surprise visit to Birmingham recently he was actually not recognised by the studio staff!

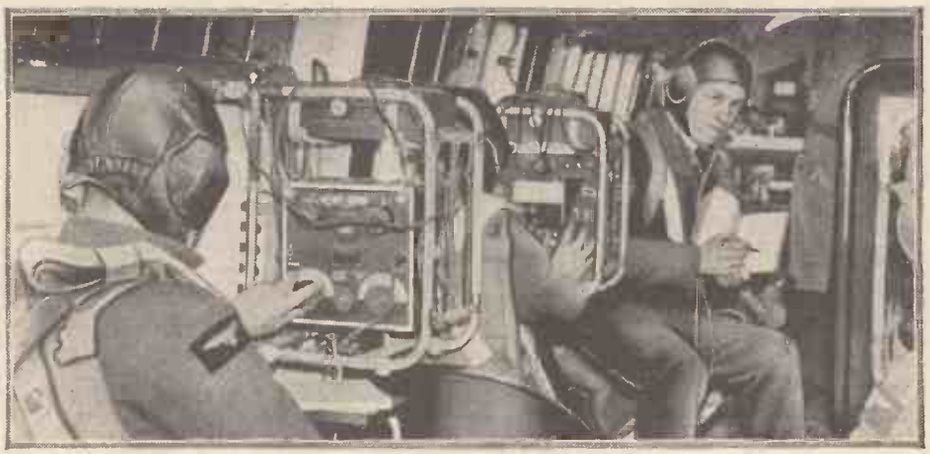
Really, these Governors must not be so modest. Come out into the open, good sirs, and tell us something about your estimable selves.

◆ ◆ ◆

This Television Race

TWO rival systems of television are rapidly approaching complete installation at the top of Broadcasting House. All very piquant, with Baird boys at one end of the building and H.M.V. boys at the other. Both aim to put over film television on the B.B.C.'s ultra-short-wave transmitter, which, as you may know, has been testing on the roof for the past eighteen months.

Meanwhile, the B.B.C. engineers at Nightingale Lane, Clapham, where most of the research is done, are busily getting ready special ultra-short-wave receivers, but no one seems to know where the television part of the apparatus is coming from. We must wait and see—or shan't we?



A Vickers-Victoria aeroplane equipped for wireless instruction, which is undertaken in the air. Five pupils use five separate receivers

100,000 WHO CAN LEAD THE WAY IN RADIO!

Will You Be One of Them?

WILL you be one of the readers of AMATEUR WIRELESS who, by building a new set for use during the coming winter, can set up a fresh conception of what good radio should be? Will you help to carry on that fine pioneer spirit that for eleven years has placed the amateur constructor ahead of the commercial manufacturer?

There is no getting away from facts. At least a hundred thousand copies of this issue of AMATEUR WIRELESS are on sale. And every reader is a prospective constructor of a set described in our pages. *When did you last build a set and when are you going to build your next?*

Ahead by Leaps and Bounds

Whatever you have been doing, radio development has gone ahead by leaps and bounds during the past six months. A set that was built last winter will not give you anything like the results that you will be able to get with one of the new season's designs. And a new season's constructor design will in most cases put you technically ahead of your friends who buy their receivers.

There are those who think that what has happened in America will happen over here—that the mass production of cheap commercial sets will kill all constructor interest. They are mistaken: British people have an inborn love of doing things for themselves that will not die for generations. There will always be thousands who will build their own sets just for the fun of the thing. Every man needs a hobby, and the best hobby that a man can have in the home itself is radio construction.

But that is not enough for some people. Whilst they are inclined to build their own sets they will not actually do so until they are convinced that they are getting something better than they can buy complete in a shop at the same price. Many of our 100,000 readers will find themselves in this position; it is our object here to give them a few pointers.

Did you read the description of the Ideal Four in the preceding issue of AMATEUR WIRELESS and will you read about the Consolectric Two in this issue? Here are two sets, each catering for a distinctly different radio need, that definitely put the constructor ahead of the manufacturer—and give him the best possible value for his money.

Let us look at the Ideal Four a moment. Results are what matter most to the user. What do we find? That in one evening—during summer time, remember, when foreign stations are certainly not coming through at their best—fifty-five stations were heard at good loud-speaker strength. But that is not all. Thanks to the special simplified form of automatic volume control developed by AMATEUR WIRELESS, many of these stations are brought in at a constant volume level and without fading. No manufacturer can offer anything like the same results for a comparable outlay.

Then consider the rest of the specification. All the parts used are standard productions: there is no delay in waiting for makers to turn out special components that will never be of any use for another design.

There are two variable-mu high-frequency stages, only to be found in the most expensive commercial designs. There is an anode-bend detector to give the highest possible quality for reproduction. There are iron-core coils for the most selective and the most sensitive tuning. There is the special economy-pentode output scheme, which has all the advantages of class B.

Surely here are enough points to convince everybody that the Ideal Four does represent something outstanding in radjo technique? We will go so far as to say—and we mean every word of it—that the use of the Ideal Four will bring you a new conception of radio reception.

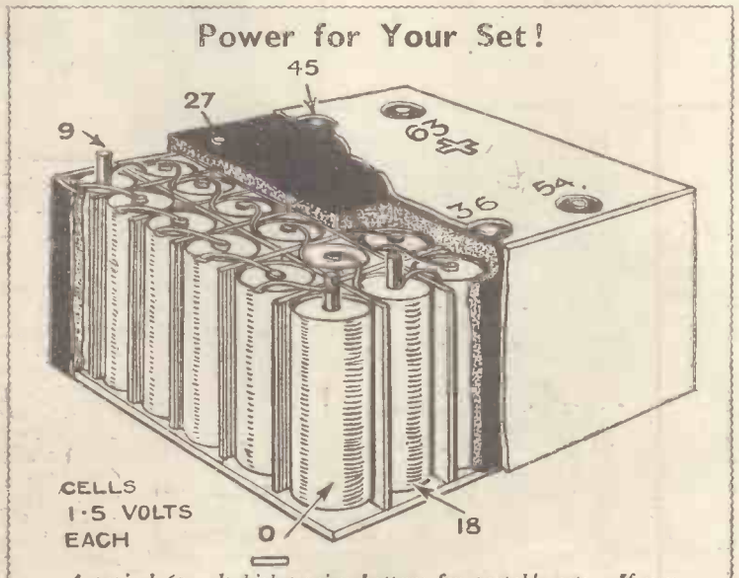
If you have A.C. mains you have a wider choice than the man who must, or prefers, to use batteries. In this issue we describe the construction of the Consolectric Two, another home-constructor design that definitely leads the way in radio technique. Will you turn to page 496 and read all about this astonishing receiver? It has a high-frequency pentode acting as a detector and a pentode output valve, a combination that has not yet appeared as a commercial set. And in one evening—again during summer time, remember—twenty-seven stations were picked up on it!

Service to Our Readers

Our object in producing AMATEUR WIRELESS is to influence an increasing number of satisfied readers; and the only way to satisfy them is to give them the best possible service. Every article that appears in our pages is carefully scrutinised from the point of view "Does it give good service to the reader?" Every set designed is considered with the whole weight of eleven years' experience of catering for the constructor. And many scores of thousands of people are interested in what we have to tell them.

At this time of the year—when summer time comes to an end and radio time begins in real earnest—you have important decisions to make. You have a home of which you are proud. You have a radio set of which you should be proud. But if it is old—and there are thousands of far-too-old sets still pitifully struggling to keep up to modern requirements—it is time you did something about it.

It is time, in fact, that you decided to be of the fraternity who can have better radio and who will lead the way to a new conception of radio entertainment by building one of the new AMATEUR WIRELESS *sets! We can promise you that you will not regret it.*



A typical 63-volt high-tension battery for portable sets. If you want hints on high-tension supply for your set, turn to pages 487-489

In its cabinet the Ideal Four is good to look at. The controls are easy to work

My Test of the Ideal Four-

Here a member of the "Amateur Wireless" Technical Staff tells you of his impressions of the four-valver described last week

"YOU will be frankly surprised at the overall performance of the Ideal Four; it's the goods," said one of the members of the AMATEUR WIRELESS Technical Staff when he handed over the set to me for test. He told me that he had given the job a "once-over" at his home, had logged over forty stations, and thought that the results were really something to shout about.

I fixed the set up at my place in South London, about twenty miles from Brookman's Park, and after giving it a thorough test, I, too, share the general enthusiasm about this new "A.W." star set.

Four Hours' Test

This set on test pleased me so much that in all I spent nearly four hours knob-twiddling and listening. I first tried the set at 6.30 p.m. —still daylight—and amused myself for half an hour just getting the feel of the controls and finding out the daylight capabilities of the set. I used a normal outdoor aerial about 65 ft. long, the specified valves and loud-speaker, and a 150-volt high-tension battery.

London National had shut down by the time I had the outfit working and the Regional was a particularly strong signal. I started then at the bottom of the medium waveband and worked up, searching for the stations that could give an alternative to the Regional.

No difficulty at all; Fécamp, Hilversum, Poste Parisien, Brussels No. 2, Langenberg, Brussels No. 1 came in without any "squeezing" and were worth listening to. On the long waves I heard seven or eight stations giving equal entertainment. So much for a daylight test; very satisfactory.

While waiting for darkness I measured the anode current and found that with no signal the current taken was about 12 milliamperes and with strong signals it varies between 8 and 20 milliamperes, so giving an average of about 14 milliamperes.

Then I tried using a smaller aerial and found that even with an indoor wire about 15 ft. long London Regional still came in at full loud-speaker strength.

The big test started at 8.30 p.m., when every station in Europe was pouring its kilowatts into the ether. Faithfully following instructions, I tuned in a reasonably weak station. I chose Budapest right at the top of the dial, pushed in the local-distance switch on the extreme right, and adjusted the manual volume control until Budapest was heard at maximum strength. As a matter of interest, the maximum point on the manual control is a little more than half-way round.

After these preliminary adjustments I slowly turned the tuning knob and hoped for the best. It was one of the most thrilling "knob-twiddles" I have had. Station after station came in all at about the same strength, London Regional was the exception. When I came to the big local, I pulled out the local-distance switch and the volume was reduced to normal level.

Entertainment!

All the stations on the log were tuned in during an hour. Most of them were heard at real entertainment value. The Moscow 100-kilowatter on 424.3 metres came in as loud as North Regional and provided me with unusual entertainment for nearly half an hour. Another feature of the medium waveband is the tuning range. You can see from the log that it extends from Plymouth on 218.5 metres to Budapest on 550 metres.

Long-wave selectivity was especially good. All stations on the log could be easily separated with the exception of Eiffel Tower and Warsaw. There was also slight interference between Warsaw and Motala.

In the middle of the evening I switched from the outdoor aerial to the 15-ft. wire again and found very little difference in the results. On the small wire I logged over forty stations, all at listening strength.

Fine sensitivity coupled with a good degree of selectivity is one of the set's main features. I was so pleased with the sensitivity that before I finally disconnected the outfit I tried using a 2-ft. piece of rubber-covered wire as an aerial. This test was made at 11 p.m.

After slightly readjusting the pre-set condenser and the ganging I found that, even then, the set would bring in the locals at full loud-speaker strength, half a dozen foreigners at reasonable listening strength, and a dozen more rather less. Further proof of the sensitivity.

As a proof of selectivity, London Regional was easily cleared in three degrees.

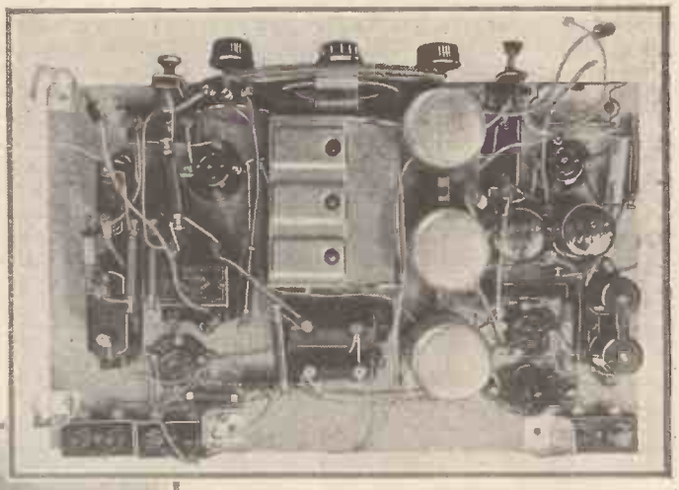
LIST OF STATIONS RECEIVED IN ONE EVENING

LONG WAVEBAND

Station	Dial
Oslo	19
Kalundborg	25
Luxembourg	29
Motala	39
Warsaw	43
Eiffel Tower	47
Daventry National	56
Deutchlandsender	64
Radio Paris	70
Huizen	82

MEDIUM WAVEBAND

Station	Dial
Plymouth	0
Beziers	1
Cork	3
Fécamp	4
Nurnberg	7
Trieste	10
Gleiwitz	11
London National	14
Bari	16
Rennes	17
Turin	18
Heilsberg	19
Bratislava	20
Scottish National	22
Hilversum	24
North National	25
Bordeaux	26
West Regional	27
Common Wave	28
Breslau	32
Poste Parisien	33
Milan	34
Brussels No. 2	37
Brno	38
London Regional	42
Hamburg	47
Scottish Regional	48
Toulouse	50
Leipzig	52
Midland Regional	55
Söttens	57
Athlone	60
Berlin (Funkstunde)	62
Moscow	64
Stockholm	66
Rome	68
Beromuenster	73
Lyons	75
Langenberg	77
North Regional	79
Prague	81
Brussels No. 1	85
Vienna	87
Munich	93
Budapest	100

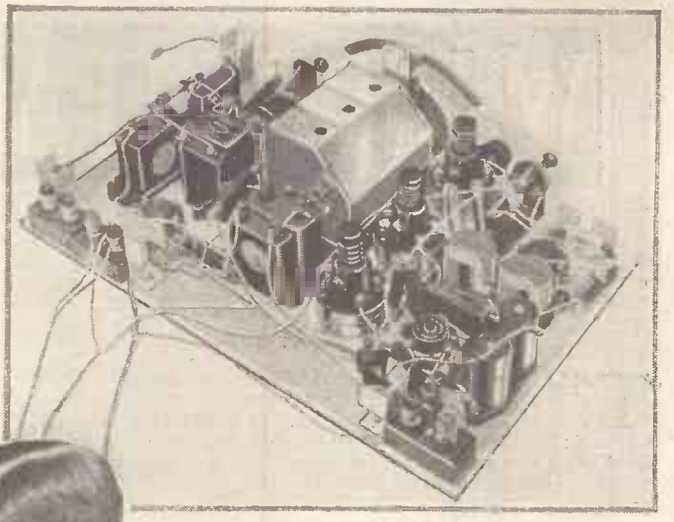


Plan view of the completed Ideal Four with all the components in position and wired together

The three coils in the Ideal Four are fully screened to prevent interaction and instability

-and Operating Hints

Hints on the operation of the Ideal Four by the "Amateur Wireless" Technical Staff. Constructional details appeared last week



The Ideal Four as it looks when completed but without the valves in position

WHEN we designed this set we had in mind the necessity for producing a set that would be essentially simple to operate and yet that would not in any way suffer as the result of that simplicity. We think that we have succeeded.

Tuning is done by one knob and the reception of many home and foreign stations depends only on the rotation of this single control. Nothing could be simpler!

The controls are easy enough to work when you understand them. The wave-change switch has two positions, left for long waves and right for medium waves. The tuning control works the three-gang condenser and the 0-to-100-degree dial, tuning on the medium waves from 200 to 550 metres and on the long waves from 1,000 to 2,000 metres.

The sensitivity control needs careful handling. There is a point in the setting of this knob that provides the maximum sensitivity and also the full action of the A.V.C. This, carefully note, is not the maximum position of the knob, but about a third of the rotation short of that point.

Putting the Ideal Four through its final tests before fixing the chassis in the console cabinet with loud-speaker

The function of the local-distance switch is worth explaining. You appreciate that the locals and the strong foreigners can all be handled at the same volume without touching the manual volume control. That means at least twenty stations, including the locals, at good loud-speaker strength with the minimum of control—just tuning and nothing more.

When we want these stations we switch in the local-distance switch, so that the overall sensitivity is somewhat reduced, the A.V.C. action making use of the maximum possible amplification to keep the foreigners level with the locals.

Now, supposing we wish to rope in the weaker foreigners. Obviously, with the local-distance switch in circuit, as for the locals and powerful foreigners, the set is not giving its very utmost amplification, and even though the A.V.C. will try to increase the amplification to cope with the weak stations they will not come in loudly because the set has been somewhat de-sensitised by the local-distance switch.

The idea, then, is to cut out the local-distance switch, and then all the weaker stations will be amplified enough to give good loud-speaker strength. But when you tune across a powerful foreigner or a local you will find that the volume is too great on those stations, because the A.V.C. cannot stretch its action to cope with such wide limits of signal strength.

Summing up, then, you bring the local-distance switch into action when listening to locals and powerful foreigners—to the best twenty stations in the ether, in other words—and you switch out this gadget when you want to rope in the weak stations of doubtful entertainment value.

You will find that the A.V.C. of this set works with uncanny perfection if you use the local-distance switch as suggested. There is a real thrill in turning just the tuning knob and hearing station after station from various parts of Europe coming through with the same strength as the locals.

Choosing a High-tension Battery

To run this set a double-capacity high-tension battery will be quite suitable. The average anode current is around 12 milliamperes, but during quiescent periods, when there are intervals in the programmes or when a weak volume is being delivered, the anode current is much less than that, and when the volume peaks it is much more.

Make sure that your grid-bias batteries are up to the mark or the results will be impaired. Often when the high-tension battery has been carefully selected its good effect is partially nullified by using old grid-bias batteries. These are specially important in the Ideal Four, as there are three of them with different uses.

COMPONENTS YOU WILL NEED TO BUILD THE IDEAL FOUR

BASEBOARD
1—Peto-Scott Metaplex, 16 in. by 10 in.

CHOKES, HIGH-FREQUENCY
1—Telsen binocular (or Bulgin, Graham Farish type LMS).
1—Graham Farish, type LMS (or Bulgin, Telsen screened binocular).
1—British Radio Grau, type 46 (or Lissen Disc, Telsen type W75).

COILS
3—Lissen dual-range iron-cored shielded.

CONDENSERS, FIXED
2—Lissen .0001-microfarad (or Dubilier, Telsen).
1—Lissen .001 microfarad (or Dubilier, Telsen).
1—T.C.C. .01-microfarad, type tubular (or Lissen, Dubilier)
4—T.C.C. .1-microfarad type tubular (or Dubilier, Telsen).
1—Lissen .1 microfarad (or Telsen, T.C.C.).
1—Lissen 1-microfarad (or Telsen, T.C.C.).
2—Lissen 2-microfarad (or Telsen, T.C.C.).

CONDENSERS, VARIABLE
1—British Radiophone midget three-gang .0005-microfarad, type 604, with full-vision scale type 711 (or J.B. Linatune, Utility).
1—Igranic pre-set .0005-microfarad, type No. 2 (or Sovereign).

HOLDERS, VALVE
3—Graham Farish four-pin (or Lissen, Telsen).
1—Graham Farish five-pin (or Lissen, Telsen).

PLUGS, TERMINALS, ETC.
9—Clix wander plugs, marked: H.T.+1, H.T.+2, H.T.—, G.B.—1, G.B.—2, G.B.—3, G.B.+ (3) (or Belling-Lee, Eelex).
2—Clix spade terminals, marked: L.T.+, L.T.— (or Belling-Lee, Eelex).
6—Belling Lee terminals, type M, marked: Aerial, Earth, Pick-up (2), L.S.+, L.S.— (or Clix, Eelex).

RECTIFIER
1—Westector, type W4.

RESISTANCES, FIXED
1—Graham Farish 1,000-ohm (or Dubilier, Lissen).
2—Graham Farish 5,000-ohm (or Dubilier, Lissen).
1—Graham Farish 10,000-ohm (or Dubilier, Lissen).
2—Graham Farish 30,000-ohm (or Dubilier, Lissen).
1—Graham Farish 50,000-ohm (or Dubilier, Lissen).
3—Graham Farish 250,000-ohm (or Dubilier, Lissen).

RESISTANCE, VARIABLE
1—Bulgin 25,000-ohm, type VC34 (or Igranic, Watmel)

SUNDRIES
2 pairs Bulgin grid-bias battery clips, type No. 1 (or Gripso).
1—Bulgin grid-bias battery clip, type No. 2 (or Gripso).
3—Belling-Lee terminal blocks.
1—British Radiogram 1-in. metal mounting bracket.
2—British Radiogram 2-in. metal mounting brackets.
1—Peto-Scott Metaplex strip, 7½ in. by 2 in.
5 yd. thin flex (Lewcoflex).
Connecting wire and sleeving (Lewcos).

SWITCHES
1—Bulgin three-point type S39 (Lissen, Telsen).
1—Bulgin two-point type S38 (or Lissen, Telsen).

TRANSFORMER, LOW-FREQUENCY
1—Varley Nicore II (or Lissen Hypernik, Telsen Radiogrand).

SUITABLE VALVES

Make	1st H.F.	2nd H.F.	Det.	Power
Mullard ...	PM12M*	PM12V*	PM2DX*	PM22
Marconi ...	—	VS2	HL210	—
Osram ...	—	VS2	HL2	—
Cossor ...	220VS	220VSG	210Det	230PT
Hivac ...	—	VS210	D210	Z220
Mazda ...	—	S215VM	HL2	Pen220A*
Six-Sixty ...	—	215VSG	210D	230PP
Lissen ...	—	SG2V	HL2	—

*Valves used during "A.W." tests.

ACCESSORIES

BATTERIES
1—Lissen 154-volt high-tension, type Q.P.P. (or Drydex, Ever-Ready).
2—Lissen 16-volt grid-bias (or Drydex, Ever-Ready).
1—Lissen 4½-volt grid-bias (or Drydex, Ever-Ready).
1—Lissen 2-volt accumulator (or Exide, Oldham).

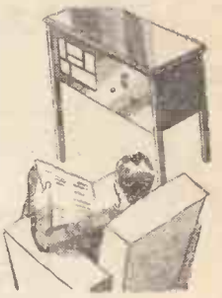
CABINET
1—Peto-Scott Special type.

LOUD-SPEAKER
1—W.B. Microlode type PM4A (or Epoch, Amplion MC22).

MISCELLANEOUS
Aerial (Electron).
Earth (Graham Farish Filt).
Downlead (British Radiophone Receptru).
Lightning switch (Bulgin type S99).
Mains unit (Atlas or Regentone).

Programme Criticisms by Whitaker-Wilson

WITHOUT FEAR OR FAVOUR



Two Hours' *Strife!* :: Vaudeville Queries :: Mixing Liszt :: Same Old *Largo!* :: Items Not To Miss

THERE is one thing I like about the B.B.C. Productions Department—its complete faith in us listeners. It says to itself: "Give them plenty for their money. Give them two-hour plays." Hence *Strife*.

Heavy-going, though quite stirring in patches. Surely some of the speeches in the men's meeting could have been halved? Also the domestic scenes—especially where Frost, the butler, moralised for ten minutes?

Four voices of special broadcasting value: C. M. Hallard as John Anthony; Frederick Lloyd as Frost; Floy Penrhyn as Enid Underwood; Barbara Couper as Madge Thomas. And the Welshy Welsh (all there was) of Hay Petrie.

How much more do I like Floy Penrhyn acting in a play than imitating actresses in a vaudeville.

Billy Cotton's . . . "Good band, good rhythm"

Berkeley Mason . . . "thundering on the organ"

There was no music between the scenes. By omitting it Mr. Rose created an artistic effect and offered a valuable silence in which listeners could discuss the play.

◆ ◆ ◆

Clinging fondly to the memory of two vaudevilles, I still seem to hear those Sisters from the South chanting their peculyerr halleluyerrs, and Michael (whose name was North) playing his accompaniments so pianistically that I wished he were not expected to sing.

The entertaining Mrs. Pullpleasure—curiously Cockney, audaciously adenoidal—must have forgotten to bring her violin again but the Laughing Couple remembered their laugh and entertained themselves by laughing and laughing and laughing at their own jokes without saying why.

Clarice Mayne, that perpetual "pillar of variety," sang those nice songs her mother taught her and lived that funny experience at the Zoo all over again, while Lawrence Baskcomb (as a compère compared with other compères) was all he should have been, but not quite all he would have been with a little more care as to detail. Still, he was funny and not merely silly.

◆ ◆ ◆

Three queries for the vaudeville query department:—

Why must Al and Bob Harvey go back to Canada when we want them over here so badly? They did not even give us time to learn the chorus of "Lucy's lipstick, sticky little lipstick," much less the delightful Canadian language. Will they please come back soon?

Why must Tessie O'Shea describe herself as the girl with the *irresistible* humour? We believe her, but will she prove it next time? *She* was quite funny, but not *that* funny. Her best is her attractive singing.

Why must Bransby Williams impersonate the characters of comedians? I have heard him funnier than those he impersonates. Now, as Beerbohm Tree in *Trilby*—well, he very nearly *was* Beerbohm Tree in *Trilby*.

◆ ◆ ◆

Toots Pounds and Robert Chisholm left a distinctly pleasing impression of themselves, which (as we could not see them) is all we could expect.

◆ ◆ ◆

Did I notice a "ladder" in the off-side stocking of the Eighth Step Sister, or was it a "clock" I heard?

◆ ◆ ◆

I lunched one day this week not with but *to* Christopher Stone. He, by the way, sounded cheerful, as though he had enjoyed his own lunch.

Amongst his excellent selection from the latest issues was a record of G. H. Elliott. The Chocolate-coloured Coon sings just as charmingly as he did when I was a boy. He simply amazes me.

I did not take a note of the record's number; this old song was *Hallo, Susie Green!*

◆ ◆ ◆

I had tea to Billy Cotton. Good band; good rhythm.

◆ ◆ ◆

Query for the Music Department at Broadcasting House: Was it wholly wise to devote a Prom wholly to Liszt? Is he not better mixed up with other nineteenth-century men?

Liszt would arrange anything for anything else. An orchestral work for piano so that he could get his huge hands over it—or a piano work for an orchestra so that he could get still bigger effects with it.

Mottl was therefore probably justified in arranging the Legend of St. Francis of Assisi preaching to the birds. Liszt certainly would not have objected, but it *sounded* like an arrangement—the worst thing it could have sounded.

The Southern Sisters . . . "chanting their 'peculyerr halleluyerrs'"

Pouishnoff is a powerful pianist. Not so much in tone (though he can produce a good deal when he feels that way inclined) as in his interpretations. I thought I knew Liszt's piano concerto backwards, but found I was mistaken. Pouishnoff taught me a good deal—and the Promsters, too, judging by the noise they made.

◆ ◆ ◆

In the *Faust* Symphony Eric Greene and the Wireless Male Voice Chorus created an astounding effect—especially with Berkeley Mason thundering on the organ at the back of them. A pity Liszt did not give them more to do.

◆ ◆ ◆

Dear Music Department,

Why this sudden craving for Handel's *Largo*? On Friday Muriel Brunskill sang it as *Ombra mai fù* in the Beethoven Prom (why there, anyhow?); on Saturday the orchestra played it on their own.

She sang it in one key; they played it in another. Same old *Largo*, whatever key it was in.

Yours, etc., *Largo-Lover*.

◆ ◆ ◆

If Evelyn Scotney ever sings better than she sang in Charpentier's *Depuis le Jour* I hope I am fortunate enough to hear her.

Stuart Robertson (all this, by the way, was in the Saturday Prom) sang the lovely but mathematically faulty *Ye twice ten hundred deities* (why not 2,000 of 'em?) in a way that would have thrilled Purcell to bits. How delightfully English!

◆ ◆ ◆

Samuel Dushkin gave me no chance of hearing him as I should have liked. The Stravinsky work was so harsh and forbidding that it was impossible to form any sort of judgment. Not worth playing, I should imagine. Certainly not worth hearing.

However, I tried him again on the Sunday afternoon in a recital of reasonable music. I enjoyed every minute of it.

Reflecting on the two sorts of music: Why may I not say what I think instead of having to think what I say?

◆ ◆ ◆

"Henceforth Sunday broadcasting is to be continuous, thus" (says an official notice) "filling up the hitherto silent period between 6 and 8 p.m." *And how?*

◆ ◆ ◆

A feature programme for you on October 7. Troise and his Banjoliers will be heard in "On the Mississippi." So tune in and hear dem niggers on dat ole man ribber!

◆ ◆ ◆

You really ought to listen to Lord Rutherford on October 11. He is to broadcast a lecture on *The Transmutation of the Atom*. A big subject!

◆ ◆ ◆

The indefatigable Mr. Mais is rushing about in America. He will be heard speaking from the States on October 13, when he will give his impressions of the life and habits of the natives.

Unfortunately he will be heard in the U.S. as well as by us, so that he will hardly dare tell us what he really thinks.

Your Guide to Economical Power

The Cheapest Ways of Getting High Tension

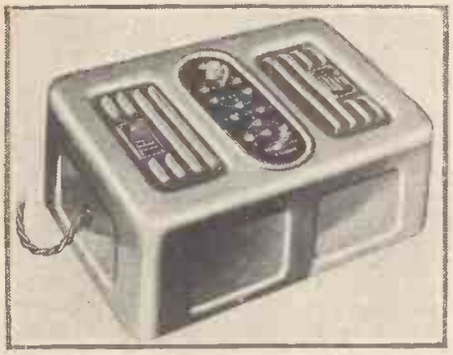
A Review by the "Amateur Wireless" Technical Staff

ECONOMY is the watchword of to-day. One of our politicians has said that true economy means wise spending. No part of the wireless equipment needs the application of this truism more than the power supply.

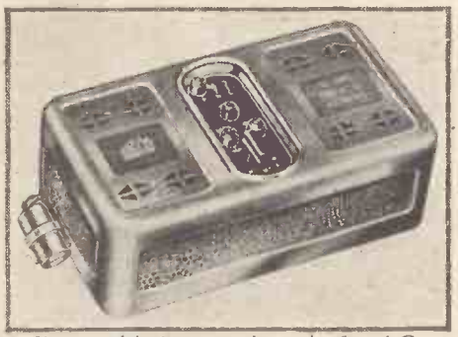
All too often a good set is literally ruined because the power supply has been wrongly chosen in the first place, or neglected after the initial installation.

Power supply does not necessarily mean batteries. To-day there are thousands of sets being run from mains units working from the electric-light supply.

Whether batteries or mains makes no difference; power means sufficient voltage and current to feed the valves of the set.



Telsen mains unit, giving maximum high tension of 150 volts at 28 milliamperes, combined with trickle charger for the low-tension accumulator



Ekco model AC25 mains unit for A.C. supplies, suitable for most types of receiver, including sets with screen-grid valves

Often we hear of listeners complaining that their sets are expensive to run. On looking into such sad cases it is quite frequently found that the so-called expense of running is due entirely to false economy in buying batteries that are too small for their job in the set.

Why do you suppose that radio firms go to the complication of putting out so many different types of high-tension battery? Take for example the Ever Ready range. Over thirty batteries feature in this range, with voltages over 100. It is not the voltages that necessitate the many types in each make, but the *current discharge rate*. The reason for such variations in current output is that sets differ very widely in the amount of current taken by the valves.

The most popular set to-day is, without doubt, the three-valver, and such a set takes an average of around 12 milliamperes. We are practically certain that most owners of such sets use standard-capacity batteries, which, on an economical basis, can deliver only 7 to 8 milliamperes of current.

If everyone realised how expensive this type of battery was for this type of set the standard capacity battery would soon be obsolete.

It is perhaps unfortunate that for the same voltage you can have the choice of the standard or small-current-output battery and the more expensive double- or treble-capacity battery.

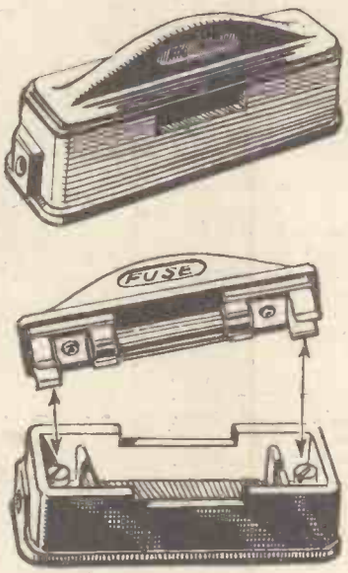
Sometimes it is argued by those who think they know better that they can buy two cheap batteries for the cost of one expensive one. This certainly would seem an inducement to economise, but when you realise that the bigger battery has seven or eight times the life you will begin to appreciate what we are driving at.

Let us try to explain exactly what is the difference between the voltage of a high-tension battery and the current output as measured in milliamperes.

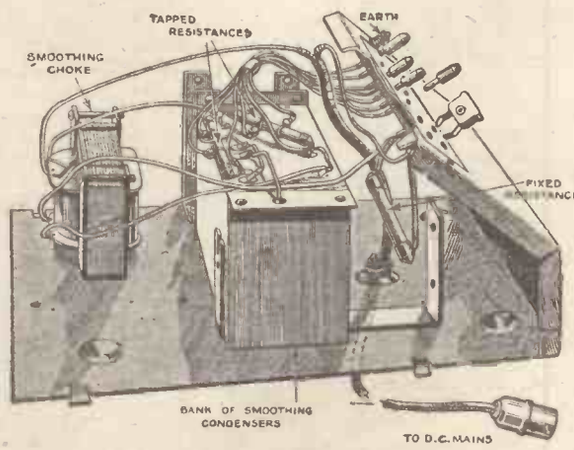
Voltage always seems, to the lay mind, to be the most important point about a high-tension battery. You go into a shop and ask for a 120-volt battery, but how often do you refer to its current output? Very seldom.

The truth is that if you buy a battery on this simple point of view you will probably spend your money very wastefully. All because you have forgotten about current output.

Now, what is this current output? Well, each of the anode circuits of the set takes a certain amount of current from the high-tension battery. That current will depend partly on the type of valve and partly on the voltage on the anode. The grid bias also affects this current.



(Above) Belling Lee fuses for use in mains sets between the mains supply and the transformer. (Right) Telsen electrolytic condenser with special fixing bracket for baseboard or metal chassis



Typical of the Atlas range of mains units is this model DC15/25 for obtaining high tension from D.C. mains

Average Current

Suppose we take, as an example, a three-valver, consisting of a screen-grid high-frequency valve, a detector, and a power valve, run from a 120-volt battery. The average consumption of a set of this type would be between 10 and 12 milliamperes.

Obviously, when you buy a high-tension battery for such a set you want to make sure that, at the voltage of the battery, it is capable of delivering this total anode current, that is, a maximum of 12 milliamperes. Such a battery would have to be a double-capacity type.

Now that brings us to the whole question of battery capacity.

Heayberd transformer as used by constructors in mains sets. It has high-tension and low-tension windings

By capacity we mean *capacity to deliver current*, which is quite different from voltage. Capacity in batteries is usually rated as standard, double, and treble. The standard battery is the smallest capacity type, and its maximum output is usually about 7 milliamperes. The double capacity is 12 to 14 milliamperes and the treble-capacity is anything over that, say 16 to 20 milliamperes. There is a quadruple capacity in some makes capable of giving up to 30 milliamperes.

Right Capacity to Buy

Going back to our three-valver, it is obvious that the double-capacity type of battery is the right one to buy. But supposing we will not go to the slightly greater expense of this battery, and wrongly choose a standard capacity of the same voltage. What then?

At first this smaller battery will work the set just as well as the larger type. Perhaps for a month or so it will work perfectly well. Then it will unaccountably fall rapidly in voltage, causing distortion, motor boating, whistling, and many other symptoms of a run-down supply.

In the long run it is definitely cheaper to buy a bigger battery. Never buy a battery that cannot give at least as much current on economical discharge as the set requires; it is a wise move to buy a battery capable of an even larger output than the set demands.

We have dealt so far with straight and simple sets needing moderate current outputs. Now what about these new sets with Q.P.P. and class-B output stages? Half the troubles of class-B working seem to be due to the use of unsuitable batteries.

Peak-Current Values

Although the quiescent or standing current of class B is only 2 to 3 milliamperes, and the average is perhaps 10 or 12 milliamperes, it must not be forgotten that the peak current may rise to 30 milliamperes. It is not much use having a high-tension battery that is incapable of delivering this peak current without loss of voltage.

Very often we receive complaints from readers who say that their class-B and Q.P.P. sets are giving distortion. If a special battery were used, capable of delivering up to 30 milliamperes for very short periods, the complaints would be fewer.

There is a vast difference between a special class-B battery and a treble-capacity battery. The class-B battery need have only double capacity to cope with the average current requirements of the set, but its internal resistance must be very low, so that the occasional peaks of current can be handled without trouble. The treble-capacity battery has, of course, a much higher average current output and costs more than the special batteries we have in mind.

For an example of this specialised type of battery we might mention the Lissen class-B battery. This battery has been designed to give these occasionally high peak currents with a 10 or 12 milliampere average current output.

Dealing now with the larger types of battery set, such as super-hets and straight sets needing 20 milliamperes current, we should emphasise that if you try to run them with a battery capable of 16 to 20 milliamperes—running the battery right up to its limit all the time, the cost will work out rather high, because the life of the battery will be relatively short.

If, on the other hand, you were to use a battery such as the Ever Ready H.P. type, which can give 30 milliamperes continuously, you would obtain long life and very satisfactory results all through that life. The Lissen Super is another good battery for such sets, and so is the Siemens Super Radio type V6.

Portable sets, again, need special battery consideration. Here we cannot use a battery that is really large enough in capacity for the current needed by the average four- or five-valve set. There is not room in the container for the size of battery needed.

Let us see what is done in a special portable battery, such as the Ever Ready type 812. This gives 108 volts, with a discharge between 6 and 10 milliamperes, and is usually specified for a four- or five-valve portable.

Keeping Down Anode Current

Now with such a battery the maximum discharge rate should not be more than 6 or 7 milliamperes, not if we want economical running. To do this we must keep down the anode current of each valve to the absolute minimum. It is a characteristic of a portable set that more than the usual number of grid-bias tappings are fitted, in order to cut down the current consumption of each valve.

Naturally we make use of a small power valve or pentode, and by increasing the bias on each valve to the absolute maximum short of actual distortion, the overall current requirement of the valves in a portable can be kept down to the economical current output of the portable battery.

Should the grid bias run down the anode current will rise very rapidly, and that is why it is so important in a portable to ensure a good grid bias and to renew it at least every six months.

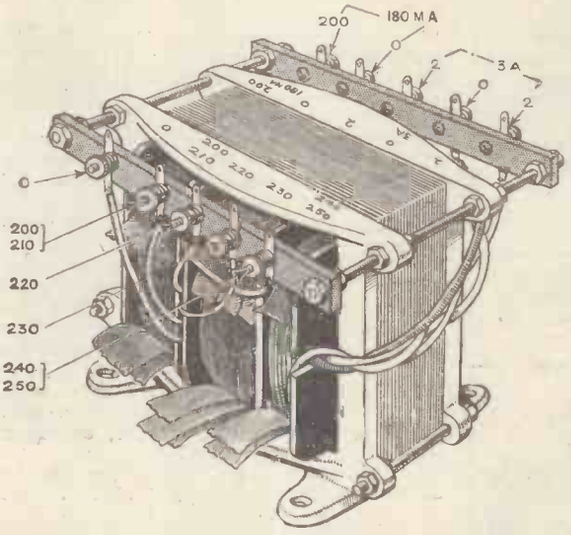
That will do for high-tension batteries, but now we must consider the low-tension supply. Usually there is not much trouble in choosing a suitable accumulator for the filament supply. If you choose a low-capacity battery it will run down more quickly than a large capacity, and you will have to get it charged more frequently.

With an accumulator you can easily work out beforehand the exact life per charge. First add up the individual filament currents and then divide the total, say .5 ampere, into the ampere-hour capacity. The answer will be the the number of hours' life you can expect.

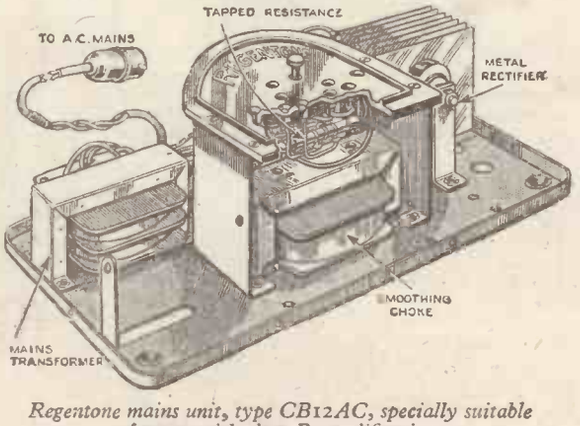
Looking at it another way, assuming you do not know what ampere-hour capacity to buy, but do know how often you propose to have the accumulator charged, you multiply the filament current by the number of hours you want the battery to last per charge and the answer is the required ampere-hour capacity.

Take, for example, a three-valve set, using a 220SG screen-grid, 210HL detector, and a 220P

Group of typical Heayberd mains-set components, including transformers, condenser block and small resistances, fixed and variable



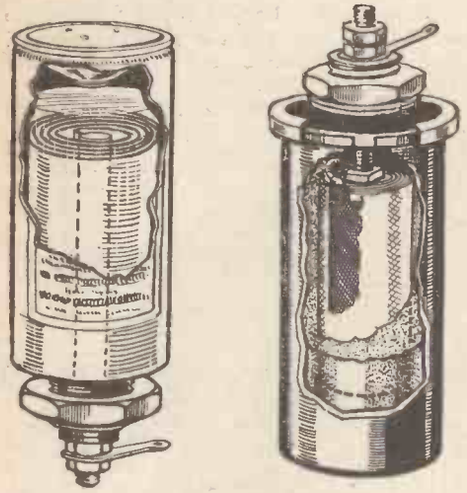
Constructional details of a typical mains transformer, clearly showing sectionalised windings, including filament output on the extreme right



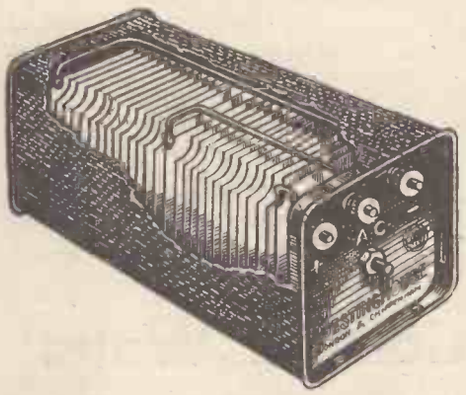
Regentone mains unit, type CB12AC, specially suitable for sets with class-B amplification

output valve. These three valves would consume .5 ampere current. If you wanted the battery to last a fortnight, at, say, 3 hours per day, that is 42 hours per charge, you need an accumulator of (42 × .5) that is 21 ampere hours. Allowing a little for safety you might buy a 30-ampere-hour battery.

One little snag about accumulators. Listeners seem inclined to run their low-tension supply until the set begins to fade out. This is a dangerous practice, because when the battery accumulator is fully discharged it is liable to sulphate; a white deposit forms on the plates, which eventually reduces the capacity very considerably and ruins the accumulator beyond repair.



Typical electrolytic condenser constructions. (Left) Wet Dubilier, consisting of a coil of flat strip metal in electrolytic liquid, the centre pillar forming a contact, the case being earthed. (Right) Dry Telsen condenser with a roll of tinfoil and damp, impregnated linen embedded in beeswax, the foil being connected to the centre screw



Typical Westinghouse high-tension rectifier with alternate copper and copper oxide plates

A little vaseline on the accumulator terminals will prevent corrosion due to the attacks of acid on the metal, and will save a lot of trouble due to the bad contacts that often are caused by corroded terminals and leads.

We have now dealt with most problems of battery supply. Before going on to the mains side of the business we might tackle a problem that is not often mentioned—the provision of a really ample supply for large sets that cannot be worked from the mains but that are too large to be worked with anything like economy from normal batteries.

The solution for such listeners is a rotary converter run from a low-tension accumulator, giving an A.C. output for the high tension and low tension. You can run from such a converter a normal all-electric set designed for A.C. mains.

Such converters can be obtained from firms such as Electro-dynamic Construction Co. and M.L. (Rotax). They really do solve the problem most effectively, and no interference is set up because special filters are fitted.

Just one more point; if you don't want to run an A.C. set, but merely want plenty of high tension, you can buy an M.L. converter giving a D.C. output suitable for feeding the valve anode with an ample high-tension supply. Here, again, the converter is run from the accumulator. A large accumulator, or good car battery, is very suitable for such converters.

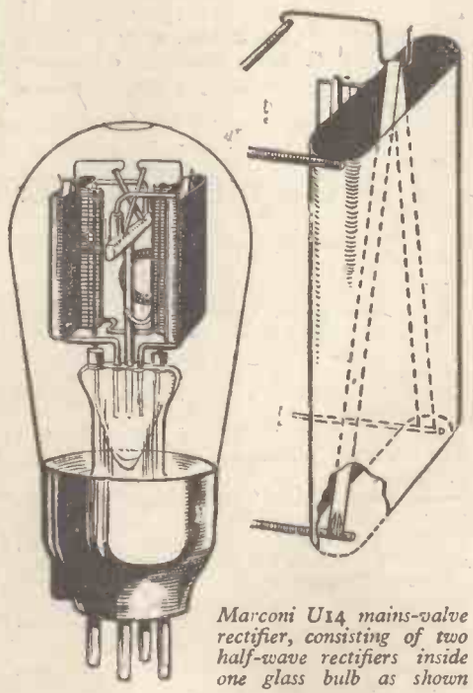
Now we come to mains supply. Very many listeners do not know the difference between A.C. and D.C. Quite a lot of people do not even realise that there *are* different types of mains. Well, for a start you must realise that some electric-light supplies consist of a high voltage of direct current, that is to say a continuous flow of "one-way" current, whereas the grid supply, which is now spreading rapidly over the country, is much the same voltage, but the current is surging backwards and forwards many times per second, usually fifty times.

Just remember when thinking about power supply for your set which type of mains you are on. This information can easily be obtained from the power meter or from the supply company.

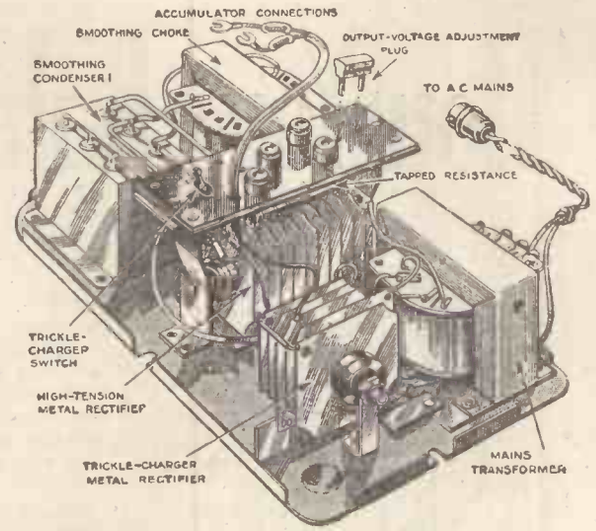
This year's radio exhibition showed that components for mains operation have greatly increased. For the high-tension supply there are many good D.C.-mains units, such as the new Telsen at 35s.

Other good makes include the Lissen, which are well known, the Ekco, the Atlas, the Regentone, and many others equally well known and cheap and efficient in operation.

If you want to make your own unit for high tension from D.C. mains, you will have to think a little. If the mains output was perfectly smooth, it would be possible to connect the set to the mains through break-down resistances to provide the correct voltages.



Marconi U14 mains-valve rectifier, consisting of two half-wave rectifiers inside one glass bulb as shown



Ekco type K25 mains unit—another unit in the wide range made by E. K. Cole Ltd. for every purpose

As the mains output is not smooth, but is, in fact, fluctuating continuously, we have to introduce components forming what is known as a smoothing circuit.

A simple smoothing circuit can be made up of two low-frequency chokes such as the Igranic C80, Telsen Heavy duty, or Heayberd, and two 8-microfarad condensers, such as the Dubilier and Telsen dry electrolytics, or the Lissen and T.C.C. ordinary mains condensers.

Use of Rectifier

On A.C. mains we have first to convert the current to "one-way" and to do this we make use of a rectifier, a unit that will pass the current only in one direction.

Two types of rectifier are available, the valve and the metal rectifier. All the valve makers supply a complete range of rectifying valves, the choice depending on the current and voltage output.

The metal rectifier can also be obtained in many output ratings from the Westinghouse Co. These rectifiers are quite cheap.

The current output of a mains unit differs from a battery in a very important aspect. You do not want a unit that will give a big excess current over that taken by the set, because it so happens that as the current load from a mains unit is reduced the voltage increases, and this may cause too big a voltage to be applied to the valves and cause damage.

There are many good A.C.-mains units on the market, including the new Telsen model 347, which, in addition to high tension, includes a trickle charger for your accumulators. The Lissen type A and B units for A.C. mains are also recommended. Then we have the Heayberd units, which can also be obtained as kits of parts for the home constructor, and complete units such as the Regentone, Atlas, Ekco, and Ferranti.

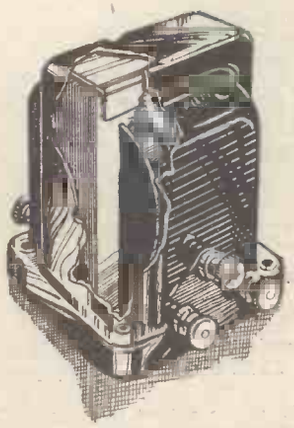
The Heayberd people, and others, can supply components for home constructors. Parmeko, for example, supply transformers giving every conceivable voltage output, and chokes carrying practically all possible currents.

Telsen have introduced this year some mains transformers that are ideal for the family set. Type W300, for example, costs only 32s. 6d. and gives an output of 32 milliamperes at 200 volts, as well as 4 volts for the rectifying valve.

An important side-line of mains working is the A.C.-mains charger. Quite a number of makers of high-tension units include a trickle charger, giving about .5-ampere charge to the accumulator, thus keeping it up to the mark every night. Ekco have done this for years, and now Telsen have embodied the idea in their new units.

How Your Bakelite Parts Are Made

By L. VERE-SMITH, Grad I.E.E.



A sectional drawing of a typical low-frequency transformer housed in a bakelite casing—a Lissen product

BAKELITE was largely due to the discoveries of Dr. Bakeland, but until the advent of wireless it had not been greatly exploited, chiefly due to the absence of a suitable market to justify the heavy expense on plant necessary, and on the research required to further perfect the product.

Synthetic resin, the basis of the material, consists of commercial phenol (carbolic acid), a by-product of coal distillation; and formaldehyde, a clear watery liquid, produced as a result of the removal of hydrogen from alcohol under a chemical process.

Mixture in a Closed Boiler

Approximately equal quantities of each are mixed together in a closed boiler, along with a very small quantity of ammonia, or caustic soda. Heat is gently applied, and the mixture is found to separate into a treacle-like substance, with a layer of water on top. This latter is taken off by vacuum apparatus, and the syrupy residue run into trays, where on cooling it sets into a hard, buff-coloured, glass-like substance.

This, then, is the synthetic resin, which possesses the property of "polymerising," or infusibly hardening under the application of the correct heat for a sufficient length of time. The art of the manufacturer lies in so furthering the state of polymerisation at each step that the final moulding stage requires only the application of a small amount of heat—one to three minutes—in the moulder's press finally and infusibly to harden into the finished shape.

The cooled resin, when cracked out of the trays, is weighed out with an equal quantity of dry woodmeal, and small amounts of the required colouring pigment and accelerating agent; the whole is then put into a "blanketing mill." This mangle-like machine consists of two heated rollers with scraping knives, in which the mixture is first made plastic by the heat, and then thoroughly masticated and kneaded. The product, after about twenty minutes, is stripped off the rollers, by means of the knives, in the form of a uniformly mixed and slightly plastic blanket, which rapidly hardens when cool.

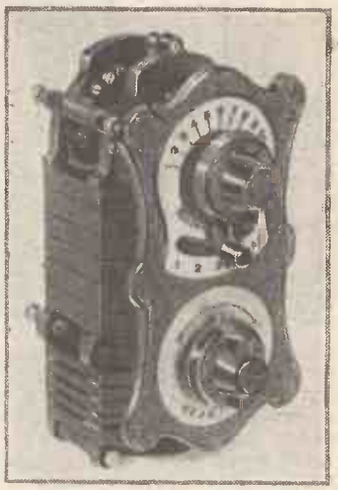
A crushing machine breaks the blanket into small pieces ready for the grinding mill, whence the finished powder emerges of the correct granularity. A final blending in the rotary powder mixer ensures uniformity of each batch, while the magnetic separator removes any metallic particles that may have crept in during manufacture, and which would cause a breakdown if the finished moulding happened to be an insulator.

The completed moulding powder is then packed into damp-proof drums and shipped off to the moulding manufacturer, where, if required, it is mixed with other colours, and usually for ease of handling, compressed into rough pellets about the diameter of a penny and up to ¾ inch thick.

To produce a moulding, sufficient pellets or loose powder are taken and put into a polished steel mould, which is a counterpart of the finished article, and heated to about 175°C. The mould is then closed, and placed in an hydraulic press having heated plattens. The action of the press compresses the powder solidly into the shape of the mould, while the heat during the first 15-20 seconds sufficiently plactizes the powder to render it homogeneous, and finally set hard and infusible. After one to five minutes the press is slightly cooled, the pressure released, the mould opened, and the article ejected—finished but for the removal of the "flash fin" caused by the joint in the parts of the mould.

The above is, of course, only a simple explanation of the moulding operation. In a modern moulding shop automatic presses and multiple impression automatic ejection moulds produce hundreds of pieces per hour; the basic principle, however, is the same.

Before concluding, it would perhaps be as well to say how the mottles, streaks, and colour blends are obtained. The coloured powders required are taken in the desired proportions, and remixed in batches.



The British General tuning unit is built up on a most complex bakelite moulding

The factor governing the result is the coarseness of the powder. Fine powder blends well, giving a more uniform or soft effect; coarse powder gives streaky mouldings, due to the small lumps of powder not mixing until squeezed in the mould.

It is the careful manipulation of this blending operation that enables the moulder to obtain the great range of effects.

To-day's Conditions in Wales

From A Correspondent

VISITING North Wales after a lapse of several years, I have found an extraordinary change in radio reception conditions. When I was there last, before the advent of the Regional stations, this must have been one of the worst-served areas of the British Isles.

In the vicinity of Pwllheli in those days I found Daventry National the only satisfying signal.

The nearest radio station, Manchester, was poor in strength and faded badly, while Cardiff was almost impossible to receive, owing no doubt to the intervening mountains.

But to-day there can be few parts of the country with more alternative programmes. The new West Regional transmission comes in splendidly in this part of North Wales, and I give it 100 per cent. as a basis of comparison in the following list of reception results:

	Percentage	Approx. Distance in miles.
West Regional	100	100
Scottish Regional	90	100
Scottish National	90	100
Belfast	80	120
North Regional	80	100
North National	80	100
Midland Regional	75	130
London Regional	50	180
London National	10	180
Athlone	95	80

After dark all these stations fade somewhat, but the generally satisfying reception of so many different programmes (on a six-valve super-het) was surprising.

Note the surprising fact that Scottish Regional gives better results than North Regional. And little Belfast acquits itself well, the transmission path between Northern Ireland and North Wales being mainly over water.

Using the Relay Stations

By J. FLETCHER TEMPEST

Very often the station you wish to hear is so badly heterodyned that reception is impossible. Here our contributor explains how it is possible to fall back on some of the relay stations, which put out the same programmes as the main stations

What we have to look forward to in the winter —happy evenings with the radio by a warm fire! This photograph shows a contented family with their Marconiphone model 256 receiver

JUST as there are more ways than one of cooking a goose, there are often several ways of obtaining one foreign broadcast programme. Most of the big stations abroad have a number of relay stations. These sometimes duplicate the entire programme of the main station, but certain of them originate their own programmes occasionally. The point is that listeners to foreign stations should always be ready to take advantage of the fact that it may be possible to get the same programme from several different stations.

Alphabetical Survey

It may be interesting and perhaps instructive to take an alphabetical survey of the relay question. Breslau comes first in order, strictly speaking, but it should be noted that Berlin (long-wave) is often relayed by other German stations, notably Frankfurt and Mühlacker. This knowledge is useful, because Berlin is apt to be jammed between Daventry National and Radio Paris, unless a set is very selective. Make sure, then, before despairing of getting a clear audibility of the Berlin programme that it is not being relayed by Mühlacker, which should now come in well separate from London Regional.

Regarding Breslau, this station, at the time of writing, is being hopelessly jammed by Poste Parisien, so that it is useful to know of Gleiwitz, on 253 metres, which relays Breslau. Gleiwitz usually offers good reception.

Prague Programmes

Brno frequently takes the Prague programmes, and vice versa. With its new high power, Prague is easier to tune than Brno, as the latter is apt to be swamped by Strasbourg. Most listeners are aware that Copenhagen is relayed by Kalundborg. In this case it undoubtedly pays to use the relay when possible. Reception from Kalundborg is nearly always drowned by the 200-kilowatt Luxembourg, and Copenhagen, which may be relatively free of "pops and bangs" owing to its wavelength position, is so tiny-powered a station that the strength is insufficient. Here it is a case of listening to the latter station.

Cork, on 224.4 metres, is worth bearing in mind as an alternative to the high-power station at Athlone, as, though the latter at present seems to give excellent reception, there may be occasions when it proves less receivable than its relay.

Frankfurt is always better obtainable direct than via its relay, Cassel, a .25-kilowatt station which shares one of the common wavelengths. Hamburg is another station whose relays are not worth bothering about. Katowice must be watched, because, though not officially a relay, this station sometimes takes excellent programmes from less accessible stations.

Lwow is not badly received. A lot of the programme comes from Warsaw, and it may seem absurd to suggest that it can ever be profitable to get Lwow when Warsaw is radiating an identical programme. Admittedly, the big power of Warsaw renders it capable of terrific volume in this country, but even Warsaw has its off nights; Eiffel Tower is badly jamming the Warsaw programmes at present. When the atmospheric curse is about Lwow is likely to prove the better station.

Milan, if it is not overshadowed by its powerful neighbour Poste Parisien, is sometimes a worth-while relay of the Turin programme. Milan works on 331.5 metres, Turin on 273.7. Better still, perhaps, is Florence on 500.8 metres, a favourable part of the medium waveband. The listener to Turin (which is inclined to be smothered by Heilsberg on an adjacent channel) also may have recourse to Genoa on 312.8 metres. There are several ways of killing this particular goose!

Paris (Poste Parisien) is often relayed by a chain of smaller PTT stations, amongst the best being Grenoble on 568.1 metres and Lille on 265.8. If Breslau is interfering badly with Poste Parisien, these may be useful alternatives.

The difficulty of separating Söttens from the Midland Regional may be averted by using the Geneva relay, if your set has a coil that covers the odd wavelength of 760 metres. Rome is much too well received to justify tuning Naples, but Stockholm can nearly always be received better through one of its numerous relays. Motala, on 1,348 metres, for instance, will generally give far greater signal strength than Stockholm, but is rather apt to be interfered with by Warsaw.

Goteborg, on 322 metres, is quite useful if you can get it clear of Breslau, and the same applies to Hörby on 257 metres, which may, however, be spoiled by Frankfurt. Sundsvall is rarely any use, in spite of its power. It is, of course, interference from Rome that frequently ruins Stockholm itself. Yet there are plenty of listeners who forget to make use of the generous quantity of available relays.

An Alternative to Vienna

Vienna is a somewhat erratic station. When she is good, so to speak, she is very, very good, but when she is bad—well, she's horrid! Do not, therefore, overlook the possibilities of securing the Vienna programme from Graz, 352 metres. This is too close to London Regional to be pleasant, but generally the station can be obtained with astonishing freedom from interference.

This concludes the alphabetical range, but there is one more point. Many of the Russian stations share programmes at certain times. It is a common thing, for example, to hear the same broadcast from three or four stations at the lower end of the long waveband. Kiev, Kharkov, Leningrad, and Tiflis will quite possibly be radiating identically. None of these stations is ideal for reception, largely on account of beacon interference, so that it is best to try Moscow Trades Unions, or—especially late at night or in the early morning—Moscow Old Komintern. Very often these two stations are duplicating the other four.

THE CONSOLECTRIC TWO—

A Twenty-seven Station Set

THERE IS A FULL-SIZE BLUEPRINT ON THE INSIDE COVERS

This fine-looking A.C.-mains two-valver is a "hot" new-season's constructor design

TO-DAY, with the B.B.C. regional scheme in full operation, most listeners are within the service area of one or other of the high-power regionals.

In this considerable proportion of the listening public are many who are on a mains supply but who still use a battery set because they cannot afford to go to the undoubtedly greater expense of a good mains-operated set.

This public wants, more than anything else, to do away with batteries, so that the convenience of the supply can be taken full advantage of.

Quality of Reception

We have therefore produced the Consolectric A.C. two-valver, which should satisfy a great many listeners whose chief interest is in the quality of the reception of the locals, with, of course, facilities for an occasional rake round the European ether.

This is not an expensive mains set to build. Yet it provides very good entertainment indeed from the nearest regional centre, the loud-speaker delivering 2 watts undistorted output when fully loaded. This output corresponds to a volume that will more than fill any ordinary living-room.

This new set is self-contained except for the aerial and earth. About that aerial; a total length of wire not more than fifty feet will be satisfactory under the reception conditions mentioned—inside the service area of any of the regionals.

Cutting Down Noises

A good earth is a great advantage in any set, of course, but in this type of set, where we are dealing with the supply mains, an earth is almost essential to cut down various extraneous noises, such as hum and mush.

Moreover, a good earth in a two-valver will materially increase the volume obtained from foreign stations, as well as stabilising the operation of the controls—especially the reaction.

Well, let us take a look at the Consolectric Two's circuit. It is a two-valver, and so, naturally, the first stage is the detector. This is coupled to the power output pentode valve by means of a step-up transformer.

The special feature of the detector stage is the high-frequency pentode valve. This is one of the first home constructor's sets to make use of such a valve in the detector position.

What are its advantages over an ordinary triode valve—or over the screen-grid type of valve?

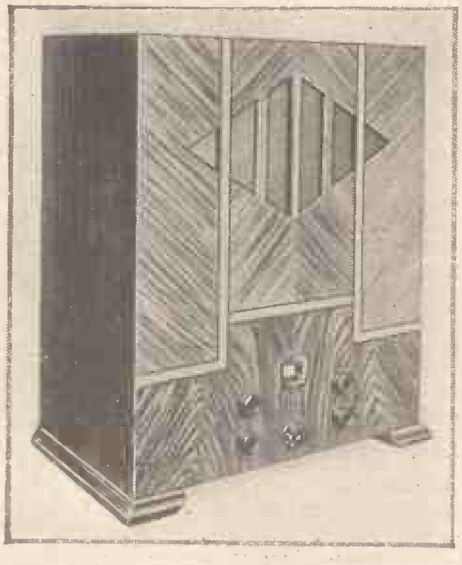
There are several: first, you get more volume from a high-frequency pentode detector than from any other sort of valve now on the market. The theoretical amplification is very high, and a good proportion of this can be made use of by careful design.

Secondly, the high-frequency pentode improves the selectivity. Its internal capacity, that is the capacity between the electrodes, is lower than usual, and this means that the "damping" on the tuning circuit preceding the valve is reduced. When a tuned circuit's damping is reduced, its selectivity is increased.

The advantage of a high-frequency pentode over a screen-grid type of valve is that the reaction is very much smoother, and there is much less chance of self-oscillation owing to entire absence of "kinks" in the pentode's characteristic.

The output valve is a standard pentode giving a big power in watts to the loud-speaker. It is not connected to an output transformer in the set because the loud-speaker used inside the same cabinet as the set chassis has an integral transformer, which takes care of the matching between the output valve and the speech coil of the loud-speaker.

These two receiving valves are powered from the mains through a metal rectifier. High-tension is derived from the rectifier through a special smoothing circuit, and the low tension comes from a 4-volt winding on the transformer we use for the metal rectifier.

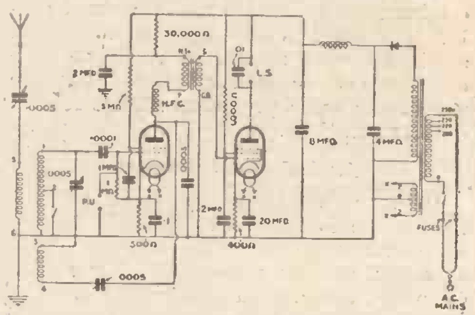


Front view of the Consolectric Two, revealing the handsome appearance of the table-console cabinet housing set and loud-speaker. A fine set for the family!

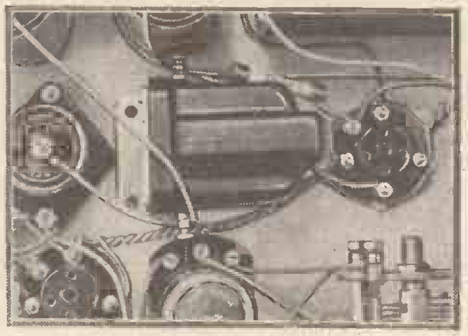
Grid bias for the pentode comes from a part of the high-tension voltage, which is stepped off by a resistance in the cathode circuit. There is also a grid-bias resistance in the detector cathode circuit, which we use for biasing the valve if it is used as an amplifier with a gramophone pick-up.

While discussing the circuit of this set we ought to mention that, still further to improve the selectivity of the aerial tuning circuit, we have made use of a panel-mounted series aerial condenser. With this you can reduce the input of the locals very considerably, so that foreigners within range can be heard at reasonable strength and free from interference.

Perhaps an even greater advantage of the



Complete theoretical circuit diagram of the Consolectric Two



Note carefully the position of the low-frequency transformer. It is mounted horizontally to avoid mains hum

aerial condenser is in cutting out background of the foreigners adjacent to the locals when the locals are wanted really free from all trace of background. For logging stations well away from the wavelengths of the locals you can, with this condenser, increase the aerial input to give good foreign-station strength. It is an admirable control to have on any set with a limited tuning arrangement, and works exceptionally well in this "two."

Still another aid to good selectivity is the use of an aerial transformer, an untuned primary coupled to a tuned secondary. This system gives sharp tuning without loss of signal strength, and when used with the aerial series condenser works splendidly in giving a good station-separating performance.

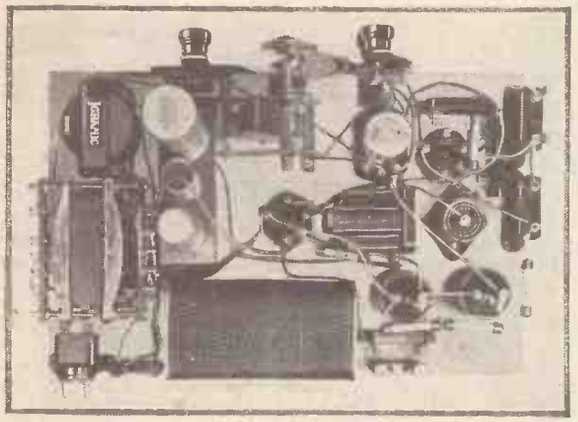
With this sort of set you can easily use a

—An Up-to-the-minute A.C. Design

Designed by the "Amateur Wireless" Technical Staff

pick-up and indeed the detector and pentode output stages together provide full loading for the output stage, giving very big volume with any normal pick-up. The detector valve, on connection of the pick-up, automatically takes up a negative bias, which makes it suitable for amplification.

With some pick-ups, especially the sensitive type, a potentiometer volume control will be needed between the pick-up and the pick-up terminals of the set. Pick-up terminals are not shown on the blueprint but this point will be dealt with next week.



This plan view of the set will help constructors to visualise the complete component layout

The last point of importance to mention in the circuit is the smoothing of the metal rectifier's output. You will notice that we have used electrolytic condensers on each side of the smoothing choke. Normally, only the output condenser is an electrolytic, but by using this type of condenser for the reservoir position, that is for the position immediately after the rectifier, we overcome a "surging" difficulty that is often ignored.

Switching On

Let us explain : When the mains set is first switched on the indirectly heated mains valves do not immediately take any load from the high-tension output, because for a few seconds the valve heaters are warming up. While this is happening there is little or no anode current flowing in either valve circuit, and so there is no current being taken from the output of the rectifier.

Now it so happens that when you decrease the load on a mains output arrangement you send up the voltage. With no load the voltage may be so great that the valves will be damaged.

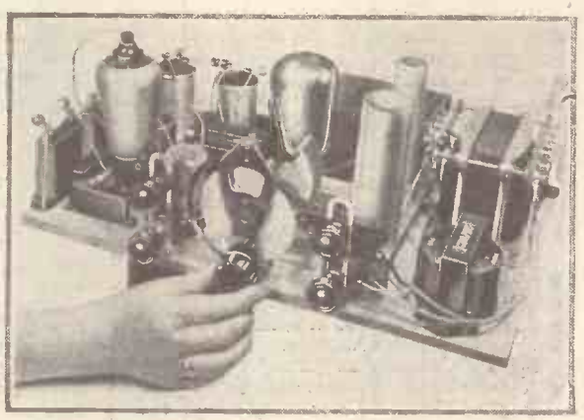
The electrolytic condenser automatically counteracts, to a large extent, this temporary increase in the output voltage. It happens that when a very high voltage is impressed on an electrolytic condenser its current rapidly increases. An increase in the current will immediately pull down the voltage.

Action of Electrolytic

The electrolytic's sudden increase in current-taking makes up for the temporary lack of current-taking by the valves of the set, and so for no appreciable length of time is there any excessive voltage output from the mains portion. Of course, when the valves have warmed up the normal load on the mains unit is exerted, and the electrolytic goes back to its normal action, as the set's load will take up the excessive voltage.

Now for a word or two on the construction of the Consolectric two : it is a simple baseboard lay-out, but there is no panel, because the controls are fitted to two brackets, and the knobs project through the table cabinet.

You can best gain an idea of the component layout from an examination of the full-size blueprint, which you will find on the inside cover of this week's issue. If you want to keep your copy intact you can buy a separate blueprint of the layout, price 1s. post paid from AMATEUR WIRELESS, 58-61 Fetter Lane, E.C.4.



Control of the Consolectric Two is really simple—there is only one tuning knob

There are five controls in all. The main control is the centre knob for tuning. To one side we have the reaction and wave-change switch, with the mains on-off switch and the aerial-coupling control on the other side.

The power-supply components are built into the set itself, and are not in a separate unit. Note when building the set that the electrolytic smoothing condensers are mounted on a special metal bracket which is fixed on the baseboard.

A very important point to note about the layout is the method of fixing the transformer. It is horizontally mounted on a special metal bracket. the dimensions being given for this on the blueprint layout.

The idea is to avoid interaction between the windings of the low-frequency transformer and the mains components of the set. That this method is essential can easily be proved if you try the experiment of mounting the transformer temporarily in any other position —there will be mains hum.

Wiring the Components

The wiring of the components is carried out with the usual No. 20 gauge tinned-copper wire, with insulated sleeving. The only exception is the wiring of the filament circuits, which is done with twisted flex to avoid mains hum. Follow the numbered sequence of blueprint wires and you cannot go wrong.

Further details next week!

LIST OF PARTS NEEDED FOR CONSTRUCTING

BASEBOARD
1—Peto-Scott Metaplex, 16 in. by 10 in.

CHOKES, HIGH-FREQUENCY
1—Telsen screened type W341 (or Wearite, Goltone).

CHOKE, SMOOTHING
1—Igranic, type CH4 (or Lissen, Telsen).

COIL
1—Telsen dual-range iron-cored, type W349.

CONDENSERS, FIXED
1—Lissen .0001-microfarad (or Telsen, Dubilier).
1—Lissen .0005-microfarad (or Telsen, Dubilier).
1—Lissen .01-microfarad (or Telsen, Dubilier).
1—Lissen .1-microfarad (or Telsen, Dubilier).
1—Lissen 1-microfarad (or Telsen, Dubilier).
2—Dubilier 2-microfarad, type 9200 (or Telsen).
1—Dubilier 20-microfarad electrolytic, type 401 (or T.C.C.).
1—Dubilier 4-microfarad electrolytic, 500 V.D.C. peak (or Telsen, T.C.C.).
1—Dubilier 8-microfarad electrolytic, 500 V.D.C. peak (or Telsen, T.C.C.).

CONDENSERS, VARIABLE
1—Graham Farish .0005-microfarad, type Zelos (or Telsen, Lissen).
2—Lissen .0005-microfarad, type reaction (or Graham Farish, Utility).

DIAL
1—Ready-Radio slow-motion (or Utility, Telsen).

HOLDERS, VALVE
2—W.B. five-pin (or Telsen, Lissen).

RECTIFIER
1—Westinghouse H.T.12.

RESISTANCES, FIXED
1—Dubilier 400-ohm (or Lissen, Telsen).
1—Dubilier 500-ohm (or Lissen, Telsen).
1—Dubilier 1,000-ohm (or Lissen, Telsen).
1—Dubilier 30,000-ohm (or Lissen, Telsen).
1—Dubilier .5-megohm (or Lissen, Telsen).
1—Dubilier 1-megohm (or Lissen, Telsen).

SUITABLE VALVES

Make	Detector	Power
Cossor	—	MPPen*
Mullard	SP4*	Pen4V
Marconi	—	MPT4
Osram	—	MPT4
Mazda	—	ACPen
Six Sixty	—	SS4PenAC
Lissen	—	ACPT

*Valves used during "A.W." tests.

SUNDRIES
3—Telsen terminal blocks (or Lissen).
1—Bulgin combined mains plug and fuses, type F15.
2—British Radiogram 4-in. metal mounting brackets.
1—British Radiogram metal bracket to specification.
Aluminium strip, 8 in. by 2 in. (Peto Scott).
Connecting wire and sleeving (Lewcos).
1—9-in. length of screened sleeving.
2 yd. thin flex (Lewcos).
2—Bulgin knobs, type K14

SWITCHES
2—Bulgin on-off rotary toggle, type S92.

TRANSFORMER, LOW-FREQUENCY
1—Lissen Hypernik (or Telsen, Sovereign).

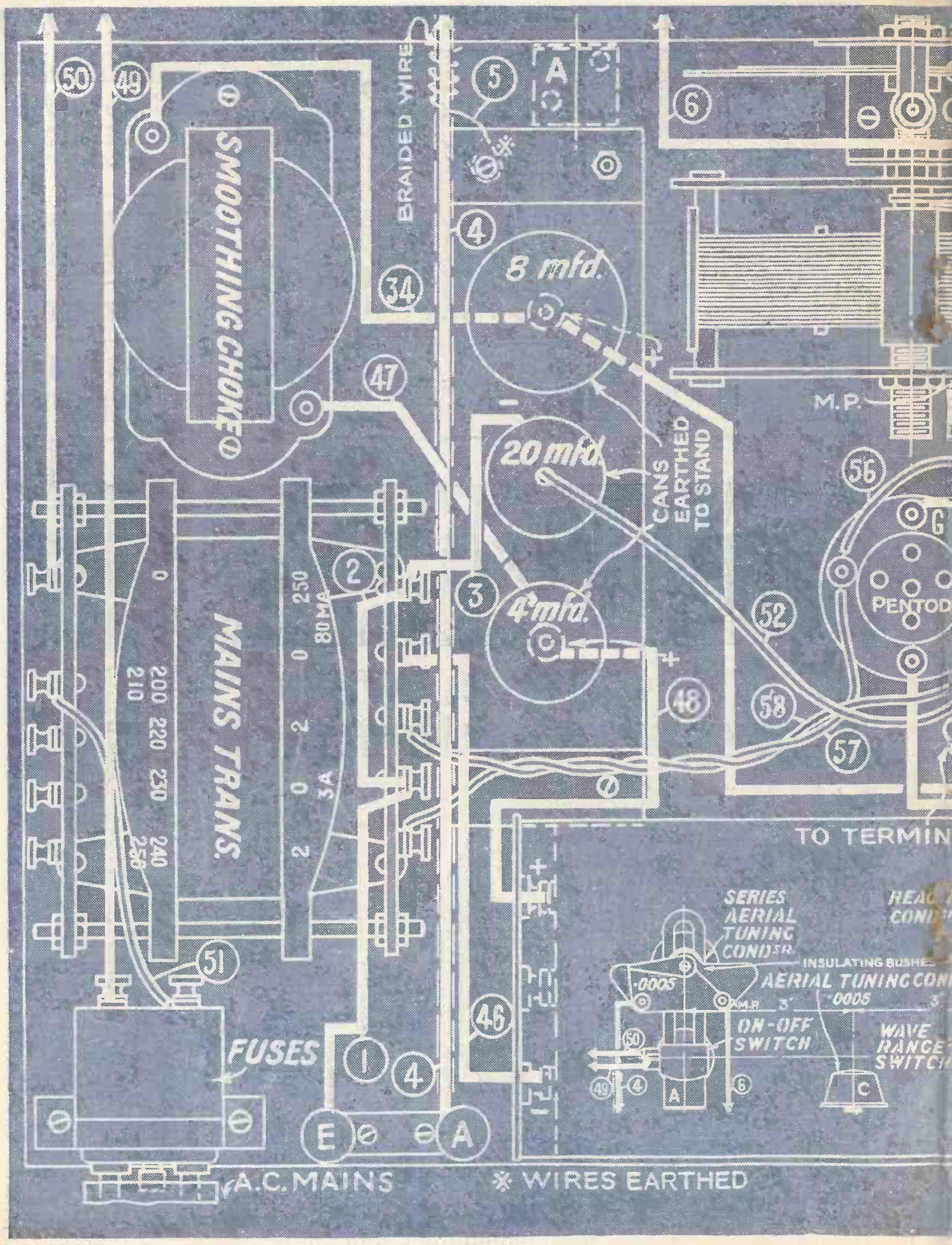
TRANSFORMER, MAINS
1—British Radiogram, type 56 (or Heayberd, R.I.).

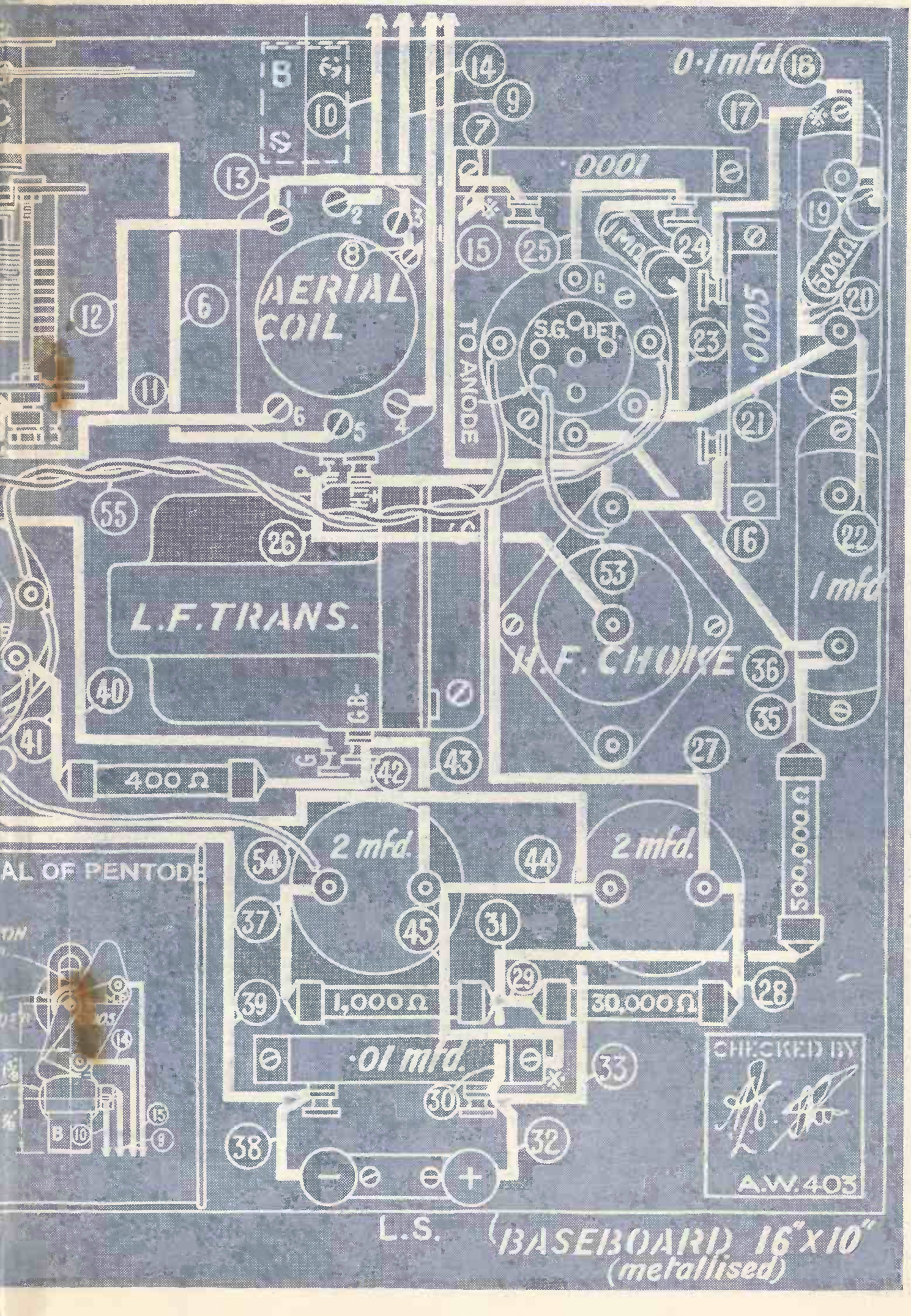
ACCESSORIES

CABINET
1—Osborn, type 252.

LOUD-SPEAKER
1—Epoch, model 20th Century (or W.B., R. & A.).

MISCELLANEOUS
Aerial (Electron).
Earth (Graham Farish Filt).
Downlead (British Radiophone Receptru).
Lightning switch (Bulgin, type S99).


BRAIDED WIRE
SMOOTHING CHOKE
8 mfd.
20 mfd.
4 mfd.
CANS EARTHED TO STAND
M.P.
PENTOD
MAINS TRANS.
0 200 210 220 230 240 250
0 80 MA 250
2 0 2 3A
FUSES
SERIES AERIAL TUNING CONDR
INSULATING BUSHES
AERIAL TUNING CON
.0005
.0005
ON-OFF SWITCH
WAVE RANGE SWITCH
TO TERMIN
A.C. MAINS
* WIRES EARTHED


AERIAL COIL
L.F.TRANS.
L.F. CHOKE
S.G. DET.
TO ANODE
0·1 mfd
0001
·005
·005
500Ω
2 mfd.
2 mfd.
1 mfd
400 Ω
1,000 Ω
30,000 Ω
500,000 Ω
·01 mfd.
CHECKED BY
A.W.405
L.S.
BASEBOARD 16"x10"
(metallised)
AL OF PENTOD

For the Up-to-date Experimenter

Solving the All-wave Tuning Problem

By *The Experimenters*

WHEN a certain young subaltern from abroad dashed into our den the other night he unwittingly started us on a series of experiments that now culminate in this article.

He was full of the wonderful programmes they had been receiving out in India from our Daventry Empire stations; of course, he had a short-wave set; wanted to know why we did not do more with the short-waves over here in this country; and, after a lot of palaver—which hadn't much to do with radio—he insisted that we should try to justify the bulldog breed by designing a set that would cover the whole of the short waves without coil changing.

Blessed With Regionals !

We were not so keen, knowing perfectly well that in this country, blessed as it is with powerful regionals, there is not the same urgent need for short waves as in isolated parts of the Empire—or even in America.

Speaking strictly as "The Experimenters," we opine that short waves will become popular *among ordinary listeners* only when tuning arrangements needed for short-wave reception are a part of the family set.

We are not for one moment forgetting the thousands of experimenters who use separate short-wave gear for spanning the world. What we are trying to remember is that the ordinary listener simply will not be bothered with the use of a second set—and, of course, there is the question of expense.

Our young "sub." was not really interested in short waves, only in the programmes they enabled him to receive. There is undoubtedly a big programme interest in the short waves if you listen at the right time and on the right wavelength. Therefore if a broadcast set can be made easily adaptable to short-wave reception a large number of our readers, not normally keen on building a short-wave set, would no doubt be interested.

Thinking along these lines we considered our friend's case as being rather typical of the average listener. He suggested first that we should make him an all-wave set, so that he could get the local medium-wavers in this country and in India, and later keep in touch with the Old Country via short waves.

It had to be a fairly cheap set, compact and easy to tune. So we got down to it. We found that by using a two-valver with a screen-grid valve as a detector, and a pentode valve giving 1 watt power output, really good short-wave results could be obtained. At the same time there was no difficulty in roping in the locals on the medium waves at good strength.

Working on this two-valver as our basic idea, it soon became obvious that the real problem in the design was the tuning. Not so simple !

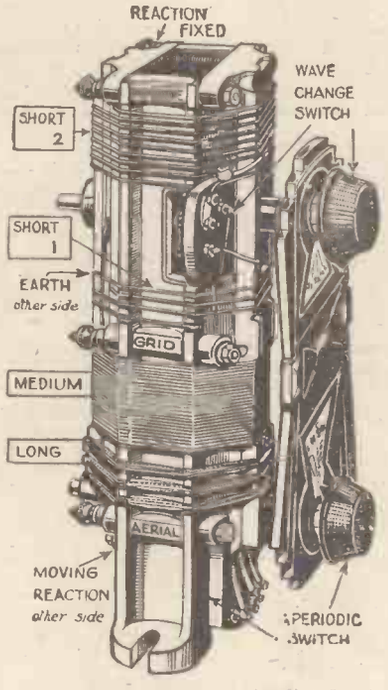
At first we thought of plug-in coils. Using one set for the short waves and another for the medium. That idea was too feeble to last long, and we went on to its logical development —using plug-in coils but avoiding the manual labour of changing them by using a switch.

This switch had to be rather complicated. The leads were longish, and the layout—well, not so good !

Still, it worked after a fashion. The medium and long waves were really quite satisfactory, but the short waves—losses all over the place.

So we scrapped our switching scheme, which is not worth illustrating here, and we decided to make ourselves a universal tuner, with short, medium and long waves all on the same former, with short internal switch wiring to keep down the losses.

We evolved a tuner. Surprisingly, rather, it worked; but it was a nasty sort of job. Lots of tappings, separate windings for reaction, and, when we had finished the job, by no means cheap.



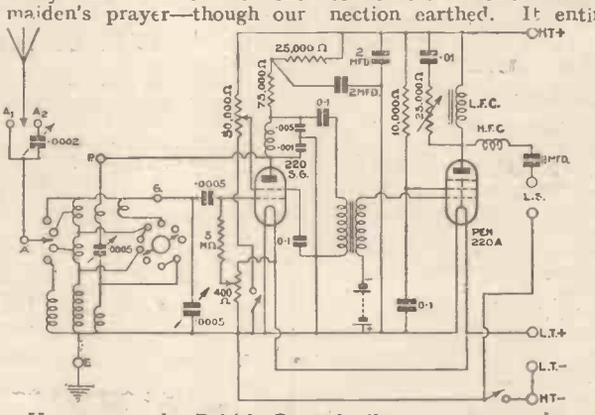
The British General tuning unit covers wave ranges of 14.5 to 40 metres; 32 to 90; 200 to 550; and 900 to 2,000 metres

By a strange coincidence the next post brought us a registered parcel containing—would you believe it?—a really well-designed all-wave tuner made by British General and sent to us with the compliments of Mr. Elliott. Evidently the cry had gone round the amateur wireless world that "The Experimenters" were keen on all-wave sets !

Looking into this tuner, we found it was just the thing for an all-wave set—and it had the added advantage of being amazingly cheap, only 9s. 6d. Truly the answer to the maiden's prayer—though our young "sub" would not like us putting it quite that way !

We tried out this tuner in the two-valver circuit already mentioned, and illustrated, by the way, this week. A few words on this circuit. It has several novel ideas, the result of many hours of hard experimenting, we assure you.

Take, for example, the detector valve. It is a screen-grid type to give the *n*th degree of amplification. If we transformer-coupled this valve to the output valve we would lose a lot of amplification.



How to use the British General all-wave tuner in a "super-hot" two-valve circuit

Why? A very simple reason, though not too easy to understand. You must make the impedance in the anode circuit—resistance, choke, or transformer primary—high compared with the impedance of the valve itself.

The obvious solution when you use a screen-grid valve as detector is to resistance-capacity couple it, because you can then use an anode resistance with an impedance that is high compared with the valve. This idea is all very well, but you then sacrifice the step-up ratio advantage of the transformer.

Combining Two Systems

So we have combined the two systems, by putting a resistance in the anode circuit and passing on the signals through a condenser to a transformer.

The next point is the reaction. This must be *very* smooth on the short waves. It *can* be made smooth even with a screen-grid valve, but we have left nothing to chance.

As you know, it is possible to alter the amplification of the screen-grid valve by varying the voltage on the screen; we have made use of this fact in our reaction system. In addition to the normal reaction condenser we have fitted a potentiometer to control the voltage on the screen.

In action you increase the capacity of the reaction condenser until the detector-valve circuit is nearly but not quite oscillating. Then you vary the screen volts so that oscillation is produced. It is a wonderfully smooth form of reaction, so silent that you can hardly hear the circuit *is* oscillating—just a gentle "shush."

A Curious Arrangement

Still another special point about this circuit should be seen in the anode circuit of the detector valve—a curious arrangement of two fixed condensers across the high-frequency choke.

We find that the more usual choke and condenser by-pass arrangement does not always give the desired elimination of high-frequency current. That is why we have used the two condensers in series with their point of connection earthed. It entirely by-passes high frequency.

Did we say entirely? Well, nearly ! For there is just a trace of high-frequency current at the loud-speaker or 'phones output. To counteract this we have put in another high-frequency choke in the anode lead of the loud-speaker. As a general rule a by-pass condenser is not needed here.

All these little points seem to make a big difference in the performance of a short-wave set. We certainly would not like to do without them.

Well, that's the circuit; simple enough after you have tried all sorts of mare's nests ! We ought to add a few bars on the British General tuner, because we really feel that it makes a simple all-wave set worth trying. The tuner consists of numerous windings on an ebonite former, with internal switching. You can tune from 14.5 to 40 metres, from 32 to 90 metres, 200 to 550 metres, and from 900 to 2,000 metres—that is to say, four steps cover the entire bands of broadcast interest.

AMATEUR TELEVISION

SPECIAL SECTION FOR THE EXPERIMENTER

CONDUCTED BY H. CORBISHLEY

WHAT THE CATHODE RAY TUBE WILL REALLY DO

AS a receiver of television images, the cathode-ray-tube is proving a serious rival to the mirror-drum apparatus, but many enthusiasts are deterred from investing in either of these components by the thought that they will only be used for a very short time in the day (or should it be night?) Though this may be the case for the immediate present, there are many developments pending which will make the possession of either type of apparatus well worth while. Also, the cathode-ray tube can be used for such a variety of interesting and useful purposes that it ought to form part of every keen amateur's equipment.

How many times have you wished for a valve voltmeter? The cathode ray tube will serve instead. Does your set overload easily? The cathode-ray-tube will tell you where the distortion is taking place. Look at the transient of a drum beat as shown by the cathode-ray-tube, and you will realise how difficult it is to reproduce satisfactorily, and how its reproduction can be improved. And the cathode-ray apparatus has its lighter moments, too. It can be made to show a fascinating whirl of patterns—lines interlacing and revolving, loops, spirals, cog-wheels—subjects for many hours entertainment when ordinary radio experimenting requires a change. Some of these patterns are shown in Fig. 1 and the apparatus for producing them can be easily made at home.

In this, and following articles, the many uses of the cathode-ray-tube will be described in detail, and when one or two simple electrical circuits have been made up, the radio enthusiast will find that he has a new and wonderful instrument of which he will never grow tired.

The Tube and How to Handle It:

Fig. 2 shows the tube mounted on a stand for experimental work, while Fig. 3 shows the details of the electrode system. Before any work can be successfully done, the owner must learn the technique of "handling" the tube, and the pitfalls to avoid.

The first and obvious pitfall is that of blowing up the tube as soon as it has been switched on! This sounds terrifying, but it need never occur if the same careful treatment is given to the tube as one would give to a large power valve.

In effect, the cathode-ray-tube is like a power valve, but with this difference: the anode current is very small, and, more important, the tube is *slightly soft*. The softness is deliberately caused, and helps to produce a sharp image on the screen, but at the same time this condition necessitates special care in the operation of the tube, especially when the anode voltage is about 900.

Like the valve, the tube has a cathode and anode, but the place of the grid is taken by a cylinder which completely surrounds the cathode and which is negatively biased. The purpose of the negatively charged cylinder or "shield" as it is called is to compress the electron stream from the cathode and cause it to pass through a hole bored centrally through the anode. (See Fig. 4). The shield plays an important part in the operation of the tube, since by altering the potential the electrons can be made to form a "jet" of fine dimensions, which will pass up the tube and produce a tiny fluorescent spot where they hit the screen.

An increased anode voltage will naturally cause more electrons to pass through the hole and thus produce a brighter spot. It is not advisable, however, to run the tube at a higher anode voltage than necessary for clear observation, as its life is shortened in proportion to the increase in "beam" intensity. A later article will be devoted to hints in the operation of the tube, but for the time being the user should remember two important precautions: never run the cathode-ray-tube above the rated current or temperature; never operate the tube without negative potential on the shield.

The electron "beam" itself behaves like a conductor carrying a current, and hence can be deflected by a magnetic field in the neighbourhood. In fact, the sensitivity of the beam is such that it is very often deflected by the magnetic field of the earth itself, but this can be overcome by slightly altering the position of the tube.

Since the beam is a collection of negatively charged particles, it will be attracted by a positively charged plate, or repelled from a negatively charged one; and it is this method which is usually used for causing the beam to move and trace a pattern on the screen.

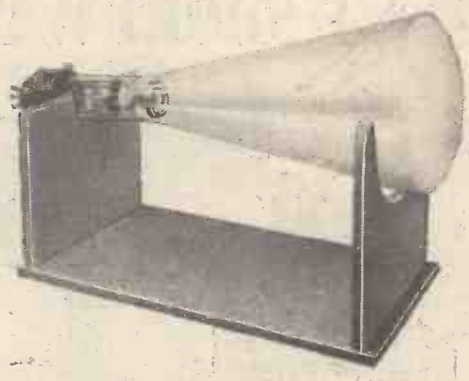


Fig. 2.—This photograph shows a convenient way of mounting the tube

Above the electrode structure in Fig. 3 will be seen two pairs of parallel plates mounted at right angles to each other, the beam passing between them on its way up the tube. Suppose an ordinary H.T. battery be connected between one pair of plates (Fig. 5). As the beam passes between them it will be attracted by the positively charged one and repelled by the other. On switching on, there-

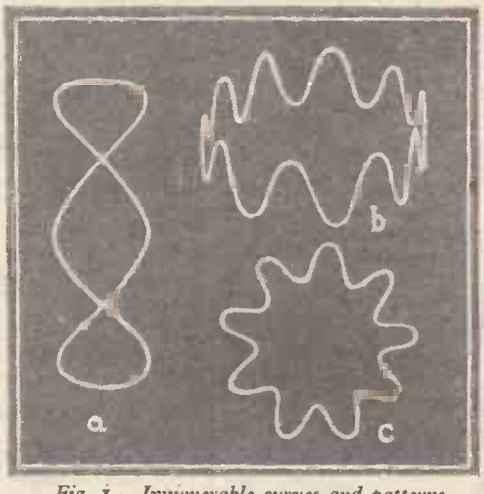


Fig. 1.—Immumerable curves and patterns can be made with the cathode-ray tube. Here are three examples

A GIANT TASK FOR BATTERIES

WHEN QUEEN'S HALL IS BROADCAST

CRASHING FINALE OR SURGING CRESCENDO MEANS A SUDDEN CURRENT DRAIN OF 30 MILLIAMPS ON MODERN TRANSIENT LOAD CIRCUITS

In a modern Transient Load—Q.P.P., Push Pull, or Class "B"— Receiver, the amount of high-tension current called for by the receiver depends upon the "noise value" of the programme. That saves a lot of high-tension current because the average programme is relatively quiet. But it reveals also a danger of severe distortion, because VERY FEW BATTERIES can stand up to the load imposed upon them by these new output stages when, for example, a heavy orchestral item is being played or when the drums predominate. A Queen's Hall concert, for instance, might well call for 30 milliamps current output from your battery on certain passages. An ordinary high-tension battery simply cannot do it—the voltage immediately drops off alarmingly and the quality of reproduction is ruined.

"BIG OXYGEN CONTENT" OF LISSEN BATTERY ALONE ENABLES IT TO RESIST VOLT DROP

HOW MANY BATTERIES CAN STAND UP TO 30 MILLIAMP DRAIN WITHOUT VOLT DROP?

The Lissen Battery contains a catalytic agent of great potency which liberates oxygen in abundance in the cells and keeps the internal resistance of the battery very low. The new circuits reveal the great advantage of this low internal resistance very strikingly, because a Lissen Battery, when called upon, can deliver 30 milliamps or more of current instantaneously without volt drop.

You have paid a big price and waited a long time for a battery set capable of giving you all the volume you want on an economical basis; it is penny wise and pound foolish to sacrifice this new beauty and power of radio by using inferior batteries. Ask very firmly for a Lissen High-Tension Battery this year—you will HEAR A DECIDED IMPROVEMENT IN LOUD-SPEAKER TONE and enjoy LONGER BATTERY LIFE for LESS MONEY.

LISSEN

"Amateur Wireless" use Lissen Batteries for the "Ideal 4" Transient Load output.

"An economical set to run," say the designers, and *so it is when you use Lissen Batteries.*

HIGH TENSION BATTERY

FOR O.P.P. PUSH PULL OR CLASS 'B' OUTPUT

fore, the fluorescent spot at the end of the tube will kick sharply, showing that the beam has been deflected from the central position. This is the simplest use to which the tube can be put—it will act as an electrostatic D.C. voltmeter, in which the voltage is indicated by the position of a spot of light. It has the advantage that it cannot be overloaded, since a high voltage will deflect the beam off the screen altogether, but will not otherwise affect the tube. If the polarity of the battery is reversed, the spot will be deflected by an equal amount in the opposite direction.

Now, suppose the battery is replaced by an alternating voltage. The beam will be deflected first one way and then the other, conforming to the change of polarity on the plates. The spot will now appear as a line, since the eye will not be able to distinguish the rapid swinging to and fro of the beam. The length of the line will be proportional to the total *peak* voltage swing and the tube is now acting as an electrostatic A.C. voltmeter, giving *peak* readings.

If the potential is applied to the other pair of plates, the beam will be deflected in a plane at right angles to its original direction, and by applying a suitable value of potential to each of the four plates, it is possible to move the beam to any desired spot on the screen.

Now let us make the circuit a little more complicated by applying an A.C. voltage to each pair of deflector plates simultaneously. If the voltages are "in phase" *i.e.* if they have the same instantaneous value at the same time, the beam will attempt to move in two planes at once! Actually, of course, it will move in a path which is a compromise between the vertical and horizontal, according to

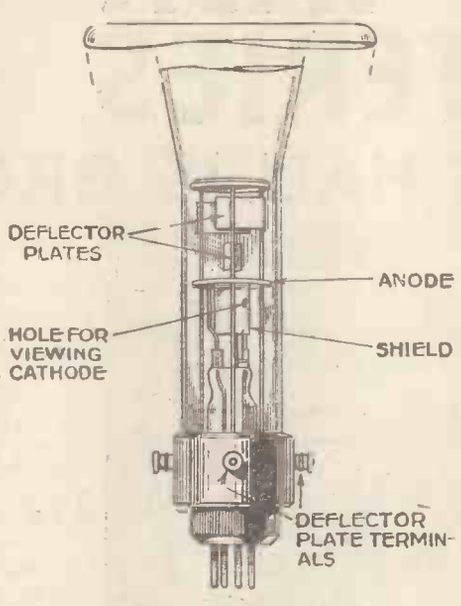


Fig. 3. The details of the electrode system of the cathode-ray tube

Fig. 6. If the voltages are equal, the line will slope at an angle of 45 degrees to the vertical.

When the voltages are not in phase, but have different values at the same instant of time, the beam will produce a simple plane figure—an ellipse (Fig. 7) or, in a special case, a circle. This figure can be made to form the basis of many pretty patterns, but its more practical use is in indicating the maximum values of each of the voltages, and the phase difference between them.

If the voltages differ, not only in phase but in frequency, there are endless patterns which can be produced. The simplest ones are those in which the frequencies of the two voltages are simple multiples of one another. For example, with 50 cycles on the vertical plates and 150 volts on the horizontal ones, the beam will swing three times horizontally for one vertical swing, and will thus produce the double hour-glass pattern shown in Fig. 1a.

If one of the frequencies is known, the frequency of the other wave can often be deduced by inspection of the figure, if it is not too complicated.

This will be clear from a study of Fig. 7.

To observe the actual form of the A.C. wave itself, a new factor will have to be introduced into the circuit—that of *time*. The wave-form gives a picture of the instantaneous variations in voltage of the supply to which the tube is connected, and in order to observe them accurately the beam must travel uniformly across the screen in one direction.

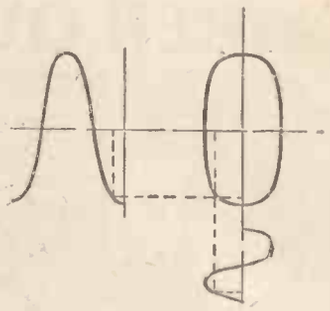


Fig. 7. An ellipse is produced when the voltages have different values at the same instant of time

If we so arrange it that the beam moves horizontally at a uniform rate, covering equal distances in equal intervals of time, it will be tracing out an accurate "time-scale" to which vertical movements can be referred.

The fitting up of this time scale or time base will require a separate article, and next week we will examine briefly the requirements of the circuit to produce it. In its simplest form it is based on a circuit which was known some years ago as the "blinking neon" circuit.

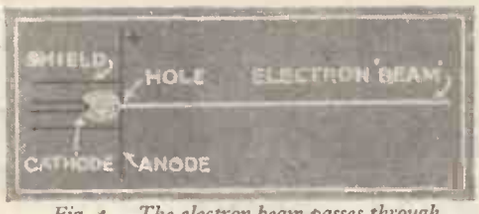


Fig. 4. The electron beam passes through a hole in the anode; note the effect of the shield

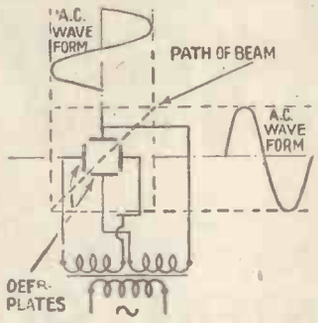


Fig. 6. The path of the beam when an A.C. voltage is applied to each pair of deflector plates with the voltages in phase

Fig. 5. The beam is attracted by the positively charged plate

Current for the "A.W." Television Receiver

THERE are four separate units for which current must be provided in the "A.W." Simpic Television Receiver which has been described in the three preceding issues of AMATEUR WIRELESS—(1) the motor; (2) the projection lamp; (3) the synchronising coils of the motor; (4) the Kerr light-modulating cell.

The two first are supplied direct from the mains and the last two from an amplifier of which preliminary details will be given next week.

At present we need only concern ourselves with the motor and projection lamp supplies. A separate circuit is given for each of these by Figs. 1 and 2, so that they may be easily followed, and the combined circuit by Fig. 3, which shows the entire wiring of the receiver.

Current for the Motor

The motor is rated at 50 volts and it is necessary, therefore, to use some form of resistance in order to limit the current to the correct value when used on mains supply which will be of a considerably higher voltage, the usual range being from 200 to 240 volts. Special resistances are obtainable but a very convenient and cheap plan is to use a lamp or lamps of the same voltage as the mains; these, of course, being placed in series with the motor. The value of the resistance required on 240 mains is approximately 575 ohms.

Reference to the diagram will show that in the motor circuit (starting with one lead at the mains plug) we first have a fuse, then the motor switch, next the regulator (which is an ordinary rheostat), then the resistance lamp or lamps, next the motor and finally another fuse. All these units are in series.

The speed of the motor requires to be 750 revolutions per minute and it is an easy matter to obtain this approximately by the use of suitable lamps used as resistances. Fine control is, of course, made with the rheostat and although a little experimenting will be necessary to get the exact speed, it will be found quite a simple matter. Exact determination of the speed can be obtained with a stroboscopic disc in a very easy manner and this will be

dealt with later when operating instructions are given.

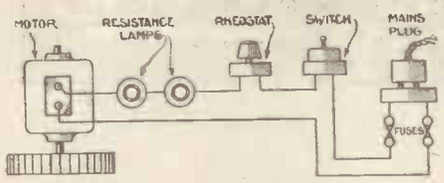


Fig. 1.—The connections for the motor

The projection-lamp circuit is also shown separately (Fig. 2) and in this it will be seen that there are the same two fuses which are used for the motor. There is also a switch and transformer. The voltage of the type of lamp used is twelve and we therefore require to step down the mains voltage to this figure and so a transformer is used with an input winding to suit the voltage of the mains and a 12-volt output which is connected direct to the lamp. Ordinary 5-ampere fuses, such as are used for electric-lighting circuits, are fitted in the mains leads.

Construction

The leads to the synchronising coils and the Kerr light-modulating cell merely need some convenient points of connection. Two pairs of terminals will facilitate connection to the amplifier and these can be arranged at the back of the baseboard. They should be mounted on ebonite or terminal blocks as good insulation must be provided.

The whole of the wiring should be carried out with good-quality rubber-covered wire, care being taken that none of it can possibly foul the mirror drum or the motor when these are in motion.

Double-break switches intended for use on mains must be used and these, together with the motor rheostat, are fitted on a small panel secured to the right-hand side of the baseboard below the synchronising control knob of the motor. With the wiring carried out the construction of the mechanical side of the receiver is finished and there

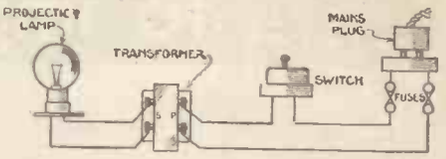


Fig. 2.—Connections for the projection lamp

only remains the amplifier, of which preliminary details will be given next week.

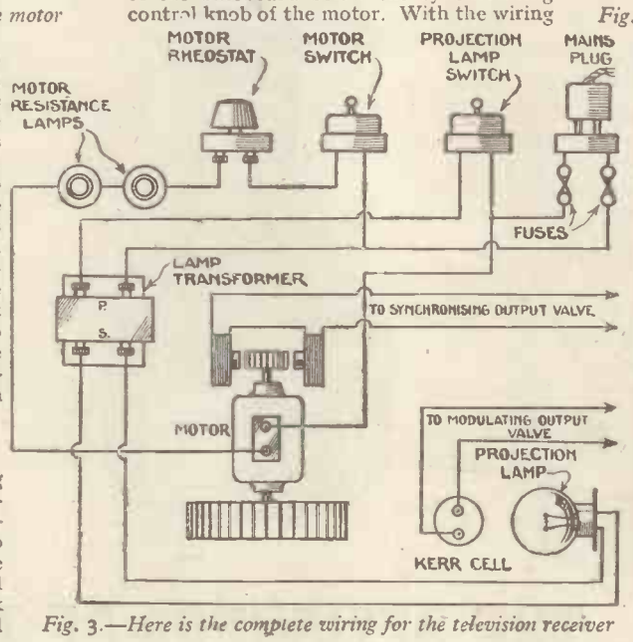


Fig. 3.—Here is the complete wiring for the television receiver

"A.W." is the only British Radio Weekly to give you a Regular Constructional Television Section

Making A Light-modulating Cell

This simple unit is incorporated in the "A. W." Television Receiver. Used in conjunction with a simple Nicol-prism substitute, it will enable you to experiment with the modulation of light

The complete unit for the Kerr cell which is fitted into a glass tube filled with nitro-benzole

THE construction of a Kerr cell such as is used for the light modulator in the Simpic Television Receiver is quite a simple matter, although the task is of a rather fiddling nature.

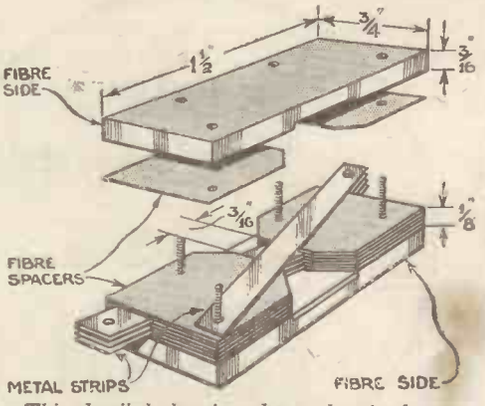
Briefly, a light-modulating cell of this type consists of a number of metal-foil plates arranged in two groups, the one group being insulated from the other; Steel, nickel or brass foil may be used for the plates, and eight is a suitable number—four in each group.

In the unit illustrated the plates consist of steel foil six-thousandths of an inch thick with a separation space between them of eight-thousandths of an inch. Each plate is 1½ in. long and ¼ in. wide, and their separation is maintained by paper fibre .008 in. thick. The shape of the fibre separators will be clear from the drawing. In order to make the whole unit rigid a thick block of fibre is placed at each side, the whole being held together by 8 B.A. screws and nuts.

It will be observed that the two groups of plates are placed at an angle relative to each other. This is merely for convenience of construction and obviates drilling clearance holes in the plates for the screws as would be necessary were these parallel. In the unit illustrated the fibre side blocks and the corners of the separating pieces are cut away slightly in order to allow as much light to pass between the plates as possible.

When the unit is assembled it is placed in a glass cell or tube, this being filled with redistilled nitro-benzole. Connection to the two groups of plates may be made in any convenient manner, but they must be so supported in the glass cell that the apertures made by the plates should be in the centre of the optical arrangements of the receiver. A strip of ¼-in. brass is used in the unit illustrated.

In making a cell of this description the fibre pieces should be cut to shape and then assembled, the whole lot being drilled through at once. As each hole is drilled a screw should be fitted in order to ensure that the remaining holes register. The holes in the metal plates should also be drilled whilst they are clamped tightly together between two pieces of hardwood or fibre, otherwise difficulty will be experienced with the drill tearing the thin metal and raising a burr, which would prevent the plates being placed the correct distance apart.



This detailed drawing shows the simple construction; the cost of the unit is but a few pence

Wonderful *RADIO* Secret

DISCLOSED TO ALL WHO WANT TO

Make Money!

DO you want to make more money? Would you like a regular extra income—week after week—month after month? Would you like to be free from Financial Worry—independent of Trade Depressions? Then let us disclose to you a wonderful radio secret, fully protected and patented, by means of which many men and women like you have DOUBLED THEIR INCOMES! Let us introduce you to a REALLY GENUINE SPARE-TIME Business which is going ahead so rapidly that we MUST have more and more licencees to keep pace with the demand!! What is the work? It is making Patented Wireless Batteries by a special secret method which is so simple that you can start right away on your kitchen table and even the children can help you!! Now *YOU* know that the demand for Wireless Batteries runs into MILLIONS—and is STILL GROWING!! And when we tell you we will show you FREE how to make 60-volt batteries for only 2/3 you will realise what a GOLDEN OPPORTUNITY this is!!

Why waste your spare hours doing nothing—getting nowhere? Think of all the luxuries you could enjoy with a few easily-earned extra pounds per week—a house, a car, freedom from financial worry and the unemployment bogey! Start this money-making business NOW!

Security—Independence—Money to save! This No-Drudgery, Spare-Time Business is the way to prosperity for you and yours! Let us tell you the secret!

NO PREVIOUS EXPERIENCE REQUIRED

You need not have the slightest previous experience or technical knowledge. Even if you have never *seen* batteries before you can start making them and making money by means of our secret method and improved formula! No expensive plant or machinery is required. You need only a few simple tools and presses, most of which you can make yourself at a trifling cost. You can work when you like, where you like—and your profit is limited only by the time you have to spare. Your market is unlimited. You can make up to £300 a year per licence!

FREE PARTICULARS HOW TO START!

The work is clean, safe, pleasant and simple. What little tuition is necessary we will give you FREE. Post the Coupon below TO-DAY and we will send you Free Particulars of how you can start RIGHT AWAY making money!! Why delay? Why go on making money for others instead of making money for yourself! Get out of the rut—learn this money-making secret and be your own "master."

PROFITS GUARANTEED

There is no doubt about the BIG PROFITS waiting for wideawake men and women to whom we divulge our secret. Indeed we GUARANTEE you profit. If necessary we will take sufficient of your output off your hands to ensure you a weekly profit—provided that your work comes up to the easily attained standard of efficiency. And we will also undertake to continue your training FREE as long as required.

£5 per Week—5 Hours a Day!

Dear Sirs,—I am writing to let you know how well I am progressing.

I started 13 months ago with 30/- worth of chemicals. I made £4 11s. 11d. profit in the first five weeks and now have stock and plant valued at £40.

All my chemicals I buy in bulk so that I can make as much as 200 per cent. profit.

These last five weeks business has brought me in £25 7s. 6d., working 5 hours a day.

The e excellent results are due to your kind assistance at all times.—(Sgd.) E. W. Edwards.

(Original can be seen)

MANY PEOPLE LIKE YOU HAVE DOUBLED THEIR INCOMES!

ONE MAN EARNED £960 IN SPARE TIME

SEND THIS COUPON FOR FREE PARTICULARS HOW TO START

To Mr. V. ENGLAND-RICHARDS, THE ENGLAND-RICHARDS CO., LTD., 1226 King's Lynn, Norfolk.

Sir,—Please send me at once, and FREE, full details as to how I can Make a Patented Radio Speciality for 2s. 3d. to retail from 6s. to 7s. 6d. and Make Money at Home in my spare time; also Big Broadsheet of Fully Illustrated Original Testimony from those already making Big Money. I enclose 2d. stamps for postage.

"Amateur Wireless," Sept. 23rd, 1933.

Print your name and address boldly in capital letters on a plain sheet of paper and pin this coupon to it.

We Test for You

A Weekly Review of New Components and Tests of Apparatus Conducted by J. H. REYNER, B.Sc., A.M.I.E.E.

COLUMBIA PICK-UP

THREE essentials of a good gramophone pick-up are that it shall be reasonably sensitive, that it shall be heavy enough to stay in the groove on the loudest musical passages, and that the tracking error shall be a minimum. If the last two points are not considered, rapid record wear will occur. Readers are, no doubt, familiar with the white lines that appear on gramophone records after they have been in use for some time. These lines are due to incorrect tracking.

The new Columbia pick-up is an excellent example of modern design and must certainly take a place amongst the best pick-ups on the

The new Columbia model 22 pick-up, housed in a bakelite case, has a novel needle-changing device

market to-day. The whole of the casing, including the arm, is made from moulded bakelite and is very neat. The tracking error is negligible and the needle followed the record down to quite low frequencies.

The response of the pick-up over the audio range was checked. The output was about .25 volt at 1,000 cycles, rising to .6 volt at 250 cycles, below which frequency it remains fairly constant. The bass is thus well reproduced, while there is a peak at 3,000 cycles which imparts brilliance to the tone.

This pick-up may be recommended. The retail price is £1 12s. 6d.

◆ ◆ ◆

METAPLEX BASEBOARD

METAL baseboards and chassis for amateur set construction have not become really popular owing to the necessity for drilling. The use of the metal screen confers undoubted advantages, amongst which may be mentioned the ability to earth the various sections of a receiver locally, so helping to avoid any troubles due to instability. There is also, of course, the consequent simplification of the wiring as some of the common earth leads can be omitted.

In this connection we were interested to receive from Peto Scott Co., Ltd., a sample of their Metaplex baseboard. This is a normal ply-type board sprayed with metal, which gives it a pleasing grey colour. In an endeavour to estimate the efficiency of the screening, we actually measured the high-frequency and direct-current resistance along a 12-in. length of the board. The direct-current resistance was very low indeed, being only .003 ohm.

The high-frequency resistance was somewhat greater, being .48 ohm, but even this figure is low and it should be quite satisfactory to earth condensers and other parts direct to the board.

In the case of a tuned circuit, it would be advisable to include an earth return wire in the usual way.

BRITISH RADIOGRAM LOW-FREQUENCY TRANSFORMER

THE whole trend in the design of low-frequency intervalve transformers is towards smaller and smaller instruments. This has been made possible by the introduction of

A cheap low-frequency transformer with good characteristics, the new British Radiogram model

improved iron for the core, primary inductances being obtained which would have been quite impossible a short time ago. The British Radiogram transformer which we are reviewing here is made by the British Radio Gramophone Co., Ltd., and is housed in a moulded bakelite case, finished a mottled-brown colour.

The transformer was tested with a valve, having an amplification factor of 15, over the audio-frequency range and gave an effective step-up varying from 15 at 128 cycles to 48 at 3,500; this value was maintained to over 5,000 cycles. The inductance of the primary winding was found to vary between approximately 48 and 15 henries as the direct current was varied between 0 and 4 milliamperes.

Only costing 5s., the transformer should prove useful to many constructors.

◆ ◆ ◆

LISSEN UNIVERSAL LOUD-SPEAKER

THE miniature moving-coil loud-speaker has recently become popular. This fact is no doubt partly due to the advent of class-B portable and transportable receivers, and also to the midget universal receivers which are now appearing on the market.

The design of a moving-coil loud-speaker having a diaphragm with a diameter of under

A universal output transformer, enabling the loud-speaker to be used with most output stages, is fitted on this new Lissen reproducer

5 in. would, probably, have been considered impossible a few years back, but some surprising results are obtainable on the midget loud-speakers at present available.

A newcomer to this class of loud-speaker is that made by Lissen, Ltd. This is a real baby; the diaphragm diameter is only 4½ in. and that of the moving coil only ½ in., while the overall depth of the speaker is 3½ in. The makers claim that a very light moving system has been used, thus enabling a very faithful response to be obtained.

On test, their claims are well substantiated, the loud-speaker giving good results, even when compared with instruments many times its size and price. A universal input transformer is fitted, suitable for all types of power valve, including class B and Q.P.P. The D.C. resistance of the class-B tappings is 350 ohms each side; this is slightly on the high side, but satisfactory results are obtained.

The retail price of this loud-speaker is £1 5s. in chassis form and £2 10s. mounted in a cabinet.

◆ ◆ ◆

TELSEN VARIABLE CONDENSER

THE rigidity of a ganged variable condenser is a very important consideration. It is obviously essential that the capacity of the various sections of the condenser shall not alter with respect to one another at any time during the complete life of the condenser. The new Telsen three-gang condenser should prove entirely satisfactory in this respect, as it is substantially built, die-castings being used to support the various plate assemblies.

The condenser tested was of the three-gang type, each section being provided with its own trimmer, operated by a star wheel. A slow-motion friction drive is included with the condenser and the ivorine scale is marked in wavelengths. The condenser is intended for use with Telsen coils, when the scale provided will be accurate. The position of the

Telsen's new three-gang condenser is sturdily built and can be recommended

scale is, however, variable over a small angle to enable the most accurate position to be found.

On test we found the three sections of the condenser were well matched, the maximum capacity being approximately .00054 microfarad and the minimum .00004 microfarad. The high-frequency resistance of the condenser measured at 400 metres was .9 ohm.

An interesting point in the construction of the condenser is the provision of terminals and pigtails for earthing the shaft of the condenser between the three sections. The price is £1 with dustproof cover.

Output Transformers

By JOHN COLLINDALE

IT is common knowledge that in order to obtain the maximum output from a last-stage valve, the impedance of the load in the output circuit must bear a certain relation to the internal impedance of the valve.

In the case of ordinary three-electrode valves, up to, say, 1,500 milliwatts output, the load impedance should be approximately twice the valve impedance. Some of the more recent large output valves, such as the Mullard DO25, have optimum loads some five or six times the valve impedance, while for the majority of pentodes the best value for the load is from 8,000 to 10,000 ohms.

Direct Connection

If the speaker has an impedance equal to the desired load impedance, and its windings will safely carry the full anode current of the output valve, it may be connected directly in the anode circuit.

The modern tendency, however, is to isolate the speaker from the anode voltage and at the same time to avoid passing the whole anode current through the speaker by employing an output transformer. The primary of the transformer is connected in the anode circuit of the output valve, and the speaker is connected to the secondary terminals.

If the speaker impedance is equal to the optimum load for the valve, an output transformer of 1-to-1 ratio should be used.

If, however, the speaker impedance is not of the best value for the output valve, the load on the valve can be adjusted by choosing a transformer of suitable ratio.

Before considering the formula for calculating the correct ratio for the transformer, it will be well to define exactly what is meant by the "impedance" of the speaker.

Most moving-iron speakers are marked with a figure indicating their resistance in ohms. This is the resistance of the winding to a steady *direct* current. But the current operating the speaker in a radio receiver is an *alternating* current, and the *impedance* of the winding, therefore, is not constant, but varies according to the frequency.

Thus, a speaker having a *resistance* of 2,000 ohms would have an *impedance* at the middle audio frequencies of about 4,000 ohms and at the higher audio frequencies of some 6,000 ohms and often very much greater still. It is usually quite satisfactory to match the speaker at the middle frequencies, and to assume that its impedance is equal to two-and-a-half times its rated resistance.

For moving-coil speakers, however, the impedance can be assumed to be practically constant at the maker's rated figure throughout the range of audio frequencies. If the makers specify only the D.C. resistance of the speaker, its impedance can be taken at twice this figure.

Having determined the actual value of the speaker impedance, the correct ratio for the output transformer can be calculated from the formula:

$$\text{Ratio} = \sqrt{\frac{\text{Optimum load for valve}}{\text{Speaker impedance}}}$$

In the case of most three-electrode valves and moving-iron speakers, this formula may be re-written:

$$\text{Ratio} = \sqrt{\frac{2 \times \text{Valve impedance}}{2\tfrac{1}{2} \times \text{Speaker resistance}}}$$

and, as a matter of fact, it will be found that a 1 : 1 ratio transformer will satisfy requirements in most instances.

Two examples may be given, however, showing the application of the formula to other cases.

A Moving-iron Example

Suppose it is required to operate a moving-iron speaker having a resistance of 2,000 ohms from a Mullard PM22 pentode. The optimum load for this valve is 10,000 ohms, and the ratio will therefore be:

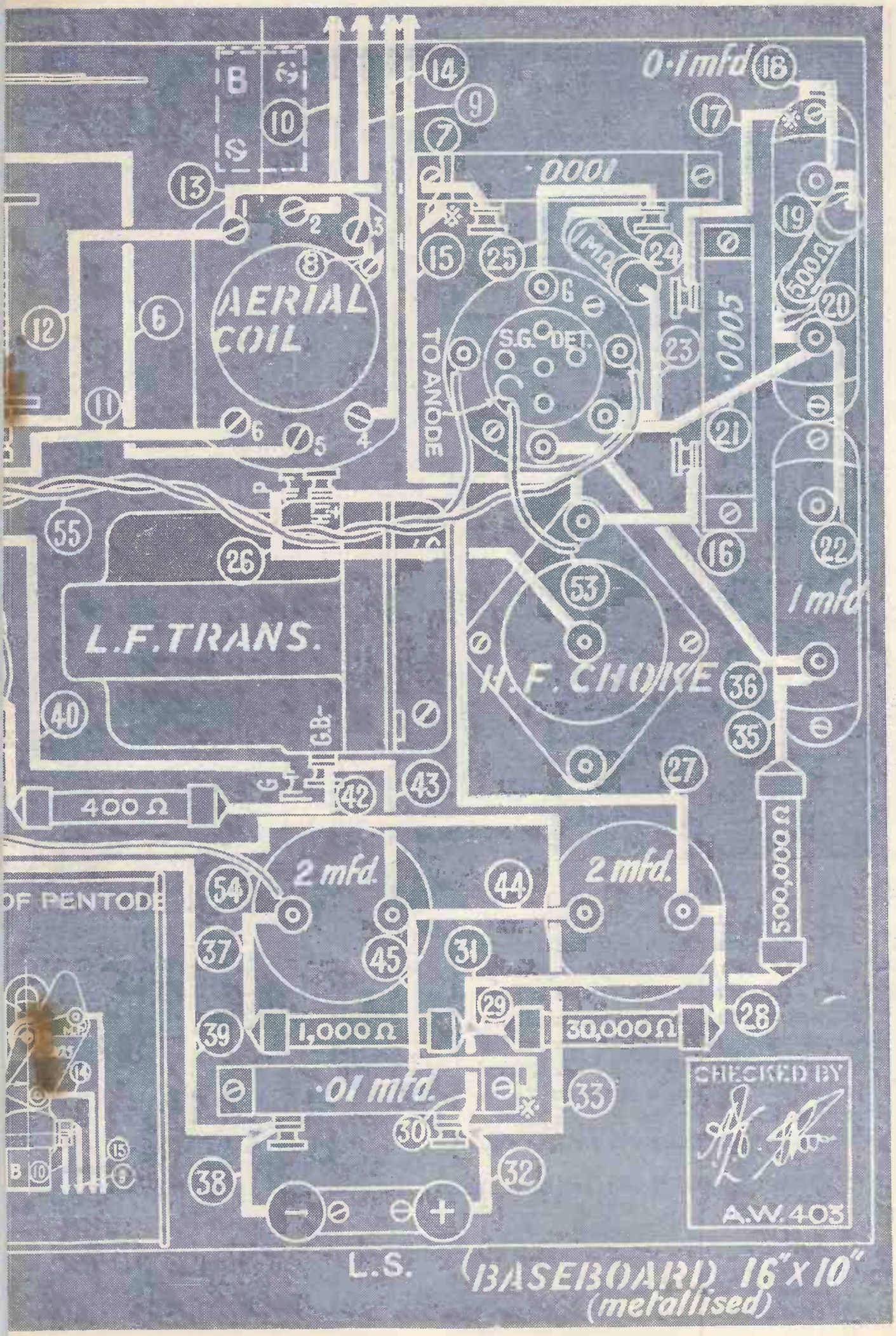
$$\sqrt{\frac{10{,}000}{2\tfrac{1}{2} \times 2{,}000}} = \sqrt{\frac{10{,}000}{5{,}000}} = \sqrt{2}$$

$= 1.41$, that is, a ratio of $1\tfrac{1}{2}$: 1 approximately.

For the final example we will take the case of a moving-coil speaker, having an impedance of 10 ohms, operated from a pentode. The ratio will be:

$$\sqrt{\frac{10{,}000}{10}} = \sqrt{1{,}000}$$

$= 31.6$, that is, a ratio of 30 : 1 (approx.).


0·1 mfd
·0001
·005
500Ω
1MΩ
AERIAL COIL
S.G. DET.
TO ANODE
L.F. CHOKE
L.F.TRANS.
1 mfd
2 mfd.
2 mfd.
400Ω
500,000Ω
1,000Ω
30,000Ω
·01 mfd.
CHECKED BY
A.W.403
L.S.
BASEBOARD 16"x10"
(metallised)