A.C. METER UNIT—See page 332

A NEWNES PUBLICATION

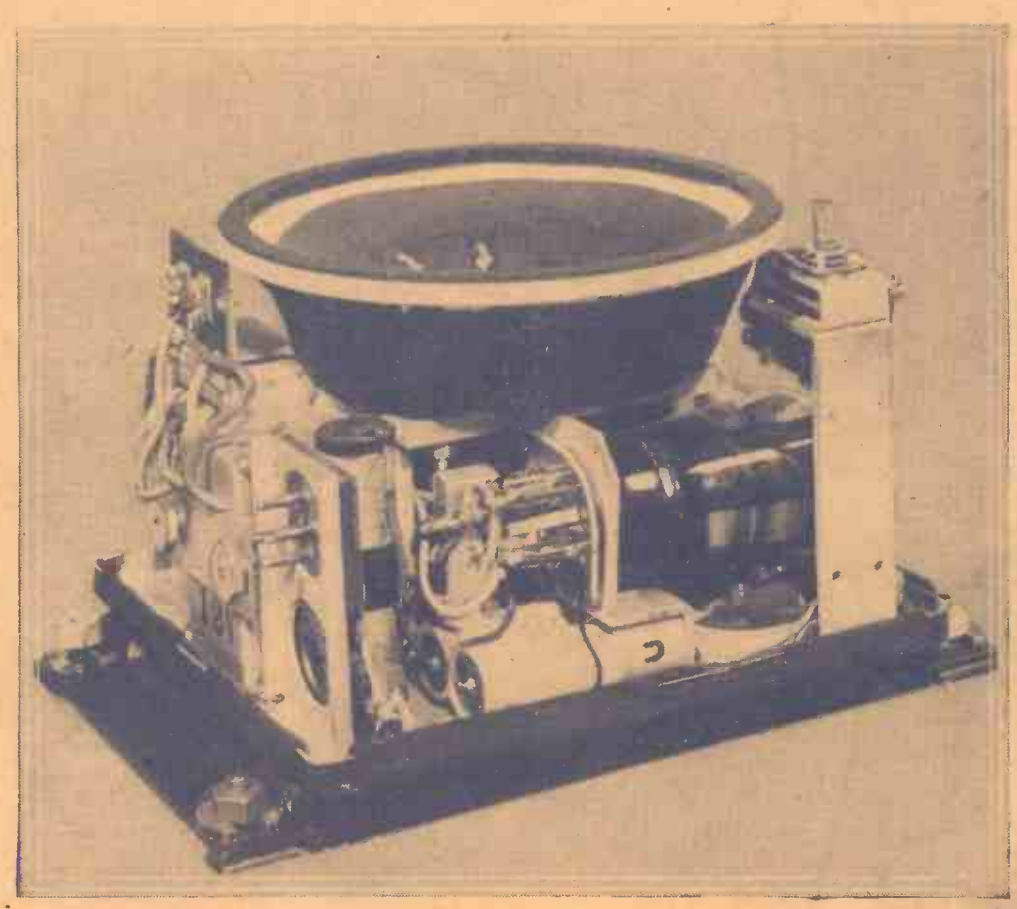
Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

Edited by F. J. CAMM

Vol. 16. No. 407. July 6th, 1940.

Contents



USES FOR CAR RADIO

Practical Wireless

BLUEPRINT SERVICE

These Blueprints are drawn full size.
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940) 4d. Post Paid
" (Issues dated June 1st, 1940, and after) 5d. Post Paid
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/4 " "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears : Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House Southampton Street, Strand, W.C.2.

PRACTICAL WIRELESS

	Date of Issue	No. of Blueprint
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The " Junior " Crystal Set	27.8.38	PW91
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 4s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The " Pyramid " One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW87
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The " Colt " All-Wave Three (D, 2 LF (RC & Trans)	18.2.39	PW72
The " Rapide " Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 " Triband " All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's " Sprite " Three (HF Pen, D, Tet)	20.3.38	PW87
The " Hurricane " All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's " Push-Button " Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's " Limit " All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
" Acme " All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The " Admiral " Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
" All-Wave " A.C. Three (D, 2 LF (RC))	—	PW51
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW55
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47
SUPERHETS.		
Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW50
F. J. Camm's Universal £4 Superhet 4	—	PW60
" Qualitone " Universal Four	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model Push Button 4, A.C. Mains Model	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The " Fleet " Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68
PORTABLES.		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW85
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW97
Four-valve : Blueprint, 1s.		
" Imp " Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans.)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans)	—	AW412
Lucerne-Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
" W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF, Pen, D, LF, P)	*May* '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C.	*May* '34	WM359
" W.M." Radiogram Super A.C.	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-Short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
" W.M." Long-wave Converter	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM362
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS.		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM393
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW402
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical and Wireless
PRACTICAL TELEVISION
EVERY WEDNESDAY
Vol. XVI. No. 407. July 6th, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Fault Finding

WE have published many interesting articles dealing with fault tracing and servicing, and in these have included constructional details of different items of test equipment. It is a recognised fact, however, that for quick fault location and for checking receiver performance, one of the devices known as a Signal Tracer is the best. This generally consists of a standard type of T.R.F. receiver, and by using the H.F. section alone, or the complete receiver, in conjunction with test prods it is possible to inject an artificial signal into a receiver and to check its passage from stage to stage. This idea is preferable to the use of a standard broadcast signal, as it is possible not only to obtain a constant signal, but also one of either the H.F. or L.F. type. Usually, however, such an instrument is. by its very nature, complicated and also bulky. We recently came across a design for a similar type of test set in which only one valve was used, and although it cannot be expected to function so well as a multi-valve tester, it does definitely offer some very interesting scope for test work, and, accordingly, we are reprinting details in this issue. These will be found on page 331.

Star Variety

A "STAR" variety programme for Home Service and Forces listeners will be broadcast from a Midland theatre on July 6th. "Top of the bill" is Carl Brisson, whose last broadcast from the Midlands was shortly before the war. A strong supporting company will include Forsythe, Seaman and Farrell, in a comedy and musical act; Vera Lynn, well-known radio singer; and Patricia Rossborough, a broadcasting pianist of great versatility. The programme will be supported by a theatre orchestra. The name of the compère will be announced later.

Tynwald Ceremony

THE ancient ceremony at Tynwald at which new laws for the Isle of Man are promulgated is to be held on July 5th, and J. H. L. Cowin, known to many listeners for his Manx broadcasts, is to give a commentary on this picturesque ceremony.

"Jack the Giant Killer"

THERE are many giants for any modern Jack to kill these days, and this idea has been seized upon by Francis Dillon, who is to produce an up-to-date and satirical version of "Jack the Giant Killer" in the Home Service programme on July 9th. In this 1940 version of an old nursery favourite listeners will meet a Jack who has settled down in his castle, only to be disturbed by the rumours of a three-headed giant who is abroad. Jack's subsequent adventures as he sets out giant-killing should make good listening—particularly the good-humoured skits on the characters of famous personalities.

Another interesting example of a military portable radio transmitter-receiver. Note the novel aerial array.

Seaside Concert Party

JACK RADCLIFFE, the high-spirited Scottish comedian, is top of the bill in a seaside concert party which will broadcast on July 6th. He will be supported by Coral Gunning, Ina Harris, Helen Norman, Bob Curnot and Jack Ansell and his Band.

Parlour Game

WILFRED PICKLES, already known for his versatility in the North as an announcer, Children's Hour artist, vocalist, compère and actor, is breaking fresh ground. This time he is devising and producing a Parlour Game—and a good game it promises to be, as he plans to pit husbands and wives against each other. Wilfred is using four couples and he will ask a wife a question, or set her some task. If she fails in the attempt then it will be her husband's turn in the opposing team.

Death Travels First

LISTENERS who heard the first instalment of "Death Travels First," the murder thriller written by John Rhode and produced by John Cheatle, will be able to hear the concluding instalment giving the solution to the crime on July 9th. The story is about five travellers on a suburban train from London during the black-out months. In the dimly-lighted compartment they all found that they knew each other. After the train had reached its destination, one of the five was found murdered in the compartment.

Variety from Scotland

SCOTTISH variety artists will entertain listeners in the Forces on July 6th in a programme which the producer, Howard Lockhart, has called "Skit to Skat." In the cast will be Jackie Kellar, a young Glasgow lad who toured and broadcast for some time with Roy Fox and his Band; he is an imitator, not merely of famous stars but of everyday sounds which he can reproduce faithfully and amusingly with the help of a microphone; the Four Smith Brothers, who model themselves on the Mills Brothers; Betty Hogg, the Rhythm Girl; and a comedy sketch will complete the programme, which will be accompanied by the George Bowie Quartet.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Comprehensive Tone Control

Constructional Details of a Useful Full-range Tone-controlling Device

MOST receivers incorporating a pentode or tetrode output stage are fitted with some form of high-note cutting device, generally referred to as a tone control. In designing receivers for high standards of reproduction, a tone control is, of course, essential, and a control which functions over very wide ranges will be found much more useful than the usual high-note cut-off just referred to. Such a wide-range control is described in this article, and a study of the accompanying diagrams will show that the unit is composed of a tapped choke, four condensers and a potentiometer; the choke, potentiometer and condenser No. 4 being connected across the speaker windings whilst condensers 1, 2 and 3 are inserted in the leads to the speaker. The arrangement is very simple, and at the same time very effective, allowing the output required to be selected at will. The most important item for construction is the choke, and this must be to the specification given or the results are quite likely to fall very much below the standard required.

The Choke

The original design was made up by using two chokes connected in series, but experiment proved that a single-tapped

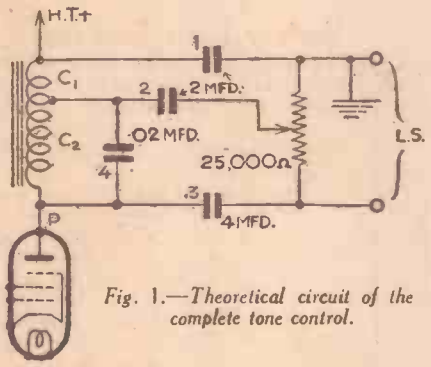


Fig. 1.—Theoretical circuit of the complete tone control.

choke might be used if the correct point of tapping was found, and it is proposed to use one choke on grounds of both expense and space. For the purpose of winding we will call the windings one and two, each part being dealt with as a separate choke until the finish. Commencing with choke 1, a hole must be drilled on one side of bobbin cheek low down near the tunnel for the commencement of the winding. Pass a short length of flex, with the outer braid covering stripped off, through the choke, clean off the insulation, and solder the end of the 36 S.W.G. enamelled wire to it. Insulate the joint with a small piece of ordinary insulating tape and all is ready for winding.

Wind on to the bobbin as evenly as possible 1,620 turns, and finish off by soldering on a length of flex as for the commencement, and passing through a hole drilled in the same cheek. This hole may be made slightly larger than the hole for the commencement, as we shall pass the lead for the next winding through this, making two leads in one hole. Having completed the winding and made fast the finishing lead, put two layers of greaseproof paper over the winding, followed by a layer of good quality insulating tape, and choke 1 is finished. Choke 2 is wound in exactly the same manner as choke 1, the lead for the commencement being pushed through the finishing hole of choke 1, and the wire for the winding soldered to it. For choke 2, 3,240 turns are needed, and in winding this amount of wire the windings are apt to get very uneven. Therefore, at the end of every 800 turns cover the winding with a layer of paper as used for the finish of choke 1. Finish as for choke 1, securing the whole of the windings with an extra layer of insulating tape to make a good firm job. A word of warning, be quite sure that all winding is done in the same direction, otherwise one choke will be in opposition to the other.

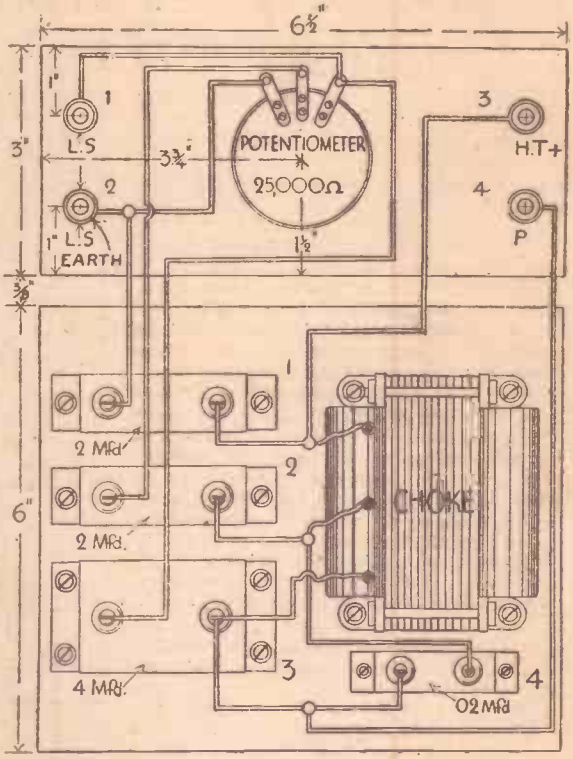


Fig. 2.—Wiring diagram showing components and layout.

Fitting Up

The laminations will be of the usual form of "T" and "U" type, and these are not fitted as so often described for transformers, but by placing all "T's" into the tunnel in the bobbin until it is filled tightly, and no further laminations can be driven in with a piece of wood. It is important that the laminations are tight if noise is to be avoided. Get the bolts loosely fitted into the clamping feet, ready to fit over the "U's," and then take enough "U" pieces to make up the thickness of the "T's" already in the tunnel. Fit the "U's" round the bobbin and slip the clamping feet over the ends to hold the whole in position, tighten up the bolts just enough to hold the laminations, but do not screw right home.

To maintain the inductance a gap must be made between the "T's" and "U's," the size of this being about the thickness of two sheets of the paper upon which this article is printed. Cut two slips of this paper and place between the ends of the "U's" and the "T" pieces, afterwards closing the laminations up tight and clamping up the feet so that any movement of the laminations is impossible.

The unit may be built into a receiver, and should this be the case the components will be arranged to suit the available space and layout of the remainder of the set, but for existing receivers where a new unit has to be made, a small paxolin panel or even wooden panel can be used to advantage with the potentiometer, and terminals on the front, and the components mounted on a baseboard.

Wiring

The wiring is very simple, and as all the components, with the exception of the choke, will have terminals, these have not been included on the choke, and connections may be made direct to the different points.

When using a separate speaker the unit may be housed in the speaker cabinet, and as one side of the speaker will be at earth potential, as in ordinary choke-capacity coupling, the terminal marked earth may be taken to the nearest earthing point. This is particularly useful when extension leads are being used.

Connections to Receiver

Terminal No. 1 to L.S.
Terminal No. 2 to L.S. and earth.
Terminal No. 3 to H.T.
Terminal No. 4 to anode of output valve.

LIST OF COMPONENTS

Seventy-two No. 30 Laminations.
One Bobbin to fit.
Four ounces 36 S.W.G. Enamelled Wire.
One Set of Feet and Bolts.
Short length of Flex.
Insulating Tape.
One 0.02 Fixed Condenser
Two 2 mfd. Fixed Condensers } T.C.C.
One 4 mfd. Fixed Condenser
One 25,000 ohms Potentiometer
One Panel, 6½in. by 3¾in. by ¼in.
One Baseboard, 6½in. by 6in. by ¾in.
Four 4 B.A. Terminals; 20 S.W.G. Tinned Copper Wire.
One and a half dozen Small Screws.

A One-valve Signal Tracer

Constructional Data of a Simple and Efficient Test Unit

As a further contribution to the test instruments which we have described, the following data (taken from a recent issue of *Radio News*) will undoubtedly appeal to many who are making up such equipment for experimental or service use. It is a very novel and simple piece of apparatus which will certainly do all that is claimed for it.

IN servicing wireless receivers, it is almost a truism that a totally inoperative set is easier to fix than one that "sort of works," i.e., is noisy, distorting, or weak. It was to make it easier to diagnose these headaches that the following device was constructed.

It is essentially a signal tracer which makes it possible to follow a signal, either from a broadcast station or from a modulated test oscillator, from stage to stage and from component to component through a set and find out just where it goes wrong. When that is settled, it is seldom much trouble to find out what is the matter.

Features of the Design

The hook-up used is a pentagrid converter circuit whose oscillator section generates frequencies which lie in the regular broadcast band. This is coupled to the aerial and earth of a good set, either a T.R.F. or superheterodyne, but one preferably without A.V.C. A signal fed into the input of the set to be repaired may then be examined anywhere in its career, either as H.F., I.F., or L.F., by being fed into the input of the converter circuit through special test cables. If the signal is to be examined in the H.F. stage, the oscillator of the converter is rendered inoperative and the signal is simply amplified and passed on to the test set. If the signal is in the I.F. stages, it is changed back to broadcast frequency in the converter, and if the signal is in the L.F. stages it is used to modulate the oscillator frequencies in the converter in the same manner as a gramophone oscillator. Thus any defective stage may be located quickly.

One prerequisite in such trouble shooting is that the device used shall not load the circuit. That was one of the great difficulties of the analyser method of set-checking; the extra capacitances introduced by the analyser cables were generally sufficient to throw the set into an entirely different frame of mind, and with a sheet of analyser readings on hand it was often more difficult to figure out what *they* indicated than it would have been to diagnose the trouble "by ear."

That difficulty is avoided in this instance by using a probe which puts such an infinitesimal load on the circuit that the effect is practically zero. In fact, if the set under observation is operating strongly at all, it is not necessary to touch the probe to the components; by simply holding the probe near them, enough energy can be picked up from the stray fields to enable one to judge the quality of the signal at that point.

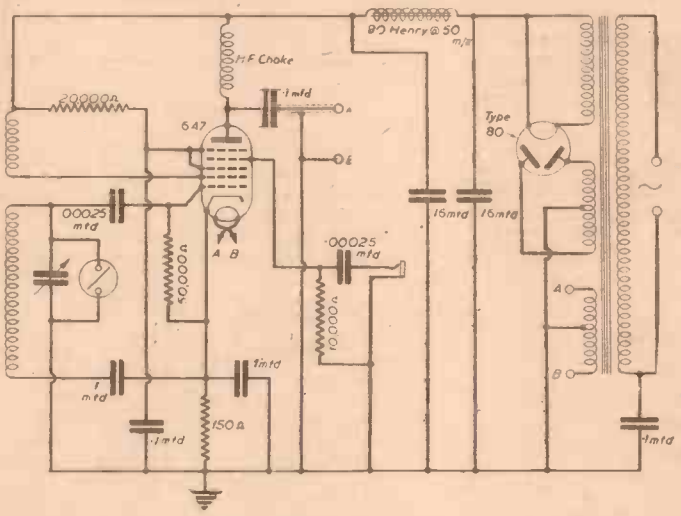
The probe is constructed of a 5in. length of bakelite or fibre tubing of an inside diameter just large enough to admit a flat-headed metal drawing-pin. Two of these drawing-pins, separated by 1/16in. make up a minute air-gap condenser in the body of the probe, which very effectually shields the probe tip from the earth capacity of the shielded cable used to transfer the signal to the input of the converter.

Test Probes

To the point of one drawing-pin a 1in. length of stiff piano wire—gauge 20 or 21 is right—is soldered and the other end sharpened. A piece of wooden dowelling, of a diameter just large enough to fit snugly in the tubing, is cut ½in. long, and a 1/32in. hole is drilled from end to end down the centre. The piano wire is pushed through this until the drawing-pin is all the way in, and a turn or two of bare copper wire is wrapped around the free end of the piano wire flush with the dowel, and soldered to hold the piano wire in place.

The centre wire of a piece of shielded cable about 3ft. long is pushed through another similar piece of dowelling and soldered to the pin of another drawing-pin. The wire is then pulled back through until the head of the drawing-pin is flush with the end of the dowel, and the wire is secured in the same manner as the other.

A very thin coating of speaker cement is then applied to the second piece of dowel and it is pushed through the bakelite tubing until the head of the drawing-pin



Circuit of the 1-valve Fault Finder.

is just ⅛ of an inch from the other end. A very small hole is drilled through both the tube and the dowel and a small brad nailed through to hold the dowel in place. The other piece of dowel is then pushed into the open end of the tube, drawing-pin first, until the two drawing-pins are separated by 1/16in. By pushing it in until the two drawing-pins touch, and then withdrawing it, this distance can be judged quite accurately. A few drops of cement and a brad hold it in place. The shielding on the cable is then brought up about an inch over the other end of the probe, and a couple of turns of friction tape wrapped around to hold it in place. A regular 'phone jack is fastened to the free end of the cable, the inside wire going to the tip and the shielding being connected to the earth side. It is then complete. This is the H.F.-I.F. probe.

Another cable is made up exactly like the first except for the probe, which in this case has a .00025 mfd. mica condenser set into a slot in the end of another similar bakelite tube and taped fast. The inside wire of the cable is soldered to one terminal of the condenser, and a 1-in. length of piano wire is soldered to the other. This is the L.F. probe.

Circuit and Wiring

As to the converter itself, its construction is not difficult. The 6A7 should be well shielded and the current well filtered; any hum which is introduced into this valve will be very confusing when you're using it to locate hum somewhere else. L and C in the diagram are any ordinary broadcast band H.F. transformer with its primary cut down to about a dozen turns, if it has more than that, and the tuning condenser that goes with it.

The leads to the primary will have to be reversed if the polarity is not correct, for then the valve will not oscillate. Satisfactory evidence of oscillation will be had by removing the grid cap from the 6A7 and, with the dial of the test set turned to about 60 and the volume control turned down low, slowly turning the tuning condenser on the converter. At about the same setting of the converter dial a loud hum should be heard when the finger-tip is touched to the control grid of the 6A7. If no such hum is heard and the connections are all right otherwise, reverse the primary leads.

Using the Unit

The method of using the instrument is quite simple. When listening in on the H.F. stages the switch on the tuning condenser is closed, rendering the oscillator inoperative. The set under observation is tuned to the strongest local available and the test set tuned to the same station. Either one wire to the speech coil of the set under observation should be unsoldered or a jumper should be put across the speech coil. Then with the H.F.-I.F. test prod the quality of the signal can be ascertained throughout the H.F. stages. If nothing suspicious is disclosed there, the test set should be tuned to some place on the low-frequency end of the dial where no station whatever can be heard normally, the oscillator switch should be opened, and the oscillator dial set higher than the dial of the test set by an amount equal to the I.F. of the set in question. The test set will then receive the I.F. of this set and, still using the H.F.-I.F. probe, the quality of the signal can be judged up to the grid of the second detector.

Passing to the low-frequency part of the receiver the L.F. probe is used and the oscillator dial is set to the *same* reading as the dial of the test set, and the volume of the latter turned down pretty low.

An A.C. Meter Unit

An Add-on Unit for Use with the 12-range Meter Described in Last Week's Issue. By W. J. DELANEY

THE twelve-range meter described in last week's issue was essentially a D.C. unit, but it is interesting to note that arrangements were made in the switching to retain the actual meter as a completely separate unit, that is, on the 1 mA range. In this condition the two test leads which were provided become, in effect, merely extensions of the two terminals on the milliammeter and, therefore, by plugging these leads into any other piece of test equipment it is possible to dispense with the use of a separate meter. For example, suppose you are building up an all-valve tester. In the normal way this would consist of a panel carrying a number of valve-holders, switches and so on, with a milliammeter inserted somewhere on the panel for indicating purposes. If you intend to make up a number of pieces of test apparatus you will find, however, that many of them have as their main indicating unit a 0-1 milliammeter, and this means that you will have to purchase separate meters in the normal way for each piece of test equipment. However, by making the twelve-range meter a kind of standard, you can afford to purchase a really good meter, and then by fitting two sockets on all your other test equipment which requires a 0-1 mA meter you can merely plug in the two leads from the twelve-range meter, set the indicator on that to read 1 mA, and go ahead with tests on the other instrument.

A.C. Voltage Readings

The series resistors which were included in the meter already described will enable the meter to be used to test any D.C. circuit, but A.C. must not be applied to it. In order to read any A.C. supply with the meter in question it is first necessary to rectify that supply and convert it into D.C.

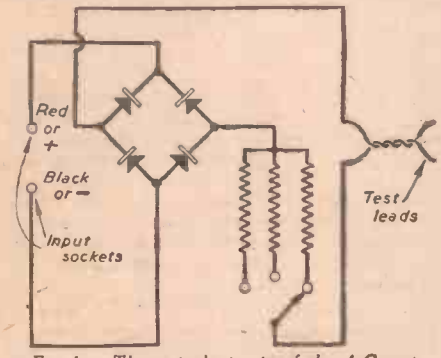


Fig. 1.—Theoretical circuit of the A.C. unit.

Smoothing is not necessary, and therefore all that is theoretically essential is a rectifier in series with the circuit. When this is done, however, it should be remembered that, as explained last week, in all tests which are made with such an instrument the meter is actually indicating the current flowing, and voltage readings are actually only interpretations of the current and resistance in circuit. Therefore, the rectifier in series will result in the meter indicating A.C. milliamps. The needle on the meter will then indicate a mean value of the current flowing, but with a true A.C. supply it is necessary to read what is known as the Root Mean Square (or R.M.S.) value. This is actually greater than the mean reading which the meter will indicate, the ratio actually being 1.11 to 1. Therefore if we include the meter across a circuit so that full scale deflection is obtained, instead of the current being 1 mA it will actually be 1.11 mA, R.M.S., A.C. The type of scale fitted to good quality moving-coil meters of the type which should be used in the meter described last week will be regular

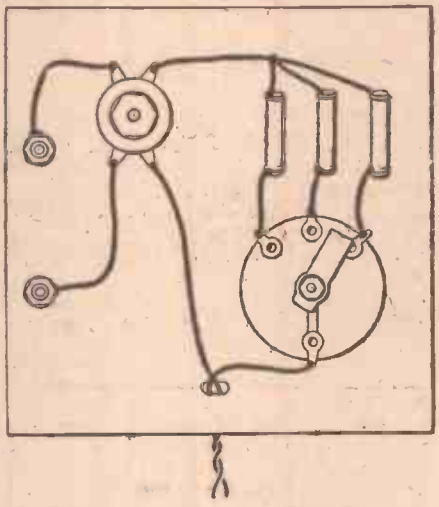


Fig. 2.—Suggested layout, and wiring diagram of the meter unit.

in its sub-divisions, and thus the proportionate readings at all parts of the scale will be correct. Thus the ratio just mentioned will hold for all ranges on that scale.

Series Resistance Values

It will be seen, however, that we do not wish to have to translate all our readings into such an odd amount, and when set to read 5 volts, for instance, we do not want to have to visualise the scale as being 5.55 volts, and then try to calculate the odd divisions of the scale in such proportions. Accordingly the series resistors which have already been fitted for D.C. will need some modification if the voltage readings are to be in A.C., and this means a fresh set of resistances. It would be difficult to make one self-contained switch also give a change-over of a range of such resistors, and it is therefore necessary to include a further switch to bring into circuit the rectifier and new resistances when A.C. voltages are to be read. Although these could all be included in one box or cabinet, in the present case it was found worth while to make up a special little A.C. box, including a selector or range switch, the rectifier, two test leads, and the necessary range of resistances. For a similar range of voltage readings to those given in the D.C. instrument one of the smaller types of selector switch may be used, for instance, the Bulgin type S.117/9. The rectifier must be of the 1 mA type, and it is held on the panel of the A.C. box by means of a small bolt. The resistors are arranged round the switch in a similar manner to those shown last week, and the wiring for the complete box will be as shown in Fig. 2.

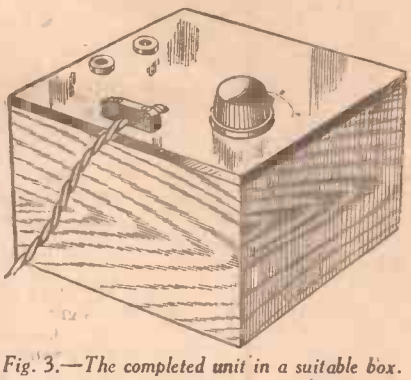


Fig. 3.—The completed unit in a suitable box.

The box may be of any desired size, either identical to the D.C. complete meter (for neatness in storage or for bench fitting) or a very small box may be made for portability. It will be noted that there are two input sockets, and into these the two leads from the D.C. meter are plugged. The two flexible leads attached to the A.C. box are then used for the purpose of testing, and there is a safeguarding element in using separate leads of this nature. You are at once aware of the fact that the meter has been changed over, and as an additional precaution and warning for this purpose it is recommended that a much heavier gauge of flex be used on the A.C. box, and also that the leads be twisted or plaited throughout their entire length. There is, of course no polarity with A.C. to worry about, and therefore two flex leads of the same colour may be used and are recommended. Thus, with the D.C. meter you have two separate red and black leads giving at once warning of polarity, whereas on the other you have similarly coloured leads indicating no polarity and thus A.C. When carrying out servicing work at high pressure, or under some form of stress such as working against time, you will find this a very valuable safeguard against connecting the instrument wrongly and damage is thereby avoided.

Resistance Values

For the benefit of those who wish to select any range of voltages for the A.C. box the following details will be found useful. The rectifier voltage drop will be about .9 volts and the voltage drop across the meter will be .1 volts. This should be deducted from the total voltage reading which is required, and the answer is then divided by 1.11 times the meter full scale current expressed in amperes. As exact values of commercial resistor to the required values will not be found obtainable it is preferable to obtain resistors of a slightly *lower* value which are standard products, and then by means of the meter described last week adjusted to the "resistance" range, to modify the value of the resistor until the desired value has been obtained. By using the carbon type of resistor (such as the Erie) the desired modification may easily be obtained by filing away the element, using a half-round file and making periodical tests as the work proceeds. Remember, however, that you need a low initial value and that removing some of the material does not lower the value, but increases it.

ON YOUR WAVELENGTH

By Thermion

Place Names

I NOTICE that a large number of wireless dealers are still displaying signs which locate the district, such as the *Mudtown Radio Stores*. Now that we have removed all signposts and obliterated milestones, and got rid of every roadside marking which would give an invader an idea of his location, it is particularly important that traders should not defeat the object by still proclaiming the name of the town in which they are situated. In any case, it is now illegal to do so, and they should remove signs at once.

The Morse Code

FROM the number of enquiries I receive it is obvious that there is an enormous revival in the interest in the morse code. Leslie Dixon tells me that he is selling large numbers of morse practice sets. Also, thousands are now listening in to morse. I do not know whether the transmitting brigade are keeping their hands in or whether it is the desire on the part of the youngsters to learn the morse code.

Valve Cartons

I AM told by a member of the B.R.V.M.A., which are the initials of the British Radio Valve Manufacturers' Association, that they are inviting dealers to save their valve boxes which they will collect for re-pulping. Apparently, they are considering the possibility of using these valve cartons again, so do not be surprised if when you purchase a valve you find that the carton has a rubber stamp impression on it, for such will be done every time the carton is re-issued. The words impressed will be "Carton Re-Issued" or "Re-issued Carton."

Another suggestion is that valves may be supplied in paper wrappings. Dealers should also salvage all cardboard boxes in which receivers are delivered.

P.A. Vans

IT now appears that the recent ban on radio in motor-cars does not apply to vans equipped with public address apparatus. The Postmaster-General has announced that he does not consider that P.A. vans come within the ambit of the recent order.

The Position of the Experimenter

I HAVE had some amusing stories from genuine British experimenters who have been suspect because of suspicious neighbours. One such experimenter was of the type who lived for the hobby, and spent most of his evenings and early mornings in his wireless den experimenting with short-wave apparatus. Naturally, therefore, he did not mix with his neighbours, who regarded him as a standoffish fellow. Therefore, after the immense publicity which has been given to the activities of Fifth Columnists and the confiscation by the Post Office of all amateur transmitting apparatus, they immediately suspected him of being a spy. Some well-meaning or malicious soul informed the police that they thought he was a spy and that he was transmitting secret messages to Germany. The police swooped down on him and collected a large amount of short-wave receiving apparatus whilst they detained him for some time for questioning. The local police could not tell a receiving-set from an Official Receiver, and it was not until he was able to satisfy them of his bona-fides that they reluctantly let him go. In any case, he does not think that he convinced the police, and he suspects that they may be watching him. My advice to him is to let them have their suspicions and to let them go on watching. An innocent man has nothing to fear. There are thousands of genuine experimenters in this country, and it is unthinkable that they should be treated as spies, although none of them would object to answering reasonable questions properly put by the police. Members of wireless clubs can always produce as evidence of their honesty their membership card to prove that they are serious British experimenters—an added reason why every amateur should join some properly organised club.

The R.S.G.B.

I HAVE no doubt that a large number of members of the Radio Society of Great Britain have been worried in this way, and I have yet to learn of one of them who has failed to satisfy the authorities. The law prohibiting amateur transmissions is very necessary during the war, and amateurs during the last war had to suffer a similar ban. The members are, however, retaining their interest, and the Society is still publishing its members' journal. When the war is over there will be a veritable boon in amateur transmitting, as there undoubtedly will be in home construction. When those who return to civilian life have had a chance to forget the war, they will return to their old hobbies with renewed zest, keen to renew their acquaintance with radio. The letters I have from readers indicate that even though on active service they are following developments with the same interest as they did when in civilian life.

R.A.F. Wireless Operators

MANY readers are joining the R.A.F. or are interested in the wireless branches of the Air Force. It is therefore interesting to note that the designation "Cadet" has been officially approved for airmen training for air crew duties—that is as pilots, observers and wireless operators/air gunners. They wear a white band round their caps.

Cadets who have been provisionally selected for commissioned rank wear, in addition, a white armlet, and are known as "Air Cadets."

Pupils for training as pilots and observers now go straight to Initial Training Wings as soon as vacancies occur. The intake has recently been speeded up to cope with the increased numbers available. Those cadets for wireless operator/air gunner duties go to one of the technical training schools before doing their course at an "I.T.W."

Tabulating Faults

I WAS speaking to a really enthusiastic amateur serviceman the other day and I found that there are hundreds of readers who take such work really seriously. One of the main difficulties of service work is the identification of a fault from some peculiar symptoms in the performance. Usually the serviceman, from constant practice, will be familiar with the effects introduced by certain faults and thus is not very long in putting a set right. When, however, some unusual symptom is experienced, there is some difficulty in identifying the fault. The amateur I refer to had made a very neat form of loose-leaf alphabetical index of faults and their effects, and every one was cross-referenced in several different ways. This prevents a considerable amount of trouble and doubt when a fault is experienced, and a glance in the book helps to indicate something on the lines which may be taken in finding the fault. I should be glad to hear of any similar idea or other service aid which readers may have adopted in this connection, and I am sure other readers will be interested in the experiences of servicemen or experimenters in this particular field.

An Appeal

ONE of the gunners attached to a searchlight detachment, who is also a reader of this journal, tells me that his company are situated in a lonely spot and they want a wireless set of the battery type. If any reader has a battery portable which they would like to give to the detachment in question, I should be glad to pass along the name and address. Carriage will be refunded.

Constructing Portables

How to Construct Portable-type Receivers from Existing Sets or Spare Parts

THIS time of the year may justly be called the portable season, and the recent restrictions regarding the use of car-radio apparatus do not apply to ordinary portables, which may still be used. We can supply certain blueprints of portables, but there are no doubt hundreds of readers who do not feel inclined to go to the expense of a completely new set of components, due to the fact that they have many useful parts on hand which they wish to make use of. It is therefore proposed to suggest a few circuits and approximate layouts of simpler types of portable receivers for the benefit of such readers.

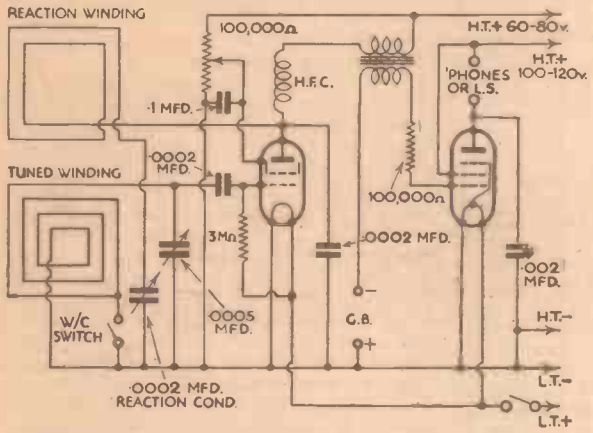


Fig. 1.—The above is a really good circuit for a simple type of portable receiver using modern valves.

Having decided to build a portable, the first question which arises is: must the set be really small and light, so that it can easily be carried by hand, or is it only required for transport from room to room? In the former case it will be better to make the simplest kind of two or three-valver, preferably housing the receiver proper in one container and the batteries in another. If weight and bulk are not very important considerations, a more pretentious and entirely self-contained outfit will be better. Another point which must be decided is whether loudspeaker or 'phone reception will be required. In most instances the speaker will be preferred, but many will content themselves with 'phones, using the set probably only for receiving news bulletins and the like.

In the majority of cases nothing more than local-station reception will be required, so that the use of a det.-L.F. type of circuit might prove quite satisfactory. Where long-distance reception is specially wanted at least one H.F. stage—preferably using a high-frequency pentode valve—will be especially desirable.

Simple Circuit Arrangement

Now that the preliminaries have been discussed a few useful circuit arrangements can be considered. One excellent circuit for local-station reception up to 20 miles or so on a loudspeaker, or over much greater distances with 'phones, is shown in Fig. 1. It will be seen that a screen-grid valve (which might be replaced by an H.F. pentode) is used as detector, this being followed by a 5 : 1 L.F. transformer and a pentode output valve. The circuit is similar to that used for an ordinary "fixed" set, except that a frame aerial, with reaction winding, is used in place of the usual aerial and coil. A "stopper" resistance is included in the grid circuit of the pentode, and a .002 mfd. condenser is connected between the anode of the pentode and H.T. negative to prevent L.F. instability. A variable potentiometer is shown for controlling the voltage on the screen of the detector, but this might well be a baseboard-mounting pre-set component, since it need not be touched after the preliminary adjustment has been made, so as to obtain smooth reaction control. A suggested arrangement of the components and frame aerial is given in Fig. 2, but this may be modified considerably so as to accommodate the parts in some available attaché-case or other container.

When the set is to be accommodated in a case separate from that containing the batteries, it will be so small that a frame aerial wound round it would not prove very effective on account of its small size. It would, therefore, be better to replace the frame by a dual-range coil, as shown in Fig. 3, and to employ an external aerial. The latter may consist simply of a short length of wire thrown along the floor or over the branch of a tree, or it might be a connection to an earth point, such as a water-pipe. The idea of using an earth for an aerial might sound rather ridiculous to those who have not tried it, but in practice it often works very well. In the case of the other extemporised aerial systems mentioned, still better results will often be obtained by using an earth connection as well, this being joined to the negative terminal on the accumulator.

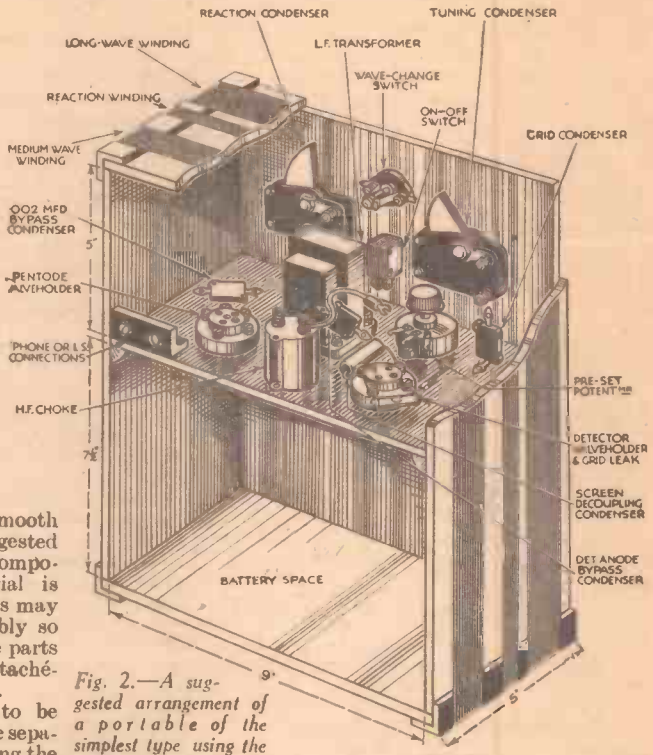


Fig. 2.—A suggested arrangement of a portable of the simplest type using the circuit given in Fig. 1. Dimensions are approximate and will have to be modified according to the batteries employed and if a speaker is to be accommodated.

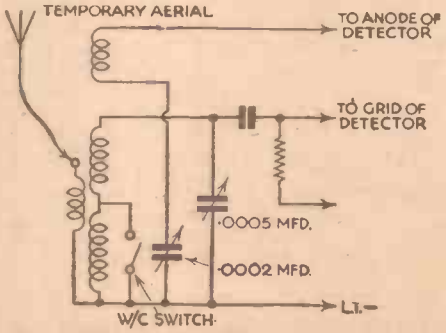


Fig. 3.—With a very small portable better results can often be obtained by replacing the frame aerial by a dual-range coil and using a short temporary aerial. The connections given above show how a coil is substituted for the frame aerial shown in Fig. 1.

It might be mentioned at this point that a fairly effective and particularly convenient "self-winding" aerial can be devised from one of the steel tape measures which can be bought from sixpenny stores. The end of the tape is soldered or otherwise connected to the aerial terminal, so that to "erect" the aerial it is only necessary to pull out the case. After use the "aerial" is wound up simply by pressing the spring-release on the side of the case. A measure only a yard long can be used but, naturally, better results can be obtained by employing a greater length than this.

Increased Volume with a Two-valve Set

The circuit given in Fig. 1 is not suitable when good speaker reproduction is required out of doors, unless the set is used within a very few miles of a regional station.

More volume can be obtained fairly easily

(Continued on facing page.)

CONSTRUCTING PORTABLES

(Continued from previous page.)

however, by replacing the single output pentode by one of the new Q.P.P. double pentodes. This would necessitate the use of an 8 or 10 to 1 Q.P.P. transformer in place of the ordinary L.F. transformer shown in Fig. 1, whilst the loudspeaker would either have to be of Q.P.P. type or else fed through a special output choke. The double pentode circuit is given in Fig. 4, and this is simply added to the detector portion shown in Fig. 1.

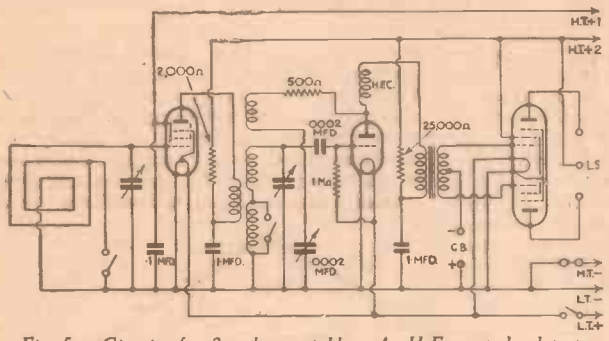


Fig. 5.—Circuit of a 3-valve portable. An H.F. pentode, detector and double output pentode are used.

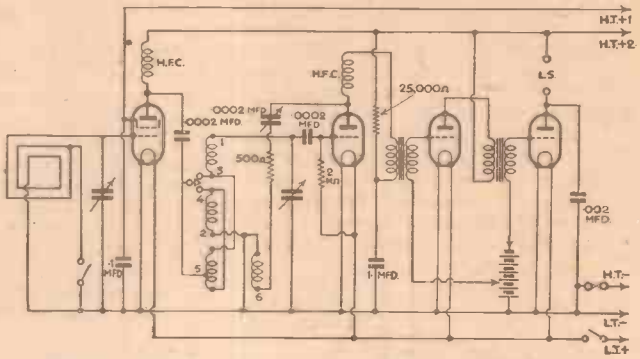


Fig. 6.—A 4-valve portable which can be built from spare parts.

Increased Range

Neither of the arrangements described so far is suitable for any other than purely local reception, and when the set is to be used at distances of more than twenty miles or so from the nearest transmitter, it is better to use a stage of H.F. amplification An excellent circuit for a powerful three-valve portable receiver is shown in Fig. 5, where it will be seen that an H.F. pentode is followed by a tuned transformer coupling, leaky-grid detector (a type H valve is very suitable), and a double pentode Q.P.P. output stage. The latter could, of course, be replaced by an ordinary pentode connected as shown in Fig. 1. When the set is being built as a separate unit the frame aerial would be replaced by a dual-range coil, and an "outside" aerial of one of the types mentioned above would be connected to it. Provided that the coil was of the same type

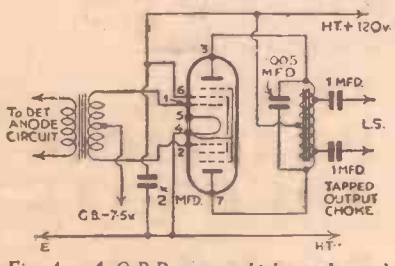


Fig. 4.—A Q.P.P. stage which can be used in a portable with good results.

as that used between the first two valves, a two-gang .0005 mfd. condenser could be employed for tuning. The component lay-out might well be very similar to that shown in Fig. 2, it being assumed that a frame aerial is to be employed, and that the set is to be entirely self-contained with its own loudspeaker and batteries. The dimensions will require to be at least 2in. greater in every direction than those shown in Fig. 2, to allow for the additional components, while an extra 4in. or so might be required in the width of the frame according to the particular loudspeaker used.

Using Old Components

Practically all the arrangements suggested so far would entail the purchase of at least a few new parts, and, therefore, a circuit is given in Fig. 6 to show what can be done by using the old and home-made parts throughout. The circuit is a standard one of the S.G.-Det.-L.F. and Power type, and operates from a frame aerial. Both H.F. chokes can be of any good screened, high-inductance type. In the interests of compactness and light weight the two .0005 mfd. tuning condensers might be of the bakelite dielectric variety, although existing air-dielectric condensers which are on hand might be used if compactness is not insisted upon. In regard to the loudspeaker, this can be of the balanced-armature type, and a suitable unit can be bought for a few shillings at the present time. Slightly better results would be obtained by using a moving-coil, but that would add to the weight and bulk, besides being more expensive if a new one were to be bought.

B.L.D.L.C.

IN spite of the existing strenuous times, during which the majority of us are having to curtail to some extent the number of hours normally devoted to our hobbies, it is very comforting to find that quite a number of members are still able to take a keen interest in the Club's activities. The harder one is working the greater the necessity for some diversion both mentally and physically; therefore if time only permits, say, half an hour devoted to receiving, the relaxation obtained from the sterner thoughts of to-day will refresh one's mind and body. As we have mentioned before, an hour at the control of the receiver is now likely to produce a more thrilling log than during normal times owing to the fact that the more distant stations are able to be received as the air is no longer swamped by the numerous British stations.

Member 6702

One or two points which we have stressed from time to time are contained in this member's letter and in view of their general interest we are repeating the major portion of his correspondence but space causes us to eliminate the rather fine log he sent in. "As a reader of PRACTICAL WIRELESS for over a long period I have noticed from time to time remarks made by readers who are contemplating trying out an H.F. Pen untuned stage of H.F. amplification in an S.W. circuit. I have also noticed that many of your readers appear to use sets of the 0-v-1 type or commercial superhets. I submit the following remarks with the hope that they will help prospective constructors who wish to try out H.F. amplification to obtain more accurate indications for them to judge its comparative worth. As an experienced short-wave constructor for over a period of ten years, I have constructed short-wave sets from the simple one-valvers to those utilising four valves, and I have found that a great deal depends on the following. Short-wave coils play a very important part in any S.W. receiver, therefore it pays one to give them careful attention when selecting suitable types. Some use coils covering two or three ranges, while others use the simple plug-in types; in my case I have always adopted the four or six-pin plug-in kind and have always found that they are superior to the multi-range types.

"High-frequency chokes can give lots of trouble if they are not carefully selected for the particular circuit under consideration. I do not agree with the idea of using a general-purpose H.F. choke, by which I mean one covering all wavelengths, in any receivers designed specifically for short-wave work.

"The selection of suitable valves is another very important matter, but from the articles which have already appeared in these pages readers will no doubt appreciate that without additional emphasis from me.

"The set in use at present consists of the following arrangement. A Mazda H.F. Pen acting as an untuned buffer between aerial and an HL2 as the detector. An L210 is used for the L.F. stage and this feeds into a PM2A in the output, the H.T. supply is obtained from an A.C. eliminator. Many short-wave enthusiasts condemn the untuned H.F. stage as being a waste of a good valve but, when one considers and appreciates the work it does, I think the man who converts an 0-v-1 to a 1-v-1 using this method, will agree that it obviates many sources of trouble experienced in 0-v-1 types of circuit. I found most definitely that the addition of the H.F. valve improved such snags as hand capacity and aerial damping in addition to giving an appreciable amount of amplification. I admit that the resultant selectivity is not what one would like, but have any of the straight types of circuit got that to their credit?"

More Unusual Faults

Servicing Experiences Showing How Troubles May Be Introduced in Unusual Ways

WE have published many articles dealing with fault-finding in its various phases, and many constructors are now turning their attention to practical radio servicing. Although there are many "rules" which can be followed in regard to the location of faults it is often found that what may be termed "unusual faults" are experienced which normal servicing methods do not reveal. For instance, an interesting problem was recently presented when it was noticed that reception had become gradually weaker and weaker, and was eventually not worth listening to. A few minutes with a milliammeter gave convincing proof that the set itself was functioning properly, and that the batteries, and so forth, were in good order. The aerial, installed in the loft, was inspected and appeared to be in excellent condition, the down lead was intact and well insulated, and the earth plate seemed beyond reproach.

The aerial and earth entered the house by two holes drilled in the window frame, and were led to a two-pin socket just inside the window, connection to the set being made by means of a plug inserted in the socket. It was in this socket that the fault was eventually located. The socket itself was a bakelite moulding, open at the back, and was packed with spiders' webs, while a certain amount of damp had gradually short-circuited the radio signals. When the socket had been cleaned out and dried, the set functioned as well as ever.

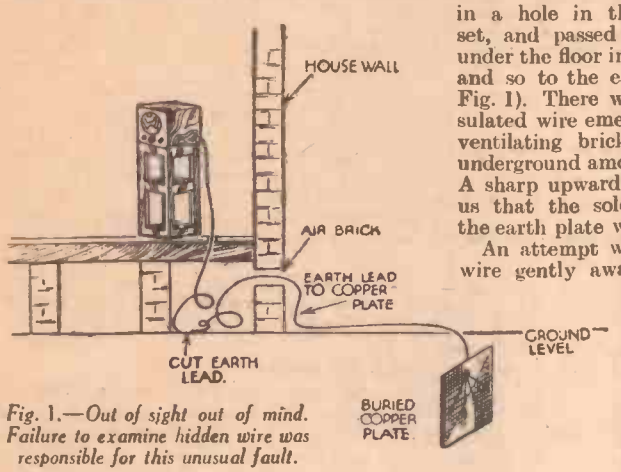


Fig. 1.—Out of sight out of mind. Failure to examine hidden wire was responsible for this unusual fault.

An Earth Lead Astray

A really mysterious incident occurred in a set that worked fairly well through the winter, but with the coming of lighter days the volume fell off more rapidly than would have been expected. As in the previous case, there was apparently nothing wrong with the set itself or with the batteries. The aerial seemed perfect, and it was, therefore, suggested that the earth was faulty. This consisted of a good copper plate, with the wire securely soldered to it. The wire from the set disappeared in a hole in the floorboard behind the set, and passed through an "air brick" under the floor into the garden, and so to the earth plate (see Fig. 1). There was a thick, insulated wire emerging from the ventilating brick and dipping underground among the flowers. A sharp upward tug convinced us that the soldered joint on the earth plate was intact.

An attempt was then made to pull the wire gently away from the house. Ten feet of wire was pulled out! On going back to the room where the set was installed, however, it was found that the earth wire was still in position. There was nothing for it but to take up a floorboard, and when this was done the mystery was solved, for the wire connected to the earth terminal of the set just led into the empty space under the floor and no farther. It appeared that the aerial and earth had been fitted while the house was being built. The earth plate, with wire already soldered to it, had been buried just outside the wall and the wire fed through the air brick. It had not been possible to manipulate the wire through the hole in the floor, so a stout wire had been pushed down the hole to "fish" for the earth wire, which had eventually been hooked and pulled up through the hole. It will be clear that the hook would have brought up a loop of the earth wire, and the loop had been cut and the wrong end of it used for the earth connection, allowing what had been imagined to be the spare end (but really the end connected to the earth plate) to slip out of sight under the floor.

Cleating a Down Lead

Here is a word of advice to those who intend to use loft aerials. Pay particular attention to their position with respect to any water pipes which may be installed in the loft. I once saw a beautifully erected aerial in a loft, the efficiency of which was reduced to a very low value because it was running immediately above a range of water pipes (Fig. 2). The "effective" height of that aerial was certainly less than one metre, and the performance of the set connected to it was very poor until the aerial was taken down and moved to another part of the loft where it was not shielded by well-earthed pipes.

A case of poor results with an indoor aerial was eventually traced to the down lead, which ran down the side of the house. Insulated wire of the single-strand variety had been used, and it was fastened to the woodwork of various window frames by so-called "insulated" staples, that is, coppered staples with a piece of thin, vulcanised fibre inside the "U." Intermittent good and bad reception led one to suspect a loose contact. Ultimately the fault was found in the down lead under one of the staples which had severed the wire, causing a disconnection, although a rubbing contact sometimes gave the full effect of the complete aerial.

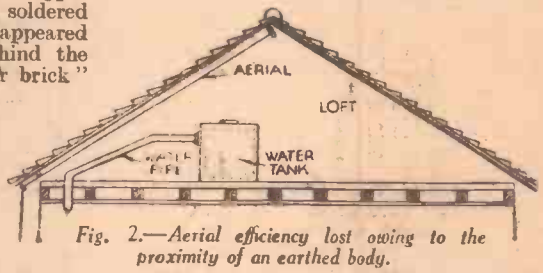


Fig. 2.—Aerial efficiency lost owing to the proximity of an earthed body.

Clothes Props

A listener complained that quite suddenly his set had developed rather alarming cracklings, and although he had thoroughly overhauled it he could trace no faulty connection to account for the trouble. When the set was switched on one afternoon, the programme came over surprisingly well, and there was no sign whatever of the reported scratchings and crackles. It was about four o'clock when he started to listen, and everything went well until about the middle of the First News, when ominous scratchings began.

Examination of the aerial showed that a large clothes prop was leaning against the wall of the house, and was pressing on the lead-in wire, causing it to touch the metal guttering, as shown in Fig. 3. A few inches of insulating tape and the removal of the clothes prop restored the performance of the radio to normal.

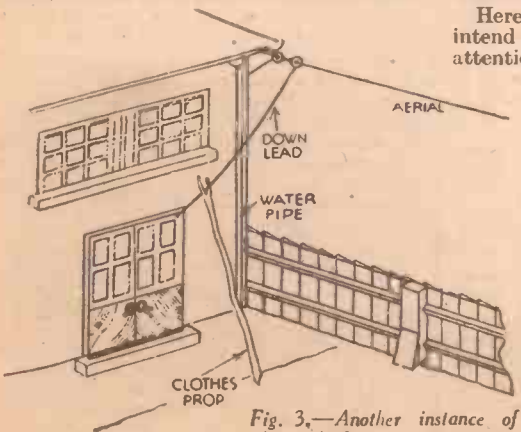
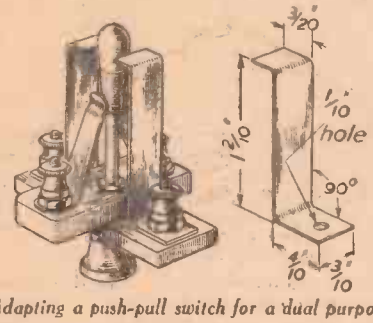


Fig. 3.—Another instance of thoughtlessness causing annoying troubles.

Practical Hints

A Dual-purpose Switch

WHEN adding an extension speaker to my set recently, I found that I needed a switch which would break one circuit and make another, and finding an



Adapting a push-pull switch for a dual purpose.

old wave-change switch, I converted this into the kind of switch I wanted by the following arrangement.

I cut a piece of 1/10in. insulation fibre, ¼in. wide, and about 1½in. long, and bored a ¼in. hole in the middle. A 1/10in. hole was then bored about ⅕in. from each end. Two strips of tin were next bent, as shown in the sketch. I then fixed the piece of fibre under the central fixing nut and screwed it down tightly.

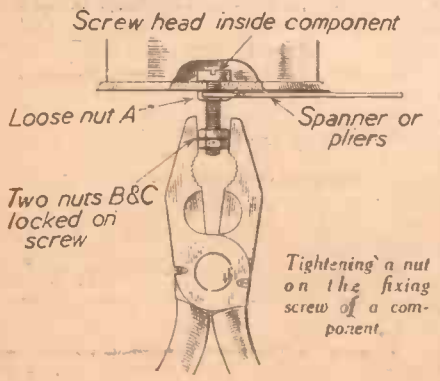
The stems of two small terminals were pushed through the holes at each end of the fibre after slipping on the tin contact strips. After adjusting the tin contacts, the switch was ready for use.—J. F. CATCHPOOL (Ampleforth).

Tightening a Loose Nut

I OFTEN find that terminals on components work loose and tightening them up again means a lot of trouble, especially with a transformer or similar component where the screw head is inside the component, and the thread will be damaged if held in pliers.

To overcome this difficulty I devised the following method for holding the screw while the nut A (see sketch) is being tightened.

Two nuts, B and C, of the same thread as the screw, were found and placed on the end of the screw. They were then locked against each other by holding one and tightening the other up against it. Then, by gripping the nuts with pliers, the screw was also held tight, and the slack nut, A, could then be made fast.—CECIL V. WILMAN (Beeston).



Tightening a nut on the fixing screw of a component.

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

SPECIAL NOTICE

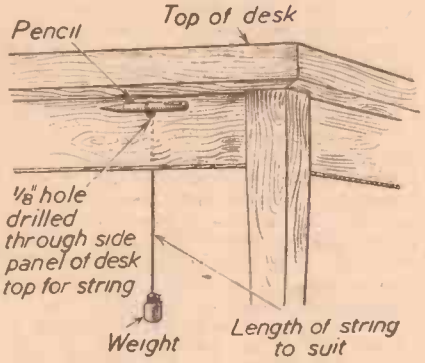
All hints must be accompanied by the coupon cut from page iii of cover.

Anchoring a Pencil

EVERY amateur knows that the most elusive piece of equipment is the common lead pencil.

It is always missing just when needed most to take down some real DX signals.

I therefore hit upon this scheme to keep



An effective dodge for keeping a pencil always at hand.

a pencil on the desk at all times. All that is necessary is to drill a ¼ in. hole just below the desk top, put a piece of string through, tie the pencil to one end, and a weight to the other end. When you require the pencil, reach under the edge of the desk where the pencil is hidden and pull it out—the weight keeps the pencil in place.—JERVIS G. HAMER (West Bridgford).

PLEASE NOTE!

Will readers please adhere to our request that all Notions sent in *must be original*. Apart from the dishonesty of copying out an idea from another magazine or even from an early issue of this paper, considerable time has to be spent in comparing not only the sketches but also the text. It should be remembered that awards are only made for wrinkles which are *original* ideas.

Aerial Fixing

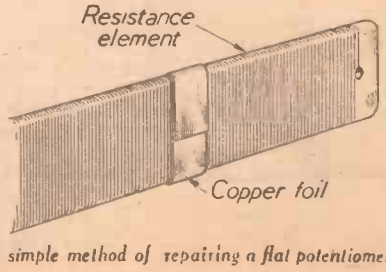
I RECENTLY wished to fit an aerial support to a chimney stack on the roof, but had no ladder which would enable me to get right round the stack. This meant that I could not place a band or similar device round the stack. After wondering how to fit the mast rigidly I adopted the following scheme: I obtained two 6in. coach bolts and a strip of iron. The latter was bent to form a "U" to fit round the mast and drilled at the ends to pass the bolt. The latter was then attached direct to the front of the stack (which was accessible) by scraping out mortar between adjacent bricks, filling the hole with cement and pushing the heads of the bolts into the wet cement. When dry the bolts are firmly held, and the mast was then held in position, the "U" clamps slipped over the mast and over the bolts and nutted up. The result is a rigid and neat-looking mast fixture.—J. HINES (Port Arthur).

Flex Bindings

TO keep the ends of flex wire tidy ordinary cycle valve tubing is ideal. The only difficulty is in getting it down over the flex braid without making this screw up and become still more untidy. I found that the simplest way of carrying out the idea was to stretch the tubing open first, after cutting off a length about 1in. long. I clamped three pieces of stiff piano wire in a small vice, and with a pair of ordinary pliers opened the three wires slightly. The valve rubber was then slipped over the three wires and they were then opened much wider, stretching the tubing out in a triangular formation. Now the bared end of the flex is slipped down inside the stretched rubber and when in the right place the vice jaws are loosened, the rubber springs in and the three wires are then removed.—O. BOURNE, (Caerphilly).

Repairing a Potentiometer

RECENTLY I had some trouble with my set, and found that the wire-wound potentiometer had broken down. Wondering what I should do, I eventually cured the trouble by taking the element off its bakelite body and, using 0-grade glass-paper, removed the insulation from the wire on either side of the break. A strip of copper foil 1/16in. wide was then placed over that section, and the element was then replaced. Contact between the body and the element kept the foil tightly in place. This effected a complete cure, and the shorting out of the few turns made hardly any difference to the resistance value.—R. HICKS (Jersey, C.I.).



A simple method of repairing a flat potentiometer.

Noise Suppression Circuits

Interesting Developments for Use in Modern Circuits

KNOWN circuit arrangements for suppressing intermittent noise voltages having an amplitude greater than that of the desired signal, make provision for developing a bias potential proportional to amplitude excess of the interference over that of the desired signal, and the bias potential is used to render the detector inoperative so long as the high amplitude noise continues. One drawback to circuits of this type lies in the fact that noise-suppressing action cannot begin until the noise amplitude exceeds the amplitude of the desired signal, for otherwise the signal itself would be partly suppressed.

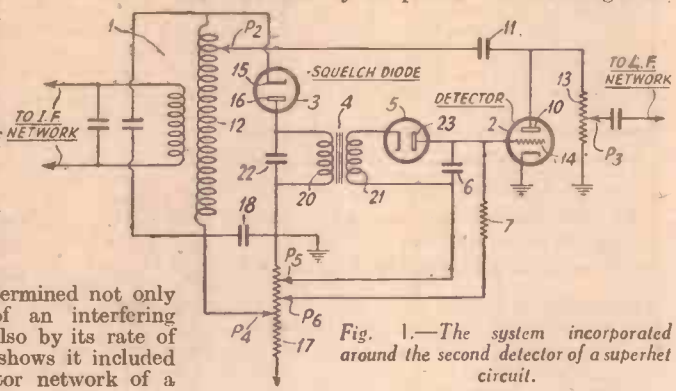


Fig. 1.—The system incorporated around the second detector of a superhet circuit.

In the arrangement described below, the detector is rendered inoperative by a voltage which is determined not only by the amplitude of an interfering noise impulse, but also by its rate of growth, and Fig. 1 shows it included in the second detector network of a superheterodyne receiver. The circuit (1) is resonated to the operating intermediate frequency, and is coupled to any desired type of I.F. network for receiving its signal energy. The detector valve itself is a triode (2) whose anode (10) is coupled by condenser (11) to a desired point on the input coil (12). The cathode of valve (2) is at earth potential, and the load impedance (13) is connected between the anode and cathode of detector valve (2). Any desired value of audio-frequency voltage may be tapped off from impedance (13) by the slidable tap (P3).

The cathode and anode of (2) provide a diode rectifier whose conductivity is regulated by the grid (14). Control bias for grid (14) is developed by a so-called noise suppressor or "squelch" diode (3) which has its cathode (15) connected to coil (12). The anode (16) of diode (3) is connected to the positive potential terminal of a current source (not shown) by a resistor (17). The anode end of resistor (17) is earthed for alternating currents and a direct current blocking condenser (18) connects the low potential end of coil (12) to the earthed end of resistor (17). The anode end of resistor (17) is earthed for alternating currents and a direct current blocking condenser (18) connects the low potential end of coil (12) to the earthed end of resistor (17). The cathode (15) of diode (3) is adjustably biased positive by the slidable tap (P4) connected to resistor (17).

Rectified current flowing through diode (3) is transformed into a voltage proportional to the rate of change of input current. This is accomplished by the transformer (4), or equivalent inductive device, whose primary (20) is arranged in series between the anode (16) and earth, the radio frequency bypass condenser (22) being connected across the primary. The secondary (21) is arranged in a series path comprising the space current path of diode (5), and condenser (6) and the grid (14) of detector valve (2) is connected to anode (23) of diode (5). The adjustable tap (P5) is employed to provide normal positive bias for the cathode of diode (5) and the tap (P6) is used to adjust the normal bias for control grid (14), the resistor (7) being arranged in the lead to the grid.

Operation

The operation of the arrangement is as follows. In the absence of interference, tap (P4) is adjusted to bias diode (3) sufficiently to prevent its drawing much current. It is permissible, however, for this bias to be adjusted to less than double the unmodulated carrier amplitude for reasons which will be pointed out subsequently. Assuming, now, that interference such as motor-car ignition sets up a transient oscillation in the intermediate frequency circuits of the receiver, the amplitude of this oscillation grows with extreme rapidity. Therefore, the resulting rectified current flowing through the primary (20) of transformer (4) has a large rate of change, and induces a correspondingly large secondary voltage. The polarity of the winding of transformer (4) is so chosen that the valve diode (5) permits current to flow only as a result of voltage caused by increasing current through diode (3). When the spark occurs, therefore, voltage induced in the secondary winding of transformer (4) overcomes the bias on valve (5), and produces a flow of current into condenser (6) thereby building up a negative charge on the grid (14) of detector (2).

The valve action of diode (5) prevents this charge from being withdrawn as transient dies away, and voltage of opposite sign is developed in the secondary of transformer (4). The negative charge thus impressed upon the grid not only paralyses the detector tube during the time when the transient amplitude is increasing, but this charge dies out only after a length of time determined by the capacity of condenser (6) and the resistance of resistor (7). By a suitable choice of these constants the detector may be arranged to remain inoperative for a predetermined length of time which will be chosen sufficient to permit transients in the intermediate frequency circuits to die out. The normal bias on valve (5) will be so chosen that a slight amount of rectification can be permitted in the absence of noise voltage at diode (3) without developing enough voltage in the secondary of transformer (4) to overcome the bias on valve (5). This is because the modulation of the desired signal is relatively slow compared to the sudden building up of transients due to shock excitation. Hence, even though the amplitude of such a sudden transient may not exceed the amplitude of the signal, yet, due to its higher rate of change, it may still produce a noise-suppressing action while the normal signal itself will not. In order to simplify the explanation, separate electrodes have been shown for each of the various functions, but any type of detector may be used. It will, also, be apparent that a separate tube (3) may be dispensed with by placing the primary of transformer (4) in the circuit of the detector itself, although it is preferable to use a separate tube in order to limit its action to interfering voltages in excess of the unmodulated carrier.

Alternative Scheme

Fig. 2 shows an arrangement similar to that of Fig. 1, except that the normal bias on diode (3) is produced by a further diode rectifier (8). The amount of this bias, as compared to the intermediate frequency voltage on diode (3), may be adjusted by the position of the tap (P7) on coil (12) of circuit (1) to which rectifier (8) is connected. For a given signal level the action of the circuit of Fig. 2 is the same as that of Fig. 1, and the only difference is that the bias on diode (3) adjusts itself automatically in accordance with the carrier voltage of the desired signal. The cathode of diode (3) is connected to the cathode end of resistor (30) arranged between the cathode of diode (8) and earth, a large condenser (31) being shunted across resistor (30). This system has been developed by the Radio Corporation of America.

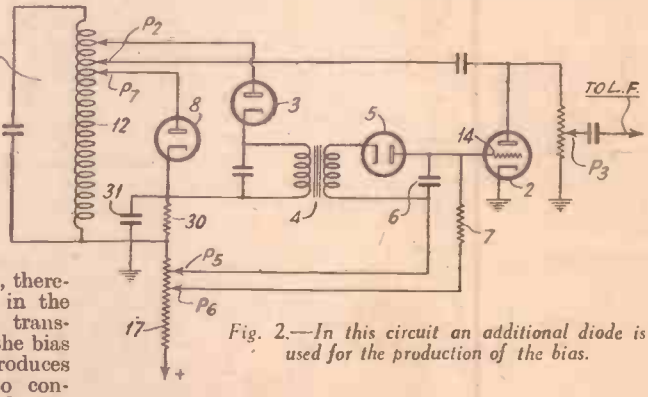


Fig. 2.—In this circuit an additional diode is used for the production of the bias.

HOME-MADE COMPONENTS

In This Article Constructional Data is Given for Making Various Types of Wire-wound Resistances

THERE are many components which the beginner can construct quite easily, and which will be found just as efficient in operation as a factory-made article. There are, of course, various difficulties which sometimes have to be overcome, but one of the types of component which does not call for any elaborate tools or apparatus is the wire-wound resistance. This may be employed for all purposes where an inductive type of resistance is permissible. Such resistances are made up in various ways according to the service for which they are intended, and either have a fixed resistance value, or are variable by means of tappings or a sliding contact. As distinct from these differences

Fig. 1.—A small resistance wound on a flat fibre former.

the construction of the resistance may differ in regard to the material employed for the former, and also in the condition and the quality of the wire itself.

Types of Wire-wound Resistances

The types of this class of resistance range from small fixed ones of the strip variety, and flexible ones of the spaghetti type, to mains resistances. These are all made "fixed," or at the most adjustable by tapping. Adjustable ones that may vary in value by the rotation of a contact arm or movement of a slider range from small rheostats and potentiometers of 3 to 5 watts rating to larger ones, mostly adjustable by means of a slider, having ratings up to 60 watts.

Fixed Resistances of Low Carrying Capacity

Resistances which come under this heading as regards carrying capacity may be wound on formers made from fibre, bakelite, ebonite, glass, or similar insulating material. One of the type referred to is shown in Fig. 1. Connections may be provided in a variety of ways, with screws and nuts as illustrated, or by means of clips having extended ends forming soldering tags. Another simple way of doing the same job is to pierce the former at each end to take eyelets. The resistance wire is then anchored under one eyelet at the commencement of the winding and secured by the other at the finish. In this way it is a simple matter, by arranging the centre distance of the eyelets correctly, to allow the resistance to form a link between the terminals of two components without using connecting wires. Resistances like this may be wound with bare wire, in which case the wire must be spaced so that adjacent turns do not touch, or where a great number of turns are required the use of silk covered nickel-copper wire will effect a saving in space. Where this is used the turns can, of course, be close together in the same manner as when wire of the same quality having an oxidised surface is to be utilised.

When the wire is space wound it is advisable evenly to serrate the edges of the former as a preventive against the turns slipping and possibly shorting. This can easily be done, where the former material is thin and of a yielding nature, by rubbing each edge of the former across a file, thus reproducing a series of nicks of the same pitch as the teeth of the file used.

Where bare wire is used to wind cylindrical resistances greater satisfaction will be obtained from the use of a threaded former.

Flexible resistances of the spaghetti type are formed by winding the wire on to a former of asbestos string. For this type of resistance the wire needs to be insulated and securely anchored at the ends in good electrical contact with metal bands clipped on to the string. Protection is afforded to the winding by covering with a length of insulating sleeving which should pass freely over the wire, and be bound to the metal clips at each end. The sleeving will then also form a safeguard against the inadvertent "pulling-out" of the wire, which otherwise might result were the string alone left to take any strain. At the ends, the resistance is finished off with tags for connecting purposes.

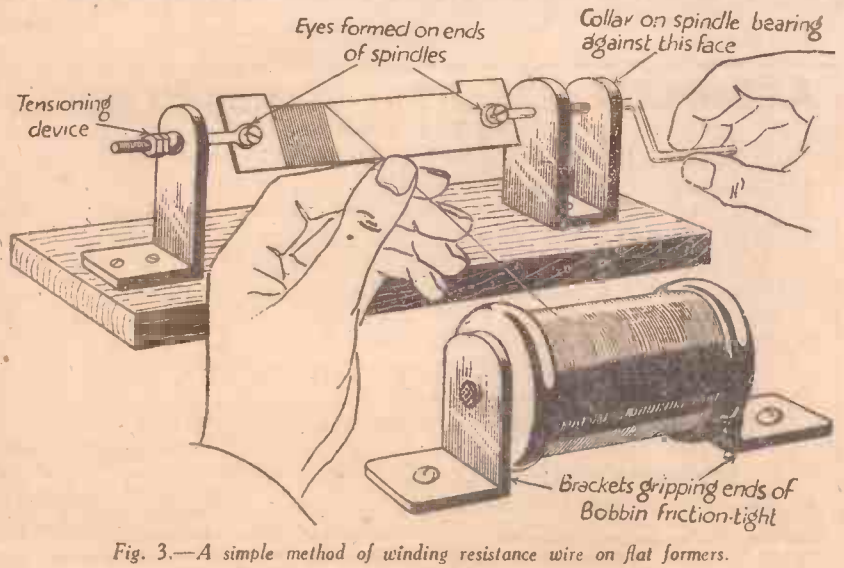


Fig. 3.—A simple method of winding resistance wire on flat formers.

Adjustable Resistances of Low Carrying Capacity

Small rheostats having a rotating contact arm may be made in several ways. Perhaps the simplest is to prepare a disc of ebonite or similar material by turning

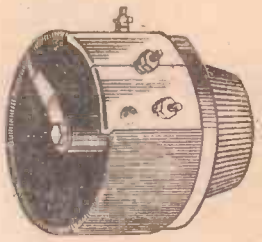


Fig. 2.—A potentiometer with the resistance wire wound on a thin sheet-fibre former.

a semi-circular groove in the edge. Two screws are fixed in the bottom of the groove about ½in. apart. The resistance wire is wound in the form of a small tension spring, the length being such that it is less than the circumference of the former at the bottom of the groove; less, of course, by the distance between the screws. After attaching each end of the coiled wire to a screw, it is sprung into the groove. When in position the "spring" must be in tension sufficiently to leave a space between each coil. A rotating contact arm, carried on a spindle working in a bush in the centre of the former, bears against the coils. Connections are made to one end of the resistance wire, and to the bush in contact with the spindle and arm. An alternative method is to cut a groove, slightly undercut towards the centre, in the face of the disc and concentric with the outside, the wire being prepared and sprung in as before.

In both cases the wire must be heavy enough so that when coiled up in position it will form a spring of sufficient rigidity to withstand the action of the contact arm, without bunching the turns close together. A superior method of construction may be obtained by winding the wire on to a threaded former made from ebonite or "erinoid" rod. The thread can be cut with a die larger than the diameter of the rod, so as to form a shallow flat, tapped thread. This is necessary to allow the wire when wound to project slightly above the surface of the rod. After winding, the rod is bent, first heating in hot water to soften the material, to fit round the edge of a grooved disc as before. In every instance bare wire is used.

Small potentiometers like that shown in Fig. 2 are wound on thin sheet fibre formers, the projections against the abutting edges forming stops for the contact arm. The wire is wound while the former is flat—Fig. 3 shows a simple means of winding—and afterwards bent to shape in steam. Wire with an oxidised surface is generally used

(Continued on next page.)

HOME-MADE COMPONENTS

(*Continued from previous page*)

for winding, the adjacent turns touching each other. The oxidisation is removed with a fine oil stone, used dry, in the track of the contact arm.

Resistances for Heavier Duty

Resistances such as those for mains or power use must, without exception, be wound on heat-resisting formers. These are usually made of porcelain or from an asbestos preparation. Fairly thick mica of an electrical quality will also serve in cases where it would prove adaptable. The porcelain formers are made with a continuous groove like a thread so that the turns of wire when wound are separated. These formers are made with both fine and coarse pitched spiral grooves; with the latter type the resistance wire is space wound on a core of asbestos string before coiling on the former.

End connections and tappings are made by means of strong clips in both cases. When made up as a variable resistance by means of a slider, the construction should be such that the whole instrument is mechanically sound, the control knob well insulated, and the slider contact must be continuous with the wire during operation.

Choice of Wire

In selecting the gauge of the wire to use for winding a resistance, the first thing to ascertain is, will the wire be capable of carrying the current. Thus it is not only necessary to know the resistance per foot or yard of the wire, but also the carrying capacity in amps. This is important, as if overloaded the wire will become unduly hot.

For the purpose of this article, resistance wire is either an alloy of nickel-copper, or nickel-chromium-iron having a high nickel content. The latter wire has a specific resistance of more than twice that of nickel-copper, consequently only half the amount is required to provide a resistance of a certain ohmic value which from a space-saving point is a valuable property.

The accompanying table gives the required data for selecting the proper gauge of wire, and an example of working out the amount of wire required is given in a simple manner.

EXAMPLE.—What gauge and how many feet of nickel-copper resistance wire is required to make a 100-ohm resistance to carry a maximum current of .3 amps. From the table it will be seen that No. 35 gauge will carry .33 amps. with a temperature rise of 100 degrees. The resistance per foot of wire equals approximately 4.09 ohms, therefore, 100 ohms, the value of the resistance required, divided by the resistance per foot of the wire, is equal to 24.5, this being the number of feet of wire required in the resistance. It should be pointed out that a silk wire would not be suitable, and where it is desired to use a covered wire a heavier gauge must be selected.

A TABLE OF WIRE GAUGES AND RESISTANCE DATA

Standard Wire Gauge	Diameter of Wire in inches	Nickel-Copper.			Nickel-Chromium-Iron.		
		Number of feet per lb.	Resistance in Ohms per foot.	Carrying Capacity in Amps. at 100° C.	Number of feet per lb.	Resistance in Ohms per foot.	Carrying Capacity in Amps. at 100° C.
16	.064	80.3	.0705	6.0	86.7	.156	4.2
17	.056	105.0	.0921	4.9	113	.203	3.2
18	.048	143.0	.125	4.3	154	.277	2.7
19	.040	206.0	.180	3.7	227	.399	2.18
20	.036	254.0	.223	3.0	274	.492	1.93
21	.032	322.0	.282	2.8	282	.623	1.66
22	.028	420	.368	2.2	453	.813	1.52
23	.024	572	.501	1.8	617	1.11	1.39
24	.022	680	.597	1.5	734	1.32	1.23
25	.020	823	.772	1.25	888	1.59	1.10
26	.018	1016	.891	1.0	1096	1.97	1.01
27	.0164	1224	1.07	0.9	1321	2.37	.95
28	.0148	1503	1.32	0.76	1621	2.91	.88
29	.0136	1780	1.56	0.68	1920	3.45	.83
30	.0124	2141	1.87	0.59	2310	4.15	.78
31	.0116	2447	2.10	0.52	2639	4.74	.73
32	.0108	2823	2.48	0.47	3045	5.47	.67
33	.0100	3293	2.89	0.42	3551	6.38	.59
34	.0092	3890	3.41	0.37	4196	7.53	.54
35	.0084	4666	4.09	0.33	5033	9.04	.40
36	.0076	5701	5.00	0.28	6149	11.0	.38
37	.0068	7120	6.24	0.26	7680	13.8	.34
38	.0060	9148	8.02	0.19	9866	17.7	.29
39	.0052	12175	10.68	0.16	13132	23.6	.23
40	.0048	14291	12.53	0.15	15414	27.7	.20
41	.0044	17000	14.91	0.14	18300	32.93	.18
42	.0040	20600	18.05	0.13	22200	39.85	.15
43	.0036	25400	22.2	0.11	27400	49.2	.13
44	.0032	32200	28.2	0.10	34700	62.27	.11
45	.0028	42000	36.83	0.08	45300	81.32	.09
46	.0024	57200	50.13	0.07	61700	110.7	.08
47	.0020	82300	72.17	0.05	88800	159.4	.06
48	.0016	129000	112.7	0.03	139000	249.0	.04

Screening the Earth Lead

SCREENING the aerial down lead to reduce local interference is now quite a familiar proceeding, and similar treatment of the earth lead is often found to help when such troubles are encountered on short waves. This latter operation, however, is not so well understood in amateur circles, and so it sometimes fails to yield the desired results; it has certain hidden snags, which must be taken into account if it is to function properly. I have a friend who is a very keen short-wave listener, and he recently moved into a house in which he found it necessary to install his receiver in a room on the second floor, where the earthing problem was a somewhat difficult one. A connection to a nearby water pipe proved unsatisfactory, producing much mains and other noises, and he was finally driven to installing a longish lead down to a plate buried in the ground.

This gave him very fair results, although he found that his set suffered from bad effects a trifle more than it had been accustomed to do in its previous location. Still, it was much the sort of practical compromise with which one must often put up under domestic conditions, and he was tolerably content with it until buses began to run past his house. When this commenced he was troubled on certain wavebands with the most acute interference from the ignition circuits of the buses, and after trying everything he knew, he inquired whether I could suggest anything further. I prescribed a screened earth lead.

When I saw him again a few weeks afterwards, he wasn't a bit pleased with me or my advice, and expressed strong opinions about both before calming down sufficiently to explain that he had spent many hours fitting up a really superfine screened earth lead, only to find that the interference was scarcely affected, while the performance of the set, he was convinced, has "gone all to bits." As I expected, he had gone astray in making connection to the screening sheath of the earth lead. He knew that it must usually be earthed, so he had simply joined it to the earth lead itself at the bottom, a method which is often less successful than one might expect.

In this case a remedy was found by simply making the earthing connection to the screen at its approximate centre, a separate lead being taken from this point to an earth tube placed a few feet away from the buried plate. The interference was then much reduced and the performance of the receiver quite unaffected.—(G. P. K.)

For The Beginner

What Is Modulation?

An Explanation in Simple Terms of the Process Which is of the Utmost Importance in Radio Reception

THE recent article on the subject of a new form of modulation has created considerable interest, but many newcomers are unable to appreciate the arrangement to the full owing to a lack of understanding of what is really meant by modulation. The term occurs very frequently in the transmitting side of radio, but it is also brought into reception. The following explanation is therefore given for those who are not fully acquainted with the process of modulation. In the radio sense, "modulation" is the name given to the process whereby the audio-frequency currents, obtained from the microphone and its associated amplifiers, are combined with radio-frequency oscillations, prior to being led to the aerial from which their power is radiated as a "modulated carrier wave." Concurrently with this, corresponding modulated high-frequency currents are produced in the aerial circuit at the receiving end; and it is the modulation which is, so to speak, sorted out by the detector and passed on to the low-frequency stages, and speaker, for reproduction as sound.

But while this is a correct definition of the specialised meaning of the word "modulation," the term is also, and quite properly, applied to all cases in which an alternating current impulse is superimposed upon another current which may be either an alternating current of a different frequency, or a direct current.

The Scheme Explained

Fig. 1 shows, in the centre diagram, a conventional audio-frequency wave, and above it an unmodulated carrier of constant amplitude. At (c) is shown the resultant wave which would be produced by the modulation of (a) by (b). Half the distance between the upper and lower crests is called the "depth of modulation," and is usually expressed as a percentage of the carrier amplitude. Two points in connection with the depth of modulation call for comment. In the first place it is clear that it is impossible to modulate a carrier-wave to an extent greater than 100 per cent. without distortion, and in Fig. 2 is shown how 25, 50, and 100 per cent. modulation is expressed diagrammatically.

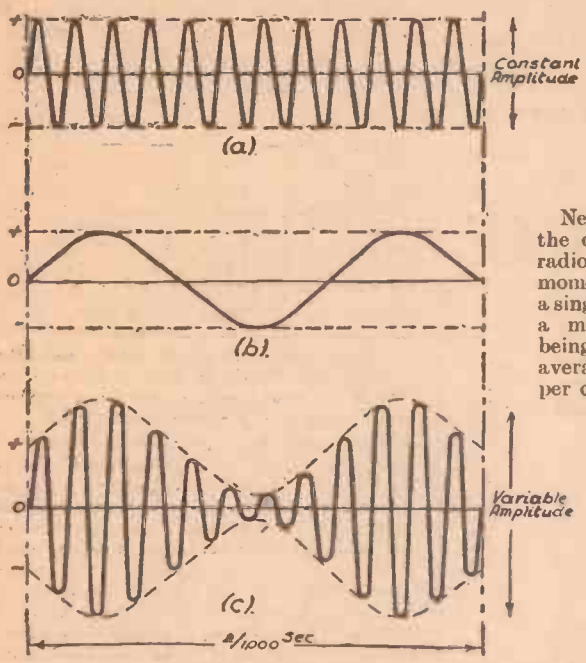


Fig. 1.—Diagrams illustrating the combination of L.F. and H.F. waves to give a modulated H.F. wave.

Next, it must be understood that the depth of modulation for any radio transmission varies from moment to moment even during a single item. Suppose, for example, a military band performance is being broadcast, and that an average modulation of, say, 25 per cent. is being employed. This degree of modulation will be obtained over the bulk of the programme, but for particularly soft passages the percentage modulation will be less, and for specially loud passages it will be considerably more.

Possible Overloading

Now for a radio-frequency signal of a given strength (that is, a carrier of a given amplitude) and for a given degree of voltage amplification in the H.F. and detector stages of the radio receiver, the audio-frequency signal applied to the grid of the output valve is proportional to the depth of modulation. If, then, the percentage modulation ranges, as it does, from a very small value up to 80 per cent. or more, it is necessary to use an output valve which will handle, without distortion, grid voltages corresponding to the strongest signal, and the fullest modulation likely to be received.

This indicates that there are two forms of valve overloading which must be guarded against. Overloading due to a carrier of excessive amplitude, can be avoided by a volume control acting on the aerial circuit, or by the use of variable-mu valves whose signal-handling capacity can be increased by increasing the grid bias. On the other hand, overloading of the low-frequency valves during periods of deep modulation calls for a conservatively rated amplifier which, while giving adequate volume with signals of average modulation, can also handle audio-frequency signals of three or four times average amplitude. This explains why, as has been pointed out many times before in these pages, a valve having a maximum output rating much greater than the normal required output must be used in the last stage if really good reproduction is to be obtained.

Whenever we begin to talk about exact quantities, such as percentages, the question of measurement arises, and it is reasonable to ask whether it is possible to make exact measurements of the depth of modulation. It is not an impossibility, but an accurate modulation meter is rather beyond the resources of most amateurs, and the measurement itself involves the use of a valve voltmeter as well as other instruments. Moreover, it necessitates various circuit changes, and certainly could not be employed during the reception of a programme in the ordinary way.

It is, however, not only possible, but very helpful, to employ a simplified system of measurement which, while not giving a definite reading of modulation depth, serves as a comparative indication, and assists the listener in operating his set under optimum conditions.

(*Continued on next page.*)

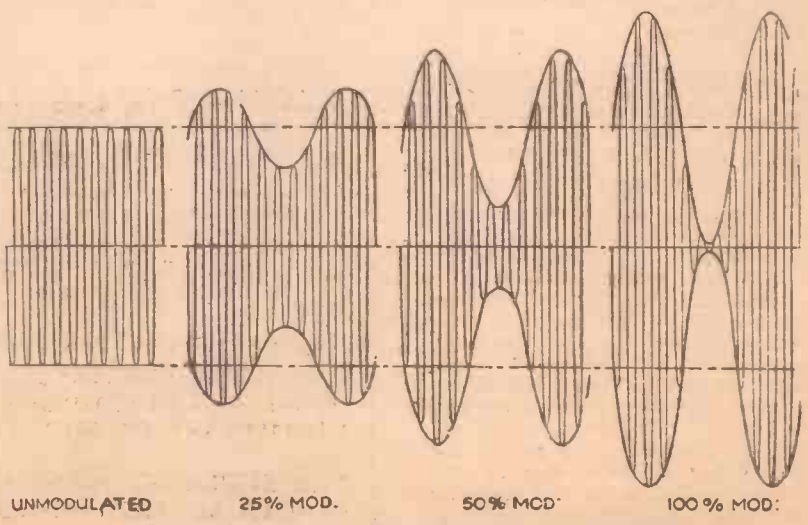


Fig. 2.—Curves illustrating the different degrees of modulation.

WHAT IS MODULATION?

(*Continued from previous page.*)

Before dealing with this point, however, it is necessary to consider other forms of "modulation." A receiving valve, when no signal is applied to the grid, passes a steady anode current, the value of which depends upon the rate at which the electrons are emitted by the filament or cathode, the voltage applied to the anode, and the bias voltage, if any, applied to the grid. When, however, a signal is applied to the grid, the value of the anode current will vary in sympathy with the signal variations, and the anode current may thus be said to be "modulated" at the frequency of the applied signal. The anode currents of the H.F. valves will be modulated at radio-frequency, the R.F. modulation being itself modulated at audio-frequency. The anode currents of low-frequency valves, will, of course, be modulated at audio-frequency; and the anode current of a detector valve will be modulated mainly at audio-frequency but with a certain R.F. component. Part of the R.F. energy component, in this case, may be returned to the grid circuit by means of the reaction arrangement, and the remainder may be—and should be—filtered out by one method or another in order to avoid its transference to the low-frequency stages.

Anode Current Modulation

Consider, now, the effect of this modulation of the anode current. In the case of an amplifying valve, the anode current will swing above and below the mean or average value, as indicated in Fig. 3. Note, however, that owing to the curvature at the bottom end of the grid volts/anode current graph, distortion will occur if the swing overlaps this region. Similarly, distortion will occur if the positive swings overlap the region in which grid current can flow.

It will thus be seen that any over-modulation of the anode current produces distortion, and is, therefore, similar in its results to over-modulation of the carrier wave. An effect of this type can be avoided if care if taken to (1) bias the valve correctly, that is, to the mid point of the straight portion of its characteristic; (2) limit the grid-input signal to a value (at maximum modulation), which the valve can handle without distortion.

Here, then, is one point at which a rudimentary form of modulation meter might be of service. Such a method is, in fact, often used by wise listeners. It consists merely of a milliammeter of suitable range included in the anode circuit of the output valve. Its function is two-fold. In the first place its steady reading when no signal is being received gives an indication that the grid-bias is of approximately the correct value. When a signal is being received, the instrument should, theoretically, give a pulsating reading corresponding to the fluctuations of the anode current. But a milliammeter of the ordinary type cannot follow the rapid changes of an audio-frequency current. What it can do, however, is to give a general indication of the state of affairs. Thus, if the kicks are mainly in an upward direction, so that the mean value of the anode current appears, on the whole, to be increased, it shows that the incoming signal is overlapping the bottom bend, with resultant distortion. The remedy is, of course, to *decrease* the grid-bias slightly and/or to reduce the input by means of the volume control. On the other hand, a general tendency for the kicks to be downward, or an impression that the mean-anode current is reduced, indicates grid-current distortion. In these circumstances the grid-bias voltage should be increased slightly, and if this fails to produce the desired result, or introduces bottom-bend distortion, the input should also be reduced.

The Detector Stage

In the case of a detector valve, the modulation of the anode current quite properly produces just the results we have to avoid in an amplifier. In a leaky-grid detector the application of a signal produces an effective reduction of mean anode current depending upon the strength of the incoming radio-frequency signal and its modulation depth. An anode-bend detector sustains a net increase in the anode current when receiving a signal.

Here again, the effective change of anode current depends jointly upon the strength of the incoming R.F. signal and upon its depth of modulation, and advantage can be taken of these changes to ensure that the set is operated in the most efficient manner. With a leaky-grid detector, for example, in which the anode current is depressed by a signal, the anode current will be at minimum when the receiver is accurately tuned to a station, and will rise as the set is brought off tune either above or below the correct tuning point.

If, therefore, a milliammeter of suitable range is connected in the anode circuit of a leaky-grid detector, it will indicate when the set is correctly tuned, because at that moment the anode current will be depressed to its lowest value. Quite a cheap instrument will do, and it need not be very accurate.

Another Case

It should be remarked that a device of this sort is not very sensitive in the case of feeble signals, but it is perfectly satisfactory when dealing with the more powerful transmissions. The same idea is also of great service in adjusting the trimming of ganged-tuning circuits. The method is to tune in to the optimum point for one station (that is, minimum reading of the milliammeter in the detector circuit), and then make any adjustments to the trimmers with the object of obtaining a further drop in the reading.

In sets fitted with A.V.C., another version of this simple modulation meter should be employed. It will be understood that the amount of additional bias fed back to the H.F. and/or I.F. stages by the A.V.C. valve depends upon the strength of the received carrier. Also that the application of this controlling bias results in a decrease in the anode current of the variable-mu valves. Therefore, a milliammeter in the anode circuit of one of the H.F. or I.F. valves will again give the lowest reading when a signal is accurately tuned in.

Some visual tuning indicators fitted to older sets work more or less on the principles described above. Not all of them, however, are plain milliammeters. Some are simple instruments of this type, having a shutter or reflector device to vary a spot or band of light or shadow, thus giving the desired indication. Others make use of the voltage drop in some component included in the anode circuit to modify the glow from a small neon discharge tube, and in others the anode current is passed through one winding of a special differential transformer, thus varying the voltage applied to a small lamp bulb.

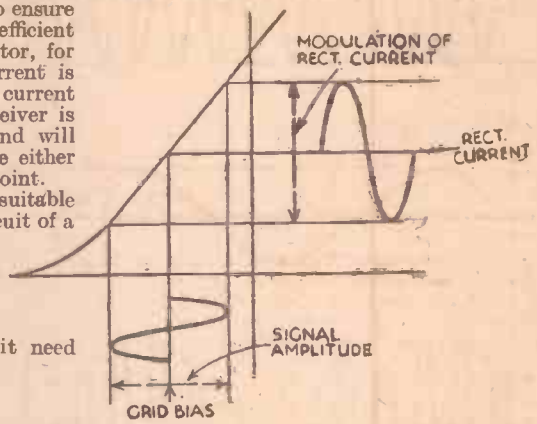


Fig. 3.—Showing the effect of modulating the rectified current in the anode circuit with a grid-voltage variation.

PROGRAMME NOTES

G. H. Elliott, the Chocolate-coloured Coon

G. H. ELLIOTT, the world-famous and original "Chocolate-coloured Coon," and one of the outstanding personalities of the British Music-hall, will make a welcome return to the microphone in the Forces programme on July 5th. The famous delineator of coon studies, whose melodious voice is so well known to thousands of listeners, will broadcast a cavalcade of coon songs, from the smooth, swinging lilt of "Lily of Laguna" to the present-day foxtrot rhythm. Even his yodelling will be in rhythm, not the waltz time as of old.

Imagined Corners

"IMAGINED CORNERS," to be broadcast on July 8th, is an amusing parable play written by Maurice Brown, who is music adviser to the B.B.C. Feature and Drama Department. In fact, "Imagined Corners" might almost be described as an experimental play. It is timeless and dateless, and deals with the story of an old man who, despite his detractors, sets out to try and prove his theory that the world is round. Strangely enough, the play ends by showing that the man does not prove his theory, but Brown says that the idea behind the play is that "it is better to go and try and find Truth, even if it is not Truth, than just to accept without question anything you are taught."

"I Know What I Like."

WILFRED PICKLES, the well-known Northern announcer and radio artist, will give listeners to the Forces programme on July 7th his idea of a gramophone record programme in the series called "I Kuow What I Like." Wilfred's programme is well balanced—neither too high nor too low-brow—and it represents his own tastes entirely. While his listeners, for instance, will hear records of Paul Robeson singing "Mah Lindy Lou" and Turner Layton singing "These Foolish Things," they will also hear a record of the Sibelius "Valse Triste," played by the Philadelphia Orchestra, conducted by Leopold Stokowski, and Elizabeth Schumann singing "Solveig's Song."

Comment, Chat and Criticism

Outline of Musical History–7

Notes on the Works of Beethoven's Contemporaries

By Our Music Critic, MAURICE REEVE

BEETHOVEN had many remarkable contemporaries who have left their mark on musical history. Whilst the Bonn master may be likened to the fountain whose waters are needed by the parched soil around it, his colleagues could be compared to the plants who luxuriate and nourish under its splashes. Chief of these were Carl Maria von Weber, 1786-1826, and Franz Schubert, 1797-1829. It will be at once noticed that both had exceptionally brief lives granted them in which to complete their work.

Weber's Operas

Weber was the son of an aristocrat whose fortunes had suffered an eclipse. His life was not unlike that of most young musicians of that day, and in 1816 he was appointed chapel master to the King of Saxony in Dresden. Here he had to wage a fierce combat against Italian influence, but it would seem to have proved the turning point in his career, as it was at that time he produced his famous operas "Der Freischütz." "La Preciosa," "Euryanthe" and "Oberon," in that order. He died soon after producing "Oberon" at Covent Garden.

Weber is called the first romantic composer, though "Don Giovanni" is unquestionably a romantic work; whilst some of Beethoven's own movements were infused with such a wealth of poetic feeling that they must be considered a leading inspiration of the movement that was on foot.

His great contribution to music lies in having imbued an intensely romantic spirit into opera, for the first time, by means of his masterly employment of German fairy tales and legends for his libretti, in place of the elaborate fustian then in use. But one must not forget the romantic plot of "Leonora," when referring to any possible antecedents.

Also, the modern overture is credited to Weber's ingenuity. He employed the themes and motifs of the opera as the subjects with better effect than anyone previously, and his practice has since been universally followed.

Mention must be made of his entrancing "Invitation to the Waltz," and some other notable piano works.

Schubert

Schubert's work is not only amongst the most highly esteemed in the musical repertory, but it is probably held in greater affection by the majority of music lovers than that of any other master. Born in Vienna, he was the son of a poor schoolmaster. He became a chorister in the Imperial Chapel, and Salieri gave him lessons whilst he was an assistant at his father's school. Later, and for some years, he was the tutor to the children of Prince Esterhazy. His serenely contented nature, so perfectly reflected in his music, didn't seem to wilt under the stress of almost constant poverty, nor did that distressing circumstance ever hinder him from pouring out a constant flow of beautiful music.

Schubert is most renowned for his collection of 650 wonderful songs, songs such as the world had never seen before, nor since. Entirely to his own original pattern, he combined a peerless melody with an accompaniment which consisted of one rhythmical figure throughout. It formed an integral part of the little work and reflected the mood of the lyric to perfection. Each song is an art work in which the components are one as important as another. Their richness and variety are astonishing, whilst the fertility of his inventive genius seems unending.

But his limitations were shown up in those works written to a bigger pattern and on a larger scale. He wrote nine symphonies, including the immortal "Unfinished," a host of magnificent chamber works, piano sonatas, etc. They are all packed with heavenly melodies, and some of his astounding enharmonic modulations have never been equalled. But they suffer from a looseness of design; he frequently failed to realise just when the right moment to stop had arrived. Like some chatterboxes, he would continue the conversation a little too long, giving the movement a lengthy incoherence and a discoursive looseness.

How the "Unfinished" might have been completed has long been one of music's most puzzling enigmas. Many people have supplied a third movement, purporting to be in tune with their idea of how Schubert would have fashioned it. But the composer's idiom and personal style were so marked that the results have never achieved complete satisfaction. Had he completed it himself it is most probable he would have given it both a minuet and trio movement as well as a finale; that is going by his own precedents.

The divine "Wanderer" fantasie for piano must receive special mention even in the briefest sketch. The modulation to the second subject—from C major to C sharp minor—is one of the most astounding things in all music. Its extreme length—for a work in one movement—might of itself have made its title very appropriate. In reality, however, it is derived from the fact that the second subject, just referred to, was used by Schubert as the theme of his incomparable song "The Wanderer."

Liszt gave this great work an orchestral accompaniment, and thereby created a dazzling and fascinating addition to the "concerto" repertory.

Next week I intend to deal with the origin and rise of the great romantic movement which so dominated nineteenth-century music, and which gave the century's music its greatest names. So I will conclude this instalment with some brief notes on some minor though not unimportant musicians of the Beethoven era.

Rossini

I mention Rossini first, and slightly out of chronological order because almost all of his most important work was all done before Beethoven's death, and because he had what to-day we might in retrospect call the effrontery to crush the great master from the affections of the fickle Viennese public. Producing "The Barber of Seville," "Tancredi," and "Semiramide" there, they completely swept the board there and made such "trifles" as the seventh symphony and the "Missa Solemnis" seem *passé* and old fashioned!

They must be remarkable works even if only for the fact that they are as fresh and as entertaining to-day as ever before. But their superficiality and theatricality—the curse of so much Italian music—is evident when seen in comparison with the work of the German masters.

Rossini is famed for magnificent crescendos, especially as they are often built up on the most trivial figures, for his skilful use of the contralto voice for principal operatic rôles; and for the suitability of his accompaniments to the action being portrayed. His finest work, "William Tell," was produced in 1829, after which he is supposed to have grown sick of music. He wrote practically nothing more from then until his death forty years later!

Hummel

G. N. Hummel, 1778-1837, was a renowned pianist and improvisator, but except for some charming rondos, his many compositions are little known to-day. They are covered with the cobwebs of time. And in the musical world, cobwebs denote the reverse of quality, as in the wine cellar. Hummel knew Beethoven well, who employed him for copying and arranging.

Cherubini

Cherubini, 1760-1842, left a mark on operatic music. Beethoven greatly admired his work. His chief operas, "Lodviska," 1791, "Les Deux Journées," 1800, and "Medée," 1797, were important events. He also wrote a standard work on fugue and counterpoint.

John Field

John Field, 1782-1837, invented the Nocturne, which Chopin was shortly to transform.

Clementi was a renowned teacher and pedagogue, and his remarkable technical exercises, notably "Gradus ad Parnassum" are still widely used. Beethoven employed him for the teaching of his nephew.

Alternative Uses for Car Radio

Many Readers are Anxious to Know If and How they can Use their Car-radio Receivers now that they have Been Removed from the Car. The Question is Answered here by Frank Preston

As all readers are no doubt aware, it became illegal to have any radio apparatus on a motor vehicle after June 1st. And it has previously been pointed out in these pages that the Order applies to both built-in car-radio instruments and to portable sets which may have been carried in the car. It applies also to any aerial fitted to the car, whether it was of the roof pattern or of any other kind—fitted under the chassis, for example.

There is no reason to suppose, however, that suppressors and allied equipment, which cannot itself be of any use for wireless reception or transmission, need be removed. It is therefore unnecessary to remove resistors and condensers, which will be useful when car-radio is again permitted, and which are effective in preventing interference with short-wave receivers in the vicinity.

Principles of Operation

It may be assumed that every PRACTICAL WIRELESS reader who had a radio receiver on his car (and the Order applies with equal force if the car is being stored) has by now removed it completely and dismantled the aerial. The question which is exercising the minds of many concerns the possible use of the car receiver in the home, in an air-raid shelter, or for any other purpose. There are various methods of operating the receiver, but few are convenient or satisfactory.

It will be remembered that in nearly every case both high tension and low tension are taken from the car battery. The valve heaters are fed direct from the battery, and the H.T. supply is obtained by means of a vibrator type interrupter; this feeds into a step-up transformer, the output from which is rectified either by means of a valve or by means of a vibratory rectifier. It is customary, as far as British receivers are concerned, to have two separate models for 6-volt and 12-volt operation. In the case of many American receivers there is only one model for use on either 6-volt or 12-volt supplies. When a 12-volt battery is used a fixed resistor is fitted to drop the voltage to six; this resistor is often included in a battery feed wire, and is referred to as a line resistor.

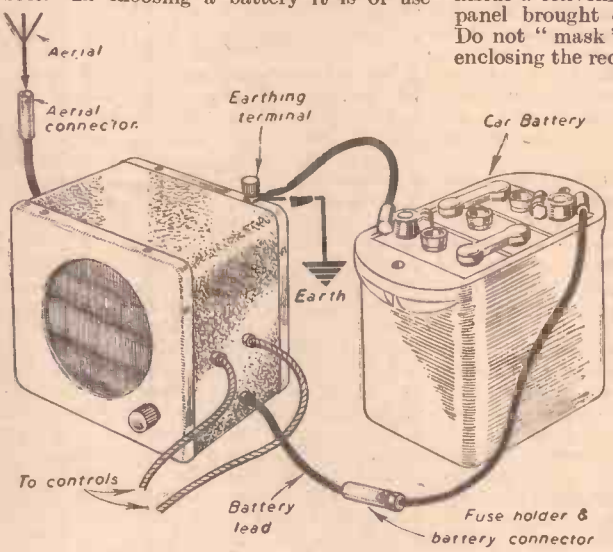
Accumulator For H.T. and L.T.

The above general explanation is given so that the reader may more readily understand the possible methods of modifying the receiver for operation away from the car. Actually, however, it is generally agreed by designers and car-radio manufacturers that the most satisfactory method of operating the set is by means of an accumulator. This should be of the voltage for which the set was originally designed, and if a line resistor is used this should be removed so that power is not wasted by it.

If the car is laid-up, the obvious method is to remove the battery from the car and use it with the set. Not only does that permit of the set being employed, but it also enables the battery to be kept in use—and battery manufacturers never recommend that a battery be allowed to lie idle, for it is almost sure to deteriorate. Where it is convenient to have the battery charged at a charging station this can be done in the ordinary way, taking care that a freshening charge is given once every month or so whether the battery is run down or not. A far better method when the house is wired for electricity is to employ a trickle charger. This is most satisfactory and economical with A.C. mains, of course. A charger with an output of one amp. is sufficient, and it can be put to good use when the car is again put into commission.

Current Consumption

Some readers may even consider it worth while to buy a new battery and charger to operate the radio, but that will be a fairly expensive undertaking, especially if a car-type battery is used—and this is best. In choosing a battery it is of use to know that the average British car-radio takes between 2 and 3 amps. if of the 12-volt type, and about 5 amps. if it is a 6-volt model.



A general method of connecting a car-radio receiver when it is used apart from the car. Battery cables can be obtained complete with connectors.

To connect the battery it will be necessary to join the battery lead attached to the receiver (this generally includes a fuse) to one battery terminal, and to make a good connection between the other battery terminal and the case of the set. The latter connection can often be made most conveniently by fitting a terminal in place of one of the screws used in fitting the front or back to the metal container. An earth lead should also be connected to the metal case. When using a car battery it is a good plan to buy a couple of terminal clamps which fit the slightly-tapered cylindrical lugs. Better still, leads of any suitable length, fitted with lugs at one end and connectors at the other, can be bought ready for use from a motor-accessory dealer. The question of polarity must be considered if the receiver was specially designed to operate with either positive or negative earth, although in many instances it is possible to reverse the polarity without producing any ill effects.

In any case it will be most convenient to follow the polarity used on the car from which the set was taken. If the positive terminal was earthed to the chassis, connect this to the case of the receiver; if the negative was earthed take a lead from this to the receiver case. An ordinary outside aerial may be used, but it will generally be found better to use a short indoor one, or a 6ft. length of wire out of doors. By this means there will be no danger of impairing selectivity or causing overloading of the receiver—which is necessarily of a sensitive type.

Since remote control is generally provided, the receiver can well be placed inside a convenient cabinet and the control panel brought out at an accessible spot. Do not "mask" the speaker, however, by enclosing the receiver completely, and avoid sharp bends in the remote-control cables.

A Charger for Power Supply

It can be argued that the idea of using a special battery for the car-radio is clumsy, but there is no doubt that that arrangement is best, especially when it is wished to avoid altering the set—and alterations to an instrument of this type are not advised unless they are made by a trained engineer who is fully conversant with the particular type of receiver. An alternative method which is *sometimes* satisfactory is to operate the set directly from a battery charger having an output of 3 or 5 amps. at 12 or 6 volts, but it must be ascertained that the voltage, on load, does not exceed 6 or 12, and it will be necessary to add a parallel load resistor or a series resistor so that the voltage applied to the set is exactly 6 or 12, since a 12-volt charger delivers more than 12 volts. This is not a very simple matter if instruments are not available. Another difficulty when using a charger in this manner is that of preventing background noise caused by the comparatively "rough" or unsteady output of D.C. The use of a 25- or 50 mfd. electrolytic smoothing condenser across the output leads is often helpful, whilst more complete smoothing might be obtained by using a very low resistance choke in series with one of the leads. But as a choke of that kind must be very massive it cannot be made cheaply!

If the purchase of a charger for this purpose is contemplated it would be wise to have one on trial before finally buying

and to check the voltage with a high-class meter. There are, of course, many other uses for the charger, and it can later be used for the car battery. If the car is still in use the charger will be a convenience immediately. It is worth mentioning that a charger can be bought or made which will provide outputs of 2, 6 or 12 volts.

When the car-radio has a double vibrator, acting as both interrupter and rectifier, one of the above methods is practically essential and the makers of the Philips "Motoradio" are emphatic in stating that they do not consider any other arrangement feasible than that of using a battery. But where a separate rectifying valve is used it is possible to feed an A.C. mains supply into this, to provide H.T., and to use a small transformer to supply A.C. at a voltage suitable for feeding the valve heaters. Both Masteradio and Philco are working on components and attachments whereby mains operation will be possible and reasonably simple. Both, however, fully appreciate the difficulties and are not likely to market units for use with their respective receivers until they are completely satisfied with the results of their experiments. Readers of PRACTICAL WIRELESS will be kept informed of any developments in this direction. It should be understood, however, that there are many difficulties to be overcome, and that the conversion is not one which can readily be made by the amateur until suitable units have been produced by manufacturers.

It has been suggested that, by removing the plug-in vibrator unit it would be possible to feed mains-voltage A.C. into the secondary of the built-in transformer and to feed low-voltage A.C. to the heater connections. This appears a very simple arrangement, but in practice it does not work out as well as may be thought after making a superficial study. One important reason is that the step-up transformer built into the receiver, and used to supply A.C. to the rectifying valve is normally designed to operate at a frequency of between 100 and 150 c/s; if a 50 c/s supply is fed into it very serious overheating is almost inevitable. Readers will remember that the number of turns per volt used in transformer construction is inversely proportional to the frequency of the supply. Thus, if 6 t.p.v. were required for a 50 c/s supply, 2 t.p.v. would be sufficient on 150 c/s. This gives a clear indication of just one of the problems which confront manufacturers having a well-equipped research department, and shows how the amateur would fare in the absence of such facilities.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Radio Training Manual

SIR,—I should like to take this opportunity, now I have had the chance of studying your Training Manual, of thanking you for your effort to help us out in these hard times. I had dropped radio for the last few years and am now anxious to revise my knowledge with a view to making use of it in some branch of the services. I had looked through several books during the past few months, and all failed in some way or another. When I obtained the Training Manual I expected this to be on similar lines, but hoped it would add up to the material in the other books so as to give me a complete "course." I found instead that the Manual is complete in itself and I do not need the other books. I can recommend it to any other readers who are similarly situated and again must thank you for a splendid effort.—G. BOLTON (Aldershot).

Peculiar Fault

SIR,—I was interested in the fault described by J. Darby in a recent issue and I experienced a similar fault in a set I was once servicing. Although not exactly the same the tuning eye did not give true indications and the fault cleared just as in Mr. Darby's case. I could not find anything wrong and returned the set to the owner. Five weeks later it came back with the same trouble, and in view of the previous experience I this time took the trouble of getting a really good ohm-meter. I went over all connections in the set and the only fault I could discover was a low-resistance contact between one socket of the tuning indicator. This was due to it being bent. I straightened it and cleaned it up until the contact was sound, and when tested the fault had gone. The set has been in use now for nearly a twelvemonth without any recurrence of the trouble.—H. BRADLEY (Eastbourne).

Fleet Short-wave Two

SIR,—I have now had ample opportunity of putting the Fleet S.W. Two through its paces, after overcoming the initial difficulty which you so kindly helped me out with. The set is certainly a worth-while addition to my array of "hook-ups" and it puts them all in the shade. I append a log of the stations which I really heard during last week. I must say that all these stations came in easily, clear and free from interference. and I often thought that many of the logs you published were merely call signs which readers had just managed to hear through jumbles of atmospherics and other signals. If they use sets such as the Fleet I can now well understand their colossal scores in the short-wave station game, and I am now an ardent S.W. fan. I shall now try to improve on last week's log and get some really long-distance stuff, and at a later date may try an additional L.F. stage to get good L.S. working on many of these.—J. GORDON (Chesterfield).

[The log was very interesting, but was too long to publish.—ED.]

Mystery Station

SIR,—I wonder if any reader could tell me the station I heard recently broadcasting announcements in French (which I don't understand) close to Wayne. I cannot find a station in my list on this wavelength, which as near as I could judge would be about 49 metres. I have heard the station on several nights, not so loud as the Wayne station, but generally blotted out when I try to keep it by one of our Empire stations.—J. HALLORAN (Colwyn Bay).

[The station was probably Saigon, French Indo-China, call sign FZR, working on 49.10 metres (6.11 kc/s).—ED.]

A National Service

SIR,—As a reader of PRACTICAL WIRELESS for some time now, I feel that I must send a letter of congratulation on the splendid work your journal is doing at a time like this. To keep on in a time like we are passing through now is literally a high form of National Service, to which I and other readers are indebted. I spend many spare hours at night in my wireless room with different wireless receivers, which I have made up through the guidance of PRACTICAL WIRELESS.—RONALD ROSE, (Quinton, Birmingham).

Correspondent Wanted

J. BYRNE, of 10, Turriff Street, Glasgow, C.5, wishes to get into touch with a reader who has a battery-operated "Trophy 3," and who would assist in short-wave work.

Prize Problems

PROBLEM No. 407

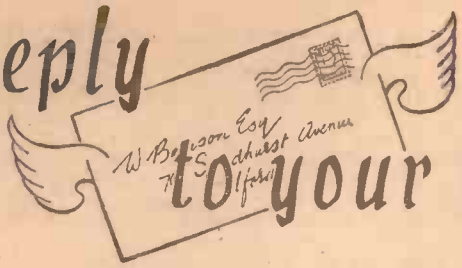
JELVES had built a four-valve set for battery operation, incorporating two H.F. stages. The set was unstable and he decided that he would make a stage-by-stage test, which he did, and as a result decided that decoupling was necessary. He found resistances and condensers of suitable value in his spares box, and incorporated these. There was hardly any improvement, in spite of the fact that H.F. instability was responsible for his trouble. Why did his components fail to effect an improvement? Three books will be awarded for the first three correct solutions opened, and each entrant should express his choice of a book selected from the list published on page 340. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 407 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, July 8th, 1940.

Solution to Problem No. 406

The variable-mu property of a valve cannot be taken advantage of in a detector stage. Variation of the bias would affect the rectification properties of the valve and this accounted for the effects experienced by Abbott.

No readers successfully solved Problem No. 405.

In reply to your letter



Converted Switch

"Some time ago you published a wrinkle in your pages showing how to convert a simple push-pull on-off switch into a three-point component. The idea was to solder a flexible lead on the tip of the switch and make this a third point. Well, I recently did this to a little device I made up and it does not work. As a result the battery I was using was not switched off and it ran out in a few days. I should like you to see that wrinkles really work before publishing them as this sort of thing can be expensive."—M. A. S. (Croydon).

THE idea of converting a switch in the manner indicated is perfectly practicable and does all that is claimed for it. It must be borne in mind, however, that with the average type of push-pull switch the component is mounted on the panel by means of a one-hole fixing bush. Through this the plunger of the switch works. Accordingly, if mounted on a metal panel the plunger and tip will be "live" to the panel. Thus, you must take the elementary precautions to see that any battery supply across the switch is open-circuited when the switch is in the off position. Even with the idea as described this could easily have been obtained by using one of the other terminals on the switch for the battery lead and transferring the lead from the tip to that terminal.

Fitting Fuses

"I enclose a circuit of a mains set I am building, and should like to know the best positions for fuses to afford maximum protection in this set. I have many different types of cartridge fuses rated at .5 and 1 amp. and do not mind how many I have to fit so that I shall not run the risk of expensive component or valve replacements."—B. N. (St. Albans).

THERE is one drawback to fitting fuses all over a set and that is that should one of them blow it will take you some time to find the faulty one, and as this may take place during an important broadcast you will waste considerable time and perhaps miss the item you require simply because you cannot easily locate the fault. There are no self-indicating fuses available which would simplify the identification of a blown fuse and therefore tests across each will have to be made. We suggest, therefore, that in an A.C. mains receiver such as that you propose the maximum protection would be afforded by two fuses—one in series with the primary of the mains transformer (1 amp.) and one in series with the H.T. negative lead (.5 amp.). This should be as close as possible to the centre tap of the H.T. winding.

Fitting Pick-up

"I have a commercial seven-valve superhet, but there are no pick-up terminals on it. As I should like to fit a pick-up, I wonder if you can tell me the best position and simplest way of adding this device."—P. T. (Nelson).

WE do not normally advise any modification to commercial apparatus. However, with a normal superhet no drastic modification is needed. The pick-up leads are merely connected across the L.F. volume control. This is generally included in the double-diode-triode stage, with the centre arm of the control joined to the grid of the D.D.T. valve. If such a valve is not fitted it may be possible to include the pick-up merely by connecting it to certain terminals of a plug-in adapter which can be inserted between one of the L.F. valves and its valveholder. Probably, therefore, the most satisfactory plan is to get into touch with the makers and ascertain their views on the modification required.

Testing a Transformer

"I have an L.F. transformer which had been taken from a set by a friend because he said it was faulty. I should like to test this and should be glad to know the best way of doing this. I have no test equipment available and must therefore carry out a kind of 'experimental test.'"—S. T. E. (Bath).

A PAIR of 'phones in series with a 1.5 volt battery would be quite satisfactory for your test. Connect the two (in series) across primary and secondary in turn. A click in the phones when the circuit is made and broken will indicate continuity and that the windings are unbroken. Leakage or shorts from primary to secondary may then be checked by connecting the battery and 'phones between each of the primary and secondary terminals. You might also conclude the test by checking for a short-circuit between any of the windings and the core.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to queriste.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

Speaker Repair

"I have been experiencing some trouble with my speaker lately and I believe it is due to some foreign body inside the gap. I have made an examination as far as possible, but am not quite certain whether it is desirable to take it to pieces or send it to the makers. Is it possible to damage it by taking it down, or will there be any difficulty in getting it back properly, as I do not want to have to send it back half assembled?"—M. C. T. (Balcombe).

IT may be unnecessary to dismantle the speaker to carry out the desired cleaning. If you have a vacuum cleaner with a blowing attachment, we suggest you try the effect of placing this fairly close to the gap so as to clear out any dust which may have accumulated. Then, if it is possible to get to the gap with a small artist's paintbrush, dip this in paraffin and carefully wipe round the gap to remove any gritty bodies or metal filings which may become fixed there. Finally, combine these two processes, brushing whilst the air jet is directed into the gap. This should effect the desired clearance, but if there is no improvement we suggest that you let the makers overhaul the speaker.

Circuit Diagram

"I am working to a circuit which was given to me by a friend and was taken from an American magazine, I believe. It does not show the usual H.T. negative-earth line, but at various places in the circuit there are components on one side of which is the symbol for earth. My friend says this means that the points indicate connections to a chassis, but I am not clear about this and as I thought of using a wooden chassis I wonder if this is the case and if it will matter. Your advice would be appreciated."—H. T. E. (King's Lynn).

THE method of indicating earthed points is quite common in America and also in some English papers. It does not, however, necessarily indicate that the points in question are connected direct to earth or to a metal chassis. Therefore it is quite in order for each of the components or points in question to be connected together and to earth or for any number to be connected together and taken to the nearest earth point. Generally speaking, a superhet or modern efficient circuit will be found more stable and satisfactory if all the points indicated are connected direct to the nearest point on the chassis, using a metal chassis earthed.

Amateur Call Signs

"I should be glad if you would tell me what countries have call signs with the letters KA and PY. Is there any place I can get a list of all call symbols?"—L. F. (Chelmsford).

KA is used for amateur calls originating in the Philippines and PY for those from Brazil. A full list of Amateur Call Signs will be found in our publications "Wireless Transmission for Amateurs," "Encyclopædia" and "Short-wave Manual."

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

H. T. (Bangor). We approve the arrangement, and it should function perfectly satisfactorily.

N. R. (Liverpool). You will find all the details in the book you have ordered. Constructional data is given fully.

The coupon on page iii of cover must be attached to every query

SHORT-WAVE SECTION

Causes and Prevention of Dead Spots

AS there are some readers who are just entering the short-wave field, it might be explained that dead spots is the name given to those portions of the tuning range over which signals cannot be received or where signal strength is much lower than at other wavelength settings. It is not uncommon to find, after completing a new set, that above and below certain wavelengths the receiver functions perfectly well, although somewhere between the two extremes it seems to be lifeless. Generally, it is found that over a narrow band the reaction control has little effect; even if the detector can be made to oscillate at all, it is necessary to advance the reaction control well beyond its normal position.

The Simplest Remedy

The trouble is most often met when using a set of the detector-L.F. type, although it is not always absent even when an H.F. amplifier is incorporated, or when the set is of the superhet type. In the simplest type of instrument, the trouble can often be overcome completely by using a different aerial—a shorter length of wire generally produces the desired effect. The reason for this is that the aerial-earth circuit tunes to a "natural" frequency or wavelength of its own, and conditions may be such that the tuned circuit acts as a form of wave-trap. By altering the constants of the circuit the "natural" wavelength is altered so that it is different from any of the wavelengths to which the receiver tunes.

It will be understood from this that an alteration to the earth lead may have the same effect as changing the aerial. If the lead is more than a few yards in length, shortening the wire will often provide a complete remedy. It is also worth mentioning, in passing, that when a long earth lead must of necessity be employed, the wire should be insulated, since it forms an important part of the complete aerial-earth system.

A Variable Series Condenser

A similar effect to that obtained by changing the characteristics of the aerial or earth can be obtained by including a condenser in series with the aerial lead-in, and if a variable condenser is used the "natural" frequency can be adjusted between fairly wide limits. This means that if a dead spot is reached during the tuning process, its effect can be eliminated by altering the capacity of the condenser. A pre-set condenser can be used, as it is in a broadcast receiver for the purpose of improving selectivity, but it is far better to use a fully variable type condenser of the air-dielectric type and with a maximum capacity of about .0001 mfd. for wavelengths down to about 20 metres, or of half this capacity for still lower wavelengths. The condenser should be mounted on the panel and the fixed vanes should be connected to the aerial terminal. The condenser is sometimes rather more useful screened, but in most cases screening has the effect of reducing sensitivity by increasing the fixed aerial-to-earth capacity.

The same effect as that obtained by using the condenser can be obtained by using a separate and untuned aerial coil variably coupled to the grid coil; a dead spot can then nearly always be eliminated by altering the position of the aerial winding. This method is not normally very convenient, however, for it is not an easy matter to mount a moving coil so that it can be moved smoothly by means of a control on the front of the set.

The Reaction Circuit

In very many cases, dead spots are due to the fact that the proportionate numbers of turns on the tuned (grid) winding and on the reaction coils are unsuitable. Some designers of coils use a greater number of turns on the reaction winding that on the grid winding, with the result that the reaction circuit is often inclined to "take charge" of the tuning; the usual result is that reaction adjustments affect the tuning and that dead spots are introduced. Because of this it is always "safer," and generally better, to have a coil whose reaction winding has about three-quarters of the number of turns used in the grid circuit. It should be remembered, however, that this makes it necessary to have a reaction condenser of comparatively high capacity. Thus, where a .00016 mfd. condenser is used for tuning, a .0002 mfd. component may be required for reaction.

Whilst referring to the reaction circuit, which is really a portion of the complete anode circuit of the detector valve, it is worth mentioning that the high-frequency choke can have a pronounced effect on the presence or otherwise of dead spots, for if this component is of too low an inductive value, or if the self capacity is comparatively high, it might be so ineffective at certain frequencies that it does not act as a "stopper" as it should, but permits the passage of H.F. currents into the high-tension circuit. Trouble need never exist in this respect if constructors make use of the correct type of choke recommended for any particular purpose by the makers of reputable components.

Look to the Grid Condenser

It is often overlooked that the grid condenser and leak may be the cause of dead spots if they are of unsuitable value. In nearly every case it will be found that a .0001 mfd. condenser and 3 to 5 megohm leak are perfectly satisfactory, but if trouble persists after checking the other parts of the set, it is worth while to try a pre-set condenser of about .00015 mfd. maximum capacity, and to experiment with various settings of this.

ELECTRONIC BREVITIES

P.E. Cell Screening

THE efficient performance of a photo-electric cell, no matter for what purpose it is employed, is dependent on a number of important factors. Naturally, the maker's recommendations as to difference of potential between cathode and anode should be adhered to rigidly, for the figure furnished has been determined after a good deal of experiment and, furthermore, any excessive divergence may result in damage to the cell itself. While in the early days of gas-filled cells it was quite a common practice to "flash" them by bringing a bright light in the immediate vicinity (often a match was struck outside the glass envelope), this method of ascertaining whether the cells are still operating satisfactorily is now deprecated owing to the enormous improvements in sensitivity. For certain work it has been found absolutely essential to provide a metallic screen to the cell and its associated leads, and yet in no way interfere with its light reactive response. Obviously, the best way to meet this requirement is to use some form of fairly wide-mesh gauze or netting. In certain studio equipment for some early spotlight television scanning, to prevent any cut-off of the reflected light from the subject being televised, chicken-run netting was used to cover the front sections of each cell mounted in a cylindrical casing. In addition, fine-mesh gauze surrounded the leads passing from the cell terminals to the amplifier held on brackets in a metal box above the cells. The scheme, while presenting a rough and ready appearance, proved to be most effective, and satisfactorily neutralised the effects of any stray fields so that complete stability was ensured.

Electronic Instruments

A SHORT time ago a very interesting dissertation was given on the historical development and the present engineering problems involved in musical instruments which depended for their operation on electronic circuits. Ever since the Duddill singing arc first made its appearance many years ago, inventors have been inspired to design electronic musical instruments which did not depend on "stroking" or striking wires of different lengths or the application of wind to pipes of different lengths, but instead made use of the oscillatory properties of electrical circuits which could be made to resonate at controllable frequencies within the acoustical range. While it is agreed that to date electronic instruments, especially the ambitious organs, are still in their infancy when compared with the traditional forms of musical instruments, a stage has been reached when developments should be of a very rapid character. In one case a cathode-ray method of waveform generation has been proposed and, although at first sight this may appear complicated, it has the attraction of avoiding moving parts in just the same way as it revolutionised both television transmitters and receivers. One of the most promising possibilities of the electronic scheme is the greatly increased scope which is offered to musicians in modes of expression. Composers are always anxious to express new ideas, but when using the standard musical instruments there is a limitation to the chromatic scale and tone colours which have remained approximately the same over a period of years. In the case of the electronic organ with its very full scope there is no reason why new tone colours and effects should not be expressed, and a minor revolution occur in the musical world.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription, £2 10s.).

Latest Patent Applications.

10106.—Philco Radio and Television Corporation.—Rotary indicating device. June 10th.

10125.—Scophony, Ltd., and Okolicsanyi, F. — Television systems. June 10th.

9973.—Standard Telephones and Cables, Ltd.—Ultra-short wave radio systems. June 7th.

9974.—Standard Telephones and Cables, Ltd.—Directional antenna systems. June 7th.

10028.—White, E. L. C., and Ball, E. W.—Tuned amplifier circuit arrangements. June 8th.

Specifications Published.

521941.—Thornton, A. A. (Philco Radio and Television Corporation).—Control circuits for gas triodes.

521942.—Thornton, A. A. (Philco Radio and Television Corporation).—Methods and means for rapid heating of electron discharge tube filaments.

521931.—Radiowerk E. Schrack Akt.-Ges.—Chassis for a radio-receiver or the like.

521983.—M-O Valve Co., Ltd., and Cosgrove, C. W.—Tuning-indicators in radio receiving-sets.

521984.—General Electric Co., Ltd., and Edwards, G. W.—Apparatus for receiving television.

521992.—Marconi's Wireless Telegraph Co., Ltd.—Television transmitter cathode-ray tubes.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2d. per word (minimum charge 2/- each paragraph). Series discounts of 5 per cent. for 13, 10 per cent. for 26 and 15 per cent. for 52 insertions are allowed. All advertisements must be prepaid.

EACH paragraph will commence with the first word printed in bold face capitals. Additional words in bold face capitals are charged at 4d. per word.

ALL communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

RADIO MAP AND GLOBE

WEBB'S Radio Map of the World enables you to locate any station heard. Size 40" by 30" 2 colour heavy Art Paper, 4/6, post 6d. Limited supply on Linen, 10/6, post 6d. WEBB'S Radio Globe—superb 12" full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post Paid. 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

READERS' BARGAINS

WANTED, 3-valve A/C receiver, any make. Pay £1 deposit, 5/- weekly. D. Sinclair, 16, Hillside, Oswestry, Shropshire.

RECEIVERS AND COMPONENTS

BANKRUPT Bargains. Brand new 1939/40 models, well-known best makes, makers' sealed cartons, with guarantees, at less 30%-40% below listed prices; also Midgets, portables. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

COULPHONE Radio, 22, Grimshaw Lane, Ormskirk. All goods previously advertised still available. Special offer. Cosmocord Series III. Crystal pick-ups, 18/6. Stamp for lists.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.
5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.
15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7". 15/- the Kit.
21/- Small Trader's Parcel of Components. 150 Articles comprising all types Condensers, Valve Holders, Resistances, Chokes, Coils, Wire, etc. Value 85/-, 21/- the parcel.
5/- 100 Wire-end Resistances, assorted capacities. ½ and 1 watt, 5/- per 100.
ORMOND Loud-speaker Units, 2/6. Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d. "P.O." Microphones, on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.
2/- Tool or Instrument Carrying Cases, ex Government Stock. Wood 9" x 7" x 7", 2/-.
SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

WE SUPPLY LATEST MODELS OF
ARMSTRONG
QUALITY CHASSIS ON
EASY TERMS
★ WRITE FOR FULL DESCRIPTIVE LIST & TERMS. PROMPT DELIVERY, CARR. PAID.
LONDON RADIO SUPPLY CO., "WINDEN," ARDINGLY RD., BALCOMBE, SUSSEX (*Evacuation Address*).

FREE ADVICE BUREAU
COUPON
This coupon is available until July 13th 1940, and must accompany all Queries and Hints.
PRACTICAL WIRELESS, 6/7/1940.

Turn Your Surplus Components Into Cash

Those components for which you have no further use can be turned into cash through the classified columns of "Practical Wireless." Readers' advertisements are inserted at the special rate of 1d. per word (minimum charge 1/-).

Send your advertisement with P.O. to:—Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

PREMIER RADIO

PREMIER SHORT-WAVE BATTERY-OPERATED KITS for OVERSEAS NEWS
Incorporating the Premier 3-Band S.W. Coil. 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2-volt valves.
3-Band S.W. 1-Valve Kit, 14/9. 3-Band S.W. 2-Valve Kit, 22/6.

DE LUXE S.W. KITS
Complete to the last detail, including all Valves and coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in Coils to tune from 13 to 170 metres.
1 Valve Short-Wave Receiver or Adaptor Kit 20/-
1 Valve Short-Wave Superhet Converter Kit 23/-
1 Valve Short-Wave A.C. Superhet Converter Kit 26/3
2 Valve Short-Wave Receiver Kit 29/-
3 Valve Short-Wave Screen Grid and Pentode Kit 68/-
4 VALVE S.W. RECEIVER KIT for A.C. mains, £4/10/-, complete with valves, coils and circuits.
Special Offer of Record Auto-Changer Units for A.C. Mains by famous manufacturer. Play 8 records. Latest type Magnetic Pick-up, Auto-stop, Start and Rejector. Limited number only at £4/19/6. Carriage Paid.
SPECIAL OFFER. ROTHERMEL PIEZO BRUSH CRYSTAL PICK-UPS. New Junior P.U. with arm, 19/6. Standard S.8 Model with arm, 29/6. P.U. head only, De Luxe Model, 19/6.
ROLA MOVING COIL SPEAKERS, complete with Transformers, 6in. P.M. 12/6. 8in. P.M. 16/6. 10in. P.M. 22/6. G12 P.M. 66/-.
MAINS TRANSFORMERS. Manufacturers' surplus. All brand new and Guaranteed.
Input 110 v. and 220 v. A.C. Output 325-325 v., 120 m.a. 6.3 v., 2-3 amps., 5 v. 2 amps, C.T., 7/6 each. Input 230 v. A.C. Output 325-325 v., 75 m.a., 5 v. 2 amps., 6.3 v. 2-3 amps. C.T., 6/6 each. Input 100-250 v., 300-300 v. 60 m.a. 4 v. 5 a. C.T., 4 v. 1 a., 6/11. Output 325-325 v. 180 m.a., 5 v. 2-3 amps., 6.3 v. 2-4 amps., 12/6.
PREMIER BATTERY CHARGERS for A.C. Mains. Westinghouse Rectification complete and ready for use. To charge 2 volts at ½ amp., 11/9; 6 volts at ½ amp., 19/-; 6 volts at 1 amp., 22/6; 12 volts at 1 amp., 24/6; 6 volts at 2 amps., 38/6.
REPLACEMENT VALVES FOR ALL SETS
EUROPA MAINS VALVES. 4 v., A.C. Types, A.C./H.L., A.C./L., A.C./S.G., A.C./V.-M.S.G., A.C./H.P., A.C./V.H.P. (5-pin), all 5/3 each. A.C./H.P., A.C./V.H.P. (7-pin), 7/6. A.C./Pens-I.H., 7/6; A.C. P.X.4, 7/3; Oct. Freq. Changers, 8/6; Double Diode Triodes, 7/6; 350 v. F.W. Rect., 5/6; 500 v. F.W. Rect., 6/6; 13 v. .2 amps. Gen. Purpose Triodes, 5/6; H.F. Pens and Var.-Mu H.F. Pen., Double Diode Triodes, Oct. Freq. Changers, 8/6 each. Full and Half-Wave Rectifiers, 6/6 each.
TRIAD HIGH GRADE U.S.A. VALVES, all types in stock. Standard tubes 5/6 each. Octal Base tubes, 6/6 each. 80's 4/6.
PREMIER Short-Wave Condensers all-brass construction, with Trolitul insulation. 15 mmf., 1/9; 25 mmf., 1/10; 40 mmf., 2/-; 100 mmf., 2/3; 160 mmf., 2/7; 250 mmf., 2/11.
PREMIER SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-49, 78-170 metres, 2/- each, with circuit. Special set of S.W. Coils, 14-150 metres, 4/9 set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres. Suitable any circuit, 2/11. 4- or 6-pin formers, 1/2.
PREMIER Morse Practice Key on Bakelite Base and Brass Movement 3/3.
GENERAL PURPOSE Morse Key, 5/10.
HEAVY DUTY TX Key on Cast Base, 10/-.
BATTERY AMPLIFIERS. Class B output complete with valves. 12 watts, 48/-; 4 watts, £3/13/6.
CARDBOARD ELECTROLYTICS, 500v. working, 4 mf. or 8 mf., 1/9; 8+8 mf., 3/6; 50 mf. 12 v., 1/2; 25 mf. 25 v., 1/2; 50 mf. 50 v., 2/-.
UTILITY Micro Cursor Dials. Direct and 100 : 1 Ratios, 4/3. 3-wave Full Vision Dial, 6/9.
LISSEN Dual Range Screened Coils, medium and long waves, 2/9 each.
Orders 5/- and over sent Post Free. Under 5/- please add 6d. postage. All enquiries must be accompanied by 2½d. stamp.

YOU MUST HAVE A
PREMIER 1940 CATALOGUE
111 PAGES . . . PRICE 6d. plus postage, 2½d.
GET YOUR COPY TO-DAY!

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723
CALLERS TO: Jubilee Works or our NEW PREMISES, 169, FLEET STREET, E.C.4. *Central* 2833
or 50, High Street, Clapham, S.W.4. *Macaulay* 2381

RECEIVERS AND COMPONENTS

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163A, Strand, W.C.2.

DENCO "Pocket Two" midget dry battery receiver. £2/15/0. Ideal for present conditions. Send for details.—Warwick Road, Clacton, Essex.

RADIO CLEARANCE, LTD. See previous issues for full list of bargains.
RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. Holborn 4361.

FEW only 5-valve A.C. Sparton sets still available, £4 5/-, carriage paid; see previous issues for technical details.—London Central Radio, 23, Lisle Street, London, W.C.2. Gerrard 2969.

TUITION

YOUNG MEN (15-20 years) urgently needed to train as Radio Officers for the Merchant Navy; military exemption obtainable; short training period; low fees; boarders accepted. Write or call for full particulars. Wireless College, Calmore, Southampton, or Wireless College, Colwyn Bay.

BOOKS

YOU need this war atlas when you read the newspapers or listen to the wireless bulletins. "Newnes Comprehensive War Atlas" will make the progress of the conflict understandable in all its aspects. 8 pages of war maps, including the Scandinavian countries, Western Front, Balkans, and all countries whose frontiers adjoin or are near those of the belligerents. With war strengths of the Armies, Navies, and Air Forces of the Nations.—Of all newsagents and booksellers, 1s. 6d. net, or by post 1s. 9d. from the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

KNOW what to do before the doctor comes.—Learn from the new book, "First Aid For The Householder," and your knowledge may be the means of saving a life. Deals in simple language with all kinds of injuries and their treatment, war-gases, shock, and the minor ailments of everyday life. Clearly illustrated.—Of all booksellers, 1s. 6d. net, or by post 1s. 9d. from the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

PLUGS
The CLIX range of Radio plugs is comprehensive to the last degree and covers every conceivable purpose.
CLIX
British Mechanical Productions Ltd., 1, Church Road, Leatherhead, Surrey

"ENGINEERING OPPORTUNITIES"
This unique Handbook shows the easy way to secure A.M.I.C.E., A.M.I. Mech.E., A.M.I.E.E., A.M.I.A.E., A.M.I.W.T., A.M.I.R.E. and similar qualifications. WE GUARANTEE—"NO PASS—NO FEE." Details are given of over 150 Diploma Courses in all branches of Civil, Mech., Elec., Motor, Aero, Radio, Television and Production Engineering, Draughtsmanship, Tracing, Inspection, Building, Government Employment, etc. Write for this enlightening Handbook to-day. FREE and post free. *Men with radio knowledge can obtain attractive posts in the Services.*
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, 409, Shakespeare House, 17, 18, 19, Stratford Place, London, W.1

RADIO TRAINING MANUAL 13 P.W.

Published every Wednesday by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rates including postage: Inland 23s. 10d. per annum, 11s. 11d. for six months; Abroad 21s. 8d. per annum, 10s. 10d. for six months. Registered at the General Post Office for the Canadian Magazine Post.

MULTI-RANGE SET ANALYSER — See Page 352

A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 408.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

July 13th, 1940.

Contents

Practical Wireless

BLUEPRINT SERVICE

These Blueprints are drawn full size.
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940). 4d. Post Paid
" " (Issues dated June 1st, 1940, and after) 5d. Post Paid
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/4 " "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

PRACTICAL WIRELESS

CRYSTAL SETS

	Date of Issue	No. of Blueprint
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94

STRAIGHT SETS. Battery Operated.

One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	20.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen),	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans)	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90

Mains Operated

Two-valve: Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve: Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW20
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve: Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets: Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets: Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
Four-valve: Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve: Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve: Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve: Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68

PORTABLES.

Three-valve: Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve: Blueprint, 1s.		
"Imp." Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated.

One-valve: Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve: Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM380
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve: Blueprints, 1s. 6d. each		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve: Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.

Two-valve: Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM304
Three-valve: Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve: Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386

SUPERHETS.

Battery Sets: Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets: Blueprints, 1s. 6d. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366

PORTABLES.

Four-valve: Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve: Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve: Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve: Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve: Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet: Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397

Mains Operated.

Two-valve: Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve: Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve: Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391

MISCELLANEOUS

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* 36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical and Wireless
PRACTICAL TELEVISION
EVERY WEDNESDAY
Vol. XVI. No. 408. July 13th, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Radio and Air Raids

THE policy at the moment is that should air raids take place during the hours when broadcasting is being conducted there will be no cessation in the programmes. Accordingly, those who wish may carry some form of extension down to their shelters so that the programmes may be heard during a raid. There will be no special broadcasts or other indications that raids are in progress, but music and light entertainment will certainly relieve some of the strain experienced by many whilst waiting in a shelter for the "All Clear." A simple portable receiver may be carried or an extension lead may be taken from the receiver and a loudspeaker only employed in the shelter. The only drawback to such a scheme is that there will be little opportunity of changing the station unless some form of relay switching is provided. This will mean a multi-cable lead or the inclusion of elaborate relays and switches. On the other hand, a small portable receiver will undoubtedly provide sufficient volume in the average shelter and offers the listener a choice of programmes with no difficulty. In this issue we deal with the problem from its various angles, and those who have not yet fitted radio in their shelters will now be able to adopt some scheme to provide music during raids.

Swotting the Chatterbug

IN a recent broadcast to the nation, Mr. Harold Nicholson, M.P., invited people to beware of what he called the "Chatterbug," and suggested several ways of dealing with this menace. The regulars at "The Pig and Whistle" have evidently taken his advice to heart. On July 16th, listeners will hear how Tom Tottergrass, the chatterbug, was swotted by Rosie Jones, Old Granfer, 'Erb, Jim Larkin, Sergeant Evergreen, and all the other "Pig-and-Whistlers." The script has been prepared by Charles Penrose (Sergeant Evergreen), and the show will be produced by Ernest Longstaffe.

Clarkson Rose's "Twinkle"

ABOUT two months ago, Clarkson Rose's well-known Eastbourne Concert Party, "Twinkle," broadcast from the B.B.C.'s studios at Bristol. On July 18th they will be heard again, the cast including Clarkson Rose himself; Tommy Fields, who is fast following in the footsteps of his more famous sister, Gracie; Olive Fox, Murray Stewart, Audrey Ackland, and Cynthia Rawson. This is the Company's sixth consecutive seaside season.

"Top of the Bill"—Vera Lynn

VERA LYNN, vocalist, will broadcast in "Top of the Bill" on July 17th, with the Dance Orchestra, directed by Billy Ternent. She is practically unrivalled

Vera Lynn, most popular of singers, who will be heard this week with the Dance Orchestra.

in this type of entertainment and first became known to the public through her broadcasts with Ambrose and his Orchestra; she undertook several tours with his band and with the Ambrose Octet, which also included Evelyn Dall and Max Bacon. During the past few weeks she has been adding to her reputation in the broadcast comedy feature, "Phoney Island." Vera Lynn has a particularly direct and confident style of singing, and it is this which has endeared her to so many listeners.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Another Wodehouse Comedy

ONE of the most amusing of the Wodehouse works which have been adapted for broadcasting was "The Crime Wave at Blandings," which was originally produced some months ago. This play is to be revived on July 13th in the Home Service programme, and will be produced by John Cheatle. It concerns the adventures with an air-gun of the occupants of a typical Wodehouse country seat.

Piping and Fiddling

GEORGE DAVIE, violin, and Pipe-Major George Cruickshank, two Aberdeen artists, will unite in a piping and fiddling programme which will be broadcast for the Forces on July 13th.

"My Day's Work"

WALES' contribution to the series called "My Day's Work" will be broadcast on July 20th. This will take the form of a discussion, and the speakers will be Ernest J. Thomas, a tin-plater, I. I. White, a channel pilot, and either a potter or a thatcher. In this series rank and file workers are talking to listeners about their daily life and reflecting the thoughts of ordinary men and women. It is always good to know what the other man does, and this series will, it is hoped, help to satisfy that need and also give a picture of a country quietly but determinedly at war.

Eddie Carroll and His Orchestra

EDDIE CARROLL will provide the "Band of the Week" beginning July 14th. He and his orchestra have broadcast regularly since the war began, and this will be their fourth week of broadcasting since the New Year. Carroll, who is London-born of Irish stock, has been pianist at one time or another with such famous band-leaders as Ambrose, Lew Stone and Henry Hall. He was with Hall on the maiden voyage of the *Queen Mary* in 1937. He has been a fairly prolific composer; among his compositions being "Ebony Shadows," "Harlem"—his signature-tune—and "The Lady Craves Attention."

Electro-chemical Faults

Details of Some Servicing Troubles Which Were Caused by the Use of Aluminium

THIS article is not a condemnation of aluminium as a useful metal to employ in the construction of wireless components. It is a record of actual service troubles encountered due to its use in places which have not been thoroughly examined by designers and where the effect of time has not been considered. These notes, it is hoped, will enable service engineers to score more victories in their constant campaign against perplexing problems and intermittent faults, faults which do not affect in any way the H.T. and L.T. voltages and currents; neither do they cause changes in the resistance values of circuits usually checked for continuity and ohms in accordance with published service information.

The source of the trouble is the characteristic of aluminium to acquire a "skin" or coating especially when in contact with another metal or under certain atmospheric conditions. This does not affect mechanical conditions, but where the contact between surfaces is made to serve also as an electrical path, the latter may be seriously affected by the chemical change which slowly takes place at the surfaces of the metals.

The following faults are from the writer's experience as a radio service manager handling many makes and types of receivers. They are facts, not faults made up to prove a principle in servicing. Many designers of modern receivers are fully aware of the peculiarities of aluminium and ensure that contact troubles will not occur by seeing that additional connection is made by welding or other means between surfaces where electrical continuity is essential, but there are thousands of older instruments which are giving trouble due to faults such as will now be described.

Non-oscillation of Frequency Changer

This fault caused considerable delay and trouble because although the suspected component was returned to the actual manufacturers, they themselves did not find anything wrong with it and quite obviously were rather inclined to doubt our diagnosis.

If you were given a triple-gang condenser to check over and test, how would you set about it? Wouldn't you examine it just for dirt between the vanes, bent and shorting vanes, broken pigtail connections, if any, and finally finish up with a megger test for low insulation between fixed and moving vanes? Yes, of course you would, and if it passed those tests you would declare it O.K. Well, in this case the gang condenser of a superhet fell under suspicion although no fault could be found with it. The symptoms were "no results," eventually traced to non-oscillation of the frequency-changer circuits. A change of valve, however, and a careful checking of coils, resistances, voltage and current measurements proved everything up to standard. Oscillator coils were changed in case they had absorbed damp or in some other way decreased in efficiency, but to no avail. There was still no oscillation, as indicated by the fact that there was no change in anode current of the oscillator section of the frequency-changer valve when the oscillator grid circuit was short-circuited.

The remaining component left for intensive investigation was the oscillator section of the ganged tuning condenser. This, of course, had been the subject of routine tests and had passed them satisfactorily, but it was felt that there must be something wrong with it, and it was returned to the makers. Back it came with an O.K. test label on it, but still the oscillator circuit refused to function. It was at this stage that fortune smiled upon the distracted service engineer and caused him to make a test that disclosed the cause of all the trouble. He was checking the oscillator section of the gang condenser for the "nth" time for high resistance with an ohm-meter, and had one test lead clipped on to the soldering tag of the fixed vanes' terminal strip. He wanted to set the pointer of his ohm-meter to zero by shorting the test leads and manipulating the zero adjuster, but instead of touching his second test lead directly on to the other, he put it on to the fixed vanes themselves, which, of course, should have given the same results. It didn't! The pointer was so far off zero that no adjustment would bring it back, and it was realised that the instrument was registering a resistance between the fixed vanes and their terminal tag.

This was the cause of all the trouble. After cross-checking, it was found that there was up to 10 ohms resistance, and as this was in series with the oscillatory circuit it was sufficient to damp out oscillations and so prevent the functioning of the receiver.

The resistance was due to the use of aluminium vanes, held in a casting also of aluminium, the whole being pressed together, but in the course of time a skin effect had built up, and although the component was as mechanically strong as on the day it was made, there was a definite resistance between each vane and the casting holding it. The resistance varied from about three ohms on one plate to over ten ohms on the worst plate. The only cure was a replacement condenser and the makers still did not find the fault until the service engineer concerned told them how to look for it.

H.F. Instability

In modern superhet receivers where the H.F. gain is high, screening is very important. Any fault in the earthing system of the screening will cause instability. Where metallised valves are not used a metal can covering the valve is employed, and it is essential that the can makes good electrical contact with the earthing system.

In many receivers the valve screening cans are made of aluminium and they fit on to a base which is riveted to the chassis. The chassis of a receiver has to be strong and is generally constructed of stout gauge steel, cadmium plated. As the base of the valve screening can is aluminium we have conditions very suitable for skin effect and there are, no doubt, many such receivers all over the country suffering from intermittent instability due to indifferent contacts between the valve screening can base and the chassis.

This contact is often weakened in the first place by the strain put on it when the screening can is put on or taken off or when there is difficulty in withdrawing a valve from a tight valveholder. In many cases the valveholder itself and the screening can base are held to the chassis by the same rivet, and any strain on either the base or the valveholder is apt to loosen the riveting. This quickens the building up of the skin effect and symptoms of instability occur.

The slightest movement of the screening can, however, changes the contacting surfaces and probably breaks down the skin resistance between them and proper earthing exists once more. However, the trouble can be provoked by the gentle rocking of the valve screening can or an actual resistance measurement may be taken by clipping one lead of an ohm-meter to the chassis and the other to the valve screening can or its base. The latter may then be rocked to see whether there is any resistance between the two and, if there is any, whether it decreases as the valve screening can is pushed about. Even a resistance of only a few ohms may be sufficient to cause trouble. The remedy is to drill out one or both of the rivets and replace them by nuts and bolts which can be screwed up really hard. In some cases fitting a metallised valve will be satisfactory. From a designer's point of view using steel screening can bases for use with steel chassis and copper rivets obviated the trouble.

Failure of A.F.C.

Another fault due to a similar cause can occur on some modern receivers incorporating A.F.C. on its push-button circuits. The preliminary adjustments to the push-button circuits necessary to set them for any desired wavelength involves the removal of the push-button escutcheon. A small switch adjacent to the escutcheon is made to open as the escutcheon is withdrawn and thus cut out the A.F.C. Symptoms were the failure to peak the push-button circuits to maximum efficiency so that the station could not be tuned properly and it was found on examination that the switch was not operating. The A.F.C. was in circuit all the time.

Nothing wrong with the switch could be found upon visual examination but an electrical test disclosed that there was no connection between chassis and the switch blade which was held to it by an aluminium rivet.

The contact itself was separated from the chassis by a small piece of insulation in order to give the switch blade sufficient clearance and springiness and the aluminium rivet had not only to hold the assembly in position but it also had to provide the necessary electrical connection between the switch blade and the chassis.

The cause of the trouble is not hard to guess from the previous faults given above and once again the skin effect between aluminium and another metal had caused a failure. Removing the aluminium rivet and replacing it by a small nut and bolt overcame the trouble.

IDEAL RECEIVER CONSIDERATIONS

Further Discussions on Good Receiver Design

By H. J. BARTON CHAPPLE, B.Sc.

THERE is not the slightest doubt that many readers of this journal have from time to time given earnest consideration to what they would term the ideal radio receiver to suit their own particular requirements. Any ruminations on the problems involved is time well spent and it has been interesting to collate the views of many friends in order to see how they dovetail one into the other. The suggestions which follow are based on this analysis coupled with a personal outlook which is the culmination of several years experience.

At the outset it should be stated that the ideal receiver has not yet been built but due to the new order of things brought about by the war and the increasing importance and time now given to radio, it is appropriate to prepare plans and where convenient undertake as much construction as possible so that when peace and normal broadcasting returns the ideal set can soon be put into domestic service. The receiver must obviously be built to give a definite performance and should be capable of receiving a good proportion of the principal home and foreign stations. Furthermore, since such a large proportion of home listening is undertaken from the one or two "local" B.B.C. stations, the quality on these must be arranged to be above reproach. Questions of layout, circuit details, selectivity, loudspeaker reproduction, and so on, will, therefore, be based on these main requirements. Another important item to consider is the suitable provision for reproducing gramophone records, the inclusion of a microphone circuit for passing messages when occasion demands, and a scheme to allow the low-frequency side to be employed in conjunction with short-wave and ultra-short-wave units.

Different Types

There may be some who feel that the ideal receiver for home use should be one that can be fitted into an ultra-modern type of cabinet which will combine utility as well as appearance. An idea based on this is shown in Fig. 1, but although satisfactory for ordinary broadcast purposes, a relatively compact set of this nature will not cover the many ramifications that seem to be necessary in order to serve all the purposes in mind. A much better scheme is to have a workmanlike job accommodated in rack form in one's own private den and from this spot programmes can be relayed to any part of the house by providing a system of extension circuits. A rather elaborate version of the scheme in mind is illustrated in Fig. 2. No attempt will be made to crowd the equipment into one or two chassis, but the individual units for radio frequency, low-frequency, power amplification, and power pack will be designed on rather generous lines with essential circuits metered to ensure optimum working conditions being secured at all times. If funds will allow, a cathode-ray oscillograph will be incorporated and provision will be made for television reception as shown in Fig. 2, but apart from the bare essentials work on this will be left over until the end of the war as it is not yet known whether picture standards will be in any way altered.

Extension Speakers

A separate energising unit for the local loudspeaker will be incorporated, while the gramophone input will be provided by an electric turntable and modern pick-up permanently installed in close proximity to the position allotted to the main receiver rack. In the main rooms of the house a really good quality speaker will be located in a position where reproduction will be acoustically satisfactory without in any way upsetting the artistic furnishings, while in the smaller rooms a more compact version of an extension speaker will be included, but here again quality will be kept up to the highest possible standard.

The best type of tuning arrangements for a set of this nature is somewhat difficult to finalise but since the number of stations it is intended to receive is somewhat limited, say a dozen for more general purposes, the most suitable idea seems to be that of marking on a plain scale the exact tuning positions that are logged for the stations it is known the set will receive with ease and clear of interference. Furthermore, to cater for the bulk of the family listening on two local programmes, a pre-set tuning scheme will be incorporated for these so that they can be operated from the sitting-room or lounge by push buttons.

Fig. 1.—Some listeners may prefer their ideal receiver to take the form of a modern piece of furniture as shown in this illustration.

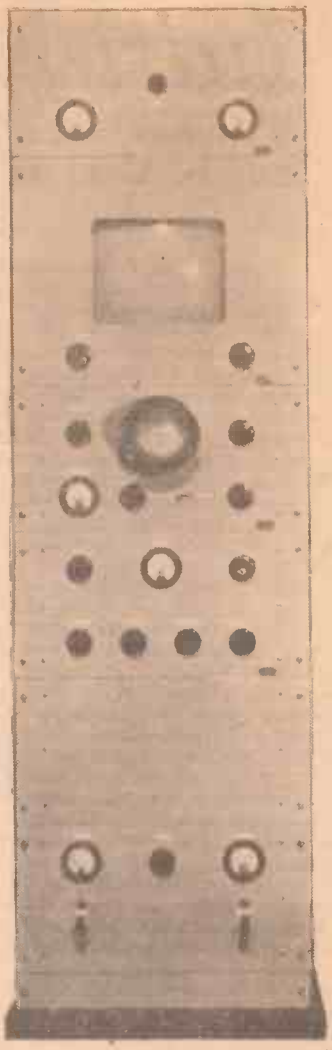


Fig. 2.—An elaborate version of "rack" type which fulfils the conditions set out in this article.

Switching

Although the main tuning will be carried out at the receiver itself, there are ideas which have been developed to enable remote tuning to be undertaken. Whether such a scheme will be finally included depends on the efficiency of those which are being examined, but quite definitely a remote control will be incorporated to enable the following to be undertaken: changing over from one local station to the other; switching from radio to gramophone so that the automatic record changer can be brought into operation and the recordings listened to at will. In addition, it will be possible to switch the set on or off from any remote loudspeaker extension listening position.

This may all seem a trifle complicated but as a technical problem the solution is not difficult to find. It is necessary to reduce the switching mechanism to the simplest and use a form of multicore cable which will withstand the voltages to be employed and be capable of connection to multi-contact switches, and if necessary carry impulses for operating any relays.

Multi-range Set Analyser

A Further Useful Addition to the Range of Test Apparatus which may be Used with the Twelve-range Meter Recently Described

By W. J. DELANEY

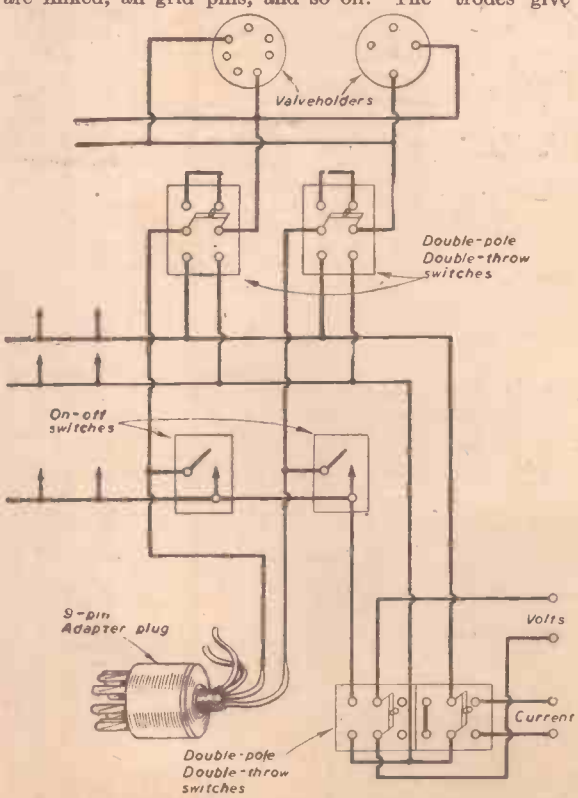
THE apparatus which has been described so far, and the type of test gear which is used most generally, is that which has an external field of use. That is to say, measurements or tests are made with the apparatus disconnected or dismantled from the receiver. It is often necessary, however, to make certain tests with all apparatus assembled and with the receiver set to its normal operating condition. Then special test apparatus has to be used. One of the most useful of these types of equipment is the signal tracer such as was described last week, but this only enables the source of a fault to be located, and it is then necessary to find the cause of the trouble, for which purpose voltage and/or current measurements have to be made. In its simplest form such tests are carried out by means of a split-electrode adapter. This consists of a plug and socket device which is inserted between a valve and its normal holder. Terminals on the side of the plug-adapter are bridged to complete the circuit, or a meter may be included between the terminals, and in this way the voltage at various electrodes, or the current flowing in the various circuits, may be ascertained. It is, of course, also possible to ascertain these figures by including a meter inside the circuit, but this means that in many cases wires will have to be cut or terminals undone and wires disconnected.

Testing in Situ

When making tests of certain modern receivers it is almost imperative that such tests be carried out without disconnecting any leads or components. Some faults will clear themselves if this procedure is not adhered to, and thus it is necessary to find some apparatus which will enable various tests to be conducted without removing any parts or wires. This may be done by what is known as a set analyser. In its simplest form this consists of a simple multi-plug adapter with a cable leading to a small base unit. To enable all types of valve to be used the adapter and the base will incorporate a 9-pin valveholder arrangement. All other types of valve may then be tested by using reducing adapters in association with the type of valve being employed. The leads in the cable will then be split and taken to a pair of terminals, one of which is carried to the valveholder on the base. Then, to make the desired test, the meter is joined to the appropriate terminals. For instance, if an anode current test is needed the meter will be set to the current range, joined between the two terminals feeding the anode pin, and all other pairs of terminals will be short-circuited to complete the various circuits. When the set is switched on, with the adapter from the unit plugged into one of the valveholders and the valve from that holder inserted in the base the anode current will be shown on the meter. Whilst this type of instrument is quite satisfactory in use (and is, in fact, now on the market in commercial form), there are several drawbacks to its use. The principle of these is the need for carrying out wiring changes on the base each time a different test has to be conducted. In all cases of set analysis, however, one of the valves must be removed and an adapter plugged in in its place.

Multi-purpose Analyser

To avoid the use of duplicated adapters and reducers it is, therefore, preferable to build up a single test panel incorporating a range of valveholders covering all those normally in use. A multi-cable is then fitted and provided with a 7- or 9-pin adapter, and a set of reducer-adapters must then be obtained so that they can be inserted into any receiver irrespective of the types of valve in use. The valve removed from the receiver is then inserted into its appropriate type of holder on the test unit and the various tests may then be carried out by means of switches. There are several ways in which this may be done and the most simple is specified and illustrated in the accompanying diagram. To simplify the diagram, only two valveholders are shown with the associated switches, but it must be understood that a further set of valveholders must be included, and for each one added a double-pole-double-throw switch and a single on-off switch must also be included. They are all wired in parallel as indicated, and the electrodes of all valveholders are interconnected. That is to say, all anode pins are linked, all grid pins, and so on. The two holders shown will convey the idea. To avoid the use of further switches, two pairs of input (meter) sockets are suggested. Each pair should be very clearly labelled to avoid damage to the meter. One pair is for voltage tests and the other for current tests. Two operations are necessary when making tests, namely, the operation of the appropriate electrode switch or switches, and the operation of the voltage-current change-over switch. The latter should be of the 4-pole double-throw type and for this one of the Wearite type of switches may be used, or two separate double-pole double-throw switches may be ganged. This switch should also be very clearly labelled to indicate the position for current and voltage. The D.P.D.T. switches in the upper part of the sketch are used for current readings, and the lower row of on-off switches is used for voltage tests. By following the wiring it will be seen that if the main selector switch is set to the current position and a milliammeter is joined to the pair of current sockets, by throwing over any one of the upper switches the circuit to the electrode fed from that switch will be opened and the meter connected in series. As a result anode current, screen current, filament current and similar readings may be taken.



Skeleton circuit of the set analyser. Other valveholders to complete the range are added in parallel, with additional switches.

Voltage Readings

Voltage tests between adjacent electrodes give a good indication of faults, besides permitting the anode voltage to be read direct. It should be remembered in this connection that it is necessary for proper testing to ascertain the voltage on the anode direct, and not on the line feeding the anode, in view of the voltage drop which may take place in the anode load component. Accordingly, by operating the lower switches in conjunction with the upper circuit switch, it is possible to couple any pair of electrodes and then, with the meter plugged into the voltage pair of sockets and the main switch thrown over to the voltage position, the voltage across the two electrodes which have been selected may be ascertained. The entire unit may be made up in a similar form to that in which the twelve-range meter was built, and there will be sufficient room to accommodate a set of valveholders and the appropriate switches. In connection with the latter it is recommended that the toggle type of component be used, and to avoid risk of damage to the valves the lower or voltage selector switches should be of the momentary type, having a permanent "off" position.

ON YOUR WAVELENGTH

By Thermion

Originality

OUR Hints, Tips and Wrinkles feature has been included in every issue without break since the first issue of this journal dated September 24th, 1932. There is an average of five hints and tips a week, and as this is the 408th issue of the journal this means that something over 2,000 hints and tips have been published and between £1,000 and £2,000 awarded to readers.

The object of this preamble is to draw attention to a matter which has been agitating my mind for some weeks. Note that it is one of the conditions that wrinkles submitted must be original and as we have published over 2,000 of them, it is extremely difficult for members of the staff to check over every hint set aside for possible use, and to ensure that we have not published it before; nor to ascertain whether it is a plagiarised version of something which we have published before.

It is equally impossible for the staff to compare all of the hints published in American and other overseas journals to ensure that dishonest people do not merely copy them out and submit them to us. By the nature of things, the number of hints of an original character must weekly grow less.

On one or two occasions in past months readers have submitted wrinkles which have been published before. Occasionally, for the reasons I have stated, one gets into print, and I am obliged to certain readers for their diligence in promptly writing to the Editor, pointing out the duplicity. This enables us to stop payment and to write to the reader who submitted the hint.

I should now like to take the opinion of readers on this feature. Will they please let me know whether they would like it continued, or whether they would prefer the space to be occupied by articles or some other regularly weekly feature? Please drop me a line concerning this.

In these days of paper shortage we are most anxious to use our space to the best advantage and to suit the majority of readers. When writing therefore, perhaps you could add a few words suggesting which other features you would like discontinued or included.

Radio in Caravans

READERS who reside in caravans have been in doubt as to how they are affected by the Order which prohibits the use of radio in vehicles. The position is now made clear. The Postmaster-General, in reply to a request for clarification by the National Caravan Council, says that radio receivers can be installed in caravans which are habitually used as residences, with the important proviso that such caravans must not have built-in engines, and the wheels must be removed. Under these conditions a caravan, of course, is in no different category from a bungalow or a house except in so far as the wheels could be replaced and render the dwelling portable. It would seem that the P.M.G. should have made it quite clear that such caravans must notify change of site, or, alternatively, that they must be fixed to a particular site.

Controlled Valves—Permits

A LETTER recently circulated by the Post Office varies the conditions which formerly governed the supply of controlled valves. Dealers may now handle controlled valves without the formality of obtaining a separate permit for each sale. These are the terms of the circular letter: "Under the terms of the Statutory Rules and Order, 1939, No. 1,689 Emergency Powers (Defence), the acquisition and supply of certain electrical apparatus without a permit from the P.M.G. is prohibited. Electronic valves capable of an anode dissipation exceeding 10 watts are included under the Order.

"It has been represented to this Department that valves capable of anode dissipations of from 10 watts to 25 watts are frequently incorporated as output valves in wireless sets supplied to the general public for broadcast reception. In order to facilitate their supply in new radio receiving sets, and for replacement purposes, the Postmaster-General is prepared to grant permission to certain selected firms to deal in such valves with other selected firms on condition that the transactions are recorded in a separate register.

"If you desire to be included among the firms to whom such general permits are granted, will you please notify this Department accordingly at your earliest convenience and confirm that you would be prepared to keep a separate register of transactions carried out under the permit."

A further letter, answering queries, reads:

"With reference to your letter. There is apparently a misconception as to the scope of the continuing permit which it is proposed to issue to approved retailers.

"The continuing permit would authorise you to buy the controlled valves mentioned without having to obtain separate permits for each transaction, but would not authorise the sale of such valves.

"A permit would still have to be obtained on Form T99G for all sales of controlled valves whether to members of the public or other traders.

"If you wish to be issued with a continuing permit, will you please advise me within seven days of the receipt of this letter that you will keep a register of the controlled valves purchased under the permit."

"Radio Engineer's Pocket Book"

A REMINDER that copies of this book are now available at 3s. 6d., by post 3s. 10d. It is handy in size, measuring only 5in. x 3½in., is strongly bound in cloth, with round corners, contains 160 pages, a full cross-referenced index, is ¾in. thick, and slips comfortably into the waistcoat pocket. It includes practically every table and formula necessary in connection with radio—as well as a large amount of material for general use, such as trigonometrical tables, logarithms, mensuration, weights and measures, wire gauges, etc. In fact, the book is of extreme use to all engineers. Copies should be ordered immediately, especially in these days of paper shortage.

"The Superhet Manual"

"THE Superhet Manual" is now ready at 5s., or 5s. 6d. by post from the offices of this journal. The entire contents are devoted to the superhet, both as to principles and servicing. Here again it is necessary to order quickly.

The Magnetic Mine

IN the early months of the war, Allied and neutral shipping suffered considerably from a new type of German weapon, subsequently known as the magnetic mine. It was not altogether a new device, because in a very crude form it had made a brief appearance at the end of the last war, but for a time it created some havoc at sea and some anxiety at H.M.S. *Vernon*, the mine and torpedo school at Portsmouth. The first unexploded magnetic mine was found last November at Shoeburyness, and the experts were able, at enormous personal risk, to take it to pieces and lay bare its secrets. I am interested to hear that the story of this discovery and the defeat of the magnetic mine will be told in a new feature programme by Bernard Stubbs, to be produced by Laurence Gilliam on July 16th. Bernard Stubbs is already well known as one of the B.B.C. News Observers and has specialised in naval affairs since last summer.

Our Roll of Merit

Our Readers on Active Service—Third List.

J. B. Dore
(Driver, R.E.),
Co. Durham.

F. G. Grant
(L.Ac.),
Andover, Hants.

R. E. Webster
(Corporal),
Fife.

J. Clipsham
(L.Ac.),
Boston, Lincs.

Portable Set Improvements

How to Increase the Range, and Other Ideas for the Modification of Portable Receivers

MANY existing portable receivers give a good standard of performance, due to the use of the superhet type of circuit. There are still in use, however, many simpler types of portable which are not so useful under modern conditions. Many readers may also like to take advantage of the details given last week regarding the construction of this type of receiver, and at a later date may wish to make some improvement in the receiver. The main advantage of the portable is that it is designed for use without an external aerial or earth and that it is easily transported from one place to another. In view of this latter fact the aerial and earth have to be discarded in its design. The first important point to be remembered when considering the modification of a portable is that the signals are picked up on the internal or "frame" aerial and that this also acts as the first tuned circuit. Accordingly it cannot, in any form of modification, be disposed of without first connecting a coil in its place.

Frame-aerial Limitations

There are two main limitations to the small frame aerial. Firstly, it will only pick up fairly powerful signals; and secondly, it will only respond to signals which are coming from a certain direction. The first-mentioned limitation renders it necessary to employ a larger number of valves for a given range than would be required if an external aerial were used, whilst the second point renders it necessary to turn the receiver about in order to hear various stations. Bearing these two points in mind, how can the user of a portable obtain better results? Firstly, he can make use of a normal external aerial and/or earth; secondly, he can adopt some indicating device to enable him to ascertain the correct direction in which to turn the receiver for a given station; and, thirdly, he can modify the internal arrangement of the parts or circuit in order to bring an old receiver up to date.

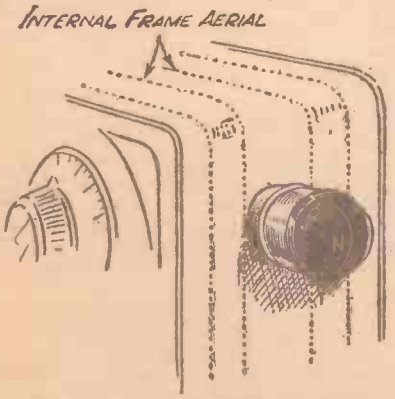


Fig. 3.—To improve the utility of a portable a compass will be found very useful.

Using an External Aerial

Dealing with these points in the order given, the first obvious improvement is to make use of an external aerial of orthodox design in order to increase the range of the receiver. The aerial should be erected with all the care that would be expended over the erection of an aerial for a normal receiver, and the usual attention should be

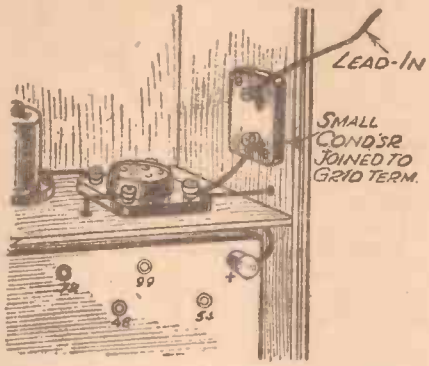


Fig. 1.—A series aerial condenser and an add-on aerial for a portable.

paid to insulation, etc. To attach the lead-in to the receiver, there are two alternative methods, and these are illus-

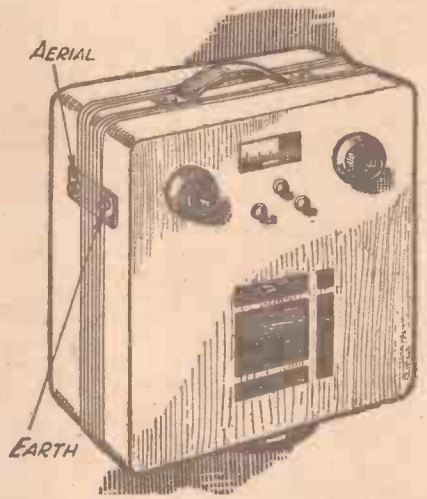


Fig. 2.—Another way of adding an external aerial to a portable.

trated in Figs. 1 and 2. In the first method, a small condenser having a value up to .0003 mfd. is joined to the grid terminal of the first valve-holder, and the lead-in is attached to the remaining terminal of the condenser. If a pre-set type of condenser is used, it may be adjusted to provide the required degree of selectivity, and thus it should be mounted so that it may be adjusted without removing the back or other part of the receiver.

The second method is to use a loose-coupled winding, consisting of four or five turns of wire, wound round the cabinet immediately over the internal winding, with terminals attached to a small piece of insulating material and joined to the ends of this winding. The aerial should be joined to one of these terminals, and the earth to the remaining terminal. If the first method is employed, the earth should be joined to the negative (—) terminal on the L.T. accumulator.

Loss of Directional Property

The attachment of an external aerial will remove the directional property of the self-contained aerial, and thus it will not be necessary to turn the receiver about for different stations. It was mentioned in the opening paragraphs that one of the limitations of the portable is the small amount of energy which is picked up, and to overcome this the circuit employed generally makes use of a large amount of H.F. amplification, and it becomes unnecessary to adopt sharply-tuned or selective circuits, owing to the directional property of the aerial. Therefore, the use of the external aerial may very probably introduce trouble owing to the flat tuning of the various circuits, and a certain amount of care will be necessary in choosing the size of the aerial, and of the coupling condenser or winding. Owing to the intricacy of design of the average portable, it is unwise to attempt to modify the H.F. side of the circuit.

A Useful Direction Finder

When the portable is used in its normal condition it is of great assistance in the location of a weak transmission if the exact direction of the station is known, so that the whole of the operator's attention may be concentrated upon accurate tuning. For this purpose you require a fairly large scale map of Europe and a small device which was introduced some time ago by Messrs. Heayberd for the use of motorists. This consists of a small compass fitted with a rubber suction cap, by means of which it may readily be attached to the portable cabinet. It must be affixed to the side of the cabinet across which passes the frame, and this point is indicated in Fig. 3, where a typical receiver is shown with the frame indicated by broken lines. Upon the map mark your own location as accurately as possible, and that when a desired station is required it is a simple matter to lay a rule or other straight-edge on the map and ascertain the direction in which the station lies. The portable should then be rotated until the required direction is seen

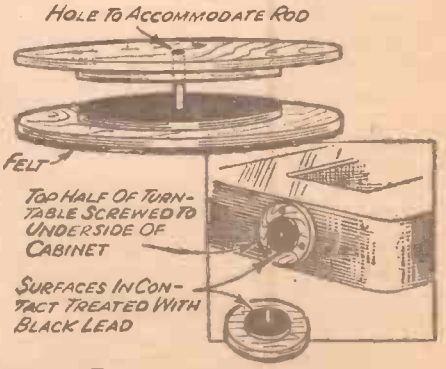


Fig. 4.—Turntables are simple to add to portable receivers.

behind the vertical line on the front of the compass, and you have a reasonable certainty of being able to hear the station if it is within range of the receiver.

The majority of portables are provided

PORTABLE SET IMPROVEMENTS

with a turntable on the base, but where such a device is not fitted one can be obtained from any good radio dealer, or made up as shown in Fig. 4. The best type, fitted with ball bearings, will enable the receiver to be moved more easily, but by smearing the surfaces of the plywood with blacklead a fairly smooth movement will be obtained.

Added a Pentode

The only circuit improvement which can be undertaken with the majority of portables is in the output arrangements, and if an ordinary L.F. or power valve is employed, the use of a pentode will enable much louder signals to be obtained on the majority of transmissions. A four-pin pentode may be plugged in in place of the present valve, with a lead from the extra terminal taken to the H.T. battery at a point slightly lower than the maximum value of the battery. The higher impedance of the pentode will necessitate a different tapping on the speaker transformer if one is fitted, and if no additional tappings are provided it will be advisable to fit a tapped pentode-output transformer somewhere in the cabinet so that correct matching may be accomplished. The lead from the anode terminal of the output valve to the speaker should then be disconnected and joined to one terminal of the primary of the additional transformer, whilst the remaining primary terminal should be furnished with the lead from the speaker to H.T. positive. The two speaker terminals should then be joined to the appropriate secondary terminals, according to the impedance of the valve, type of speaker, etc.

"Music While You Work"

A NEW daily feature has been introduced in both the Home Service and Forces programmes, entitled "Music While You Work." The title is self-explanatory, where it is found that in these strenuous times, when the nation, including a large percentage of its womenfolk, is engaged for long hours on arduous toil, certain musical programmes have a beneficial effect on the workers and so lessen the strain and may, in fact, increase efficiency by acting as a rhythmic accompaniment to busy hands and fingers.

While there has been little research in this country into the possibilities of programmes of this type, industrial psychologists and research workers have established that in factories where the work is largely repetitive, occasional musical interludes relieve monotony and consequent fatigue. The music should come after about two hours of work and should last some twenty minutes or half an hour. It should be rhythmical, non-vocal and uninterrupted by announcements.

The first "Music While You Work" programme was played by Dudley Beaven at the theatre organ in the Home Service programme at 10.30 a.m. on Sunday, June 23rd.

"Music While You Work" programmes will consist largely of dance music, marches, shanties and orchestral selections and will be broadcast twice daily, in the morning and afternoon. Generally, the programmes will be broadcast simultaneously on the Home Service and Forces wavelengths, although on isolated occasions other commitments may make it necessary to transmit "Music While You Work" in the Home Service or, alternatively, the Forces programme only.

SHORT-WAVE SECTION

The Use of H.F. Amplifiers on the Short Waves is Discussed in this Article

IN spite of the use of simple type short-wave receivers there is a wide range of opinion concerning the use of H.F. amplification. Most short-wave receivers use a detector valve unaided by any high-frequency amplification because it is contended that no useful amplification can be obtained from such a stage below about 150 metres. This is not true, however. Admittedly, the amplification is not as great as can be attained on ordinary broadcast waves, but at the same time it is worth while, and the amplifier gives the additional advantages of increased selectivity and stability of operation.

Tuned or Untuned?

The simplest H.F. amplifier is untuned. Such a stage would be useless on medium waves, but on short waves it isolates the detector from the aerial, and so removes dead-spots in the reaction control, where the detector valve refuses to oscillate owing to high damping of its grid circuit, and eliminates the effect of a swaying aerial on the signals received. It also gives some amplification.

The circuit is given in Fig. 1. The grid circuit of the screen-grid H.F. valve

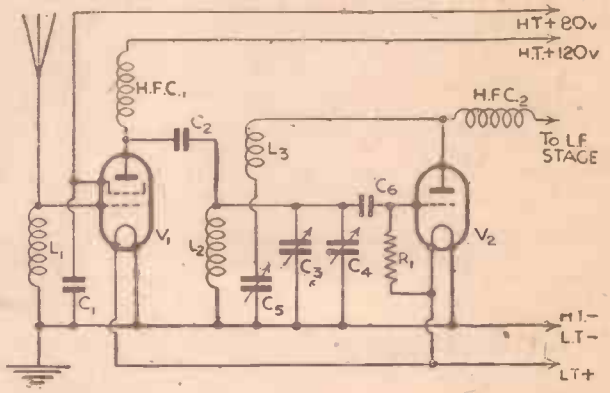


Fig. 1.—Theoretical circuit diagram of an H.F. amplifier of the untuned type.

V1 consists of a special short-wave high-frequency choke L1, made by winding fifty turns of 36 s.w.g. d.s.c. wire on a ½in. diameter ebonite or paxolin tube. The screen-grid valve is coupled to the detector by means of another H.F. choke (HFC1) and a .0001 mfd. condenser C2. HFC1 must have different characteristics from L1 or there is a risk of instability in the amplifier. C1 is a .01 mfd. mica screen-grid decoupling condenser. A non-inductive paper component may be used.

The detector circuit is standard, and ordinary component values may be adopted. Bandspread tuning is used, C3 being .000025 mfd., C4 .0001 mfd., and L2 and L3 plug-in coils. C5 is a .00015 mfd. reaction condenser and C6 .0001 mfd. grid condenser, R1 being a 5-megohm grid leak. HFC2 is a short-wave H.F. choke; its characteristics must not be the same as those of HFC1.

This circuit can be assembled without any screening between the H.F. and detector stages, although the components should not be crowded. No additional tuning control is introduced. In fact, tuning is simplified, since there is no possibility of dead-spots being troublesome.

Though not so simple to set up, the tuned H.F. amplifier offers the additional advantages of giving greater amplification and increased selectivity, as well as removing dead-spots, etc. In this case the untuned choke is replaced by a tuned circuit L1, C2, C3 (Fig. 2). C2 and C3 have the same values as C5 and C6 of the detector circuit, namely .000025 and .0001 mfd. The smaller condensers, C2 and C5, may be ganged together; the two separate .0001 mfd. condensers C3 and C6 are used for bandsetting. No difficulty need be anticipated in ganging, since the H.F. stage tuning is relatively flat.

No Ganging

Owing to this flatness of tuning, however, it is comparatively easy to use the receiver without ganging, since the two dials do not have to be kept exactly in step in order to hear stations over a small band of wavelengths. Thus, having selected one of the bands containing broadcast stations by means of the bandsetting condensers C3 and C6, initial searching is carried out on the detector bandspreading condenser C5, and when a station is heard it is brought up to maximum strength by tuning C2. The aerial is coupled through the .0001 mfd. semi-variable condenser C1.

The main snags that are likely to arise are instability and "pull." If a good deal of energy is fed back from the plate circuit of the screen-grid valve to its grid circuit, the valve will oscillate and the receiver cannot be tuned. Feedback insufficient to cause oscillation produces "pull," i.e. tuning the H.F. stage to the same wavelength as the detector stage upsets the tuning of the detector. These two evils are avoided by very careful screening between the two stages.

(*Continued on next page.*)

Layout

As a rule, it is not sufficient merely to enclose the coils in screening cans or place a vertical sheet of metal between the stages. The whole of each stage has to be built into a separate screening box. A suggested layout is given in Fig. 3. Individual boxes may be used, in which case they must be connected together and to earth by a wire as at A, or the sides and ends of the boxes can be built up on a common metal base, in which case A is not necessary. It is important in both cases to have separate walls at B; a side common to both boxes often leads to instability, since it may actually couple the two stages together. The boxes need not be very large; 7in. by 5in. is a usual size.

It will be noticed that in Fig. 2 the H.F. stage is coupled to the detector by an H.F. transformer. This is merely to suggest an alternative method to that shown in Fig. 1. Either coupling may be used whether the H.F. stage is tuned or not, and experimenting with different couplings is very interesting. If the choke coupling of Fig. 1 is preferred for a tuned stage, the same component values are suitable as were given for the untuned stage. Fig. 2 also shows throttle control of reaction, again simply as an interesting alternative, both throttle and Reinartz control being equally applicable. When choke coupling is used with a tuned amplifier, the condenser C2 and the coupling choke HFC1 of Fig. 1 are placed in the detector stage screening box, at right angles to the reaction choke HFC2 and as far from it as possible.

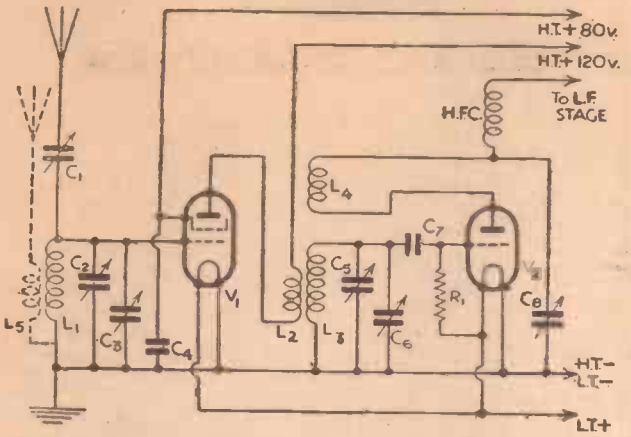


Fig. 2.—This circuit shows a tuned H.F. stage with transformer coupling to the detector valve, and throttle control of reaction.

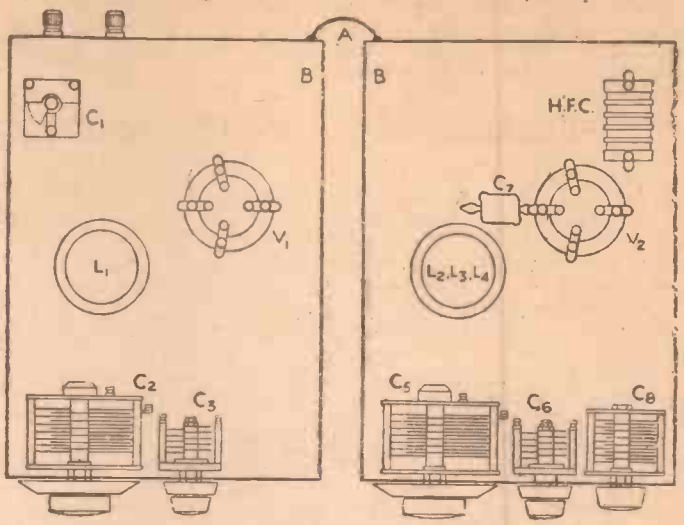


Fig. 3.—A suggested layout capable of providing efficient screening.

Tuning Coils

Suitable plug-in coils for the H.F. transformer coupling are sold by various makers. Should the constructor wish to make them himself the following data will be useful. The secondary L3 is wound with 22 enamelled wire, the primary L2 and reaction coil L4 being wound with 32 to 36 s.w.g. d.s.c. wire. The formers are 1½in. diameter ribbed ebonite tubes, unless ready-made ones of special low-loss material are used; these are preferable, since they are already fitted with a six-pin base, which is necessary to accommodate three windings. The approximate number of turns is:

Approximate wavelength range	L2	L3	L4
17 to 33.5 m. ..	5	5	3
33.5 to 70 m. ..	9	11	8
70 to 135 m. ..	20	30	15

The primaries L2 may either be wound about ¼in. from the bottom (earthed) end of the secondaries L3 or else inter-wound with the bottom turns of these windings. The reaction coils are below the primaries.

The H.F. stage grid coil L1 is wound exactly the same as L3. The alternative method of coupling the aerial by means of a coil instead of the condenser C1 is shown in Fig. 2 by the dotted coil L5; if this method is adopted L5 should have the same number of turns as the primary of the H.F. transformer L2, except for the largest coil, when twelve turns will be sufficient, or standard four-pin coils may be used. These are obtainable for all wavelength ranges from Stratton and Co. (Eddystone).

The British Long-Distance Listeners' Club

National Effort

ON another page in this issue will be found an article dealing with the modernisation of old receivers, and the subject is one which offers a particularly good opportunity for all members of the B.L.D.L.C. to make a useful contribution to the national war effort. Many of our members must have by them one or perhaps more receivers which have been replaced by more recent constructional efforts. We know that we all keep these old receivers and components by us, with the good intention of making use of them or their parts at some future date, but, strangely enough, that date never arrives. It is clear, however, after reading the article in question, that it is now up to all of us to get those receivers on the bench and make them capable of receiving the Home Service and Forces programmes. Apart from their use as stand-by receivers, quite a number of the units of our Home Defence Services are in need of a receiver to help them while away their hours of freedom.

Super One-valvers

We are still waiting to hear from those members who have been carrying out successful experiments in hotting up the humble one-valve receivers about which we have heard so much lately. From the reports received one cannot doubt the ability of these little sets to pull in the long-distance transmissions when used under average conditions. We have received quite a number of requests from the less fortunate members who have not yet had the opportunity of handling one of these receivers for more complete details; therefore, it is up to those who have one of these receivers in their station equipment to let us have such information as will give the essential constructional details accounting for the achievements they have obtained.

Correspondence

Member 6759, West Bridgford, Notts, a recently-enrolled member, makes the following comments: "My Rx for S.W. is a 1-v-2 T.R.F., the last stage being omitted when using headphones. With this arrangement, since the beginning of this year, I have received all continents except Australia and 27 countries (amateurs only).

"In this week's 'P.W.' (June 22nd) Member 6753 asks if anyone heard OK3ZN during April. I heard him on April 2nd on 'phone, and also during March on C.W. As he was only calling CQ when I heard him I have nothing of interest to offer except the mere report of reception. I also heard OK3DK in March on C.W.

The ban on sending for QSL cards makes the B.L.D.L.C. more desirable than before, in providing interest for long-distance reception. Incidentally, I have never sent for a card, because I listen for my own satisfaction."

Contacts Wanted

Solihull: Member 5959, 367, Warwick Road, Solihull, Birmingham, wishes to get in touch with other members about 16 years old interested in 10-metre work.

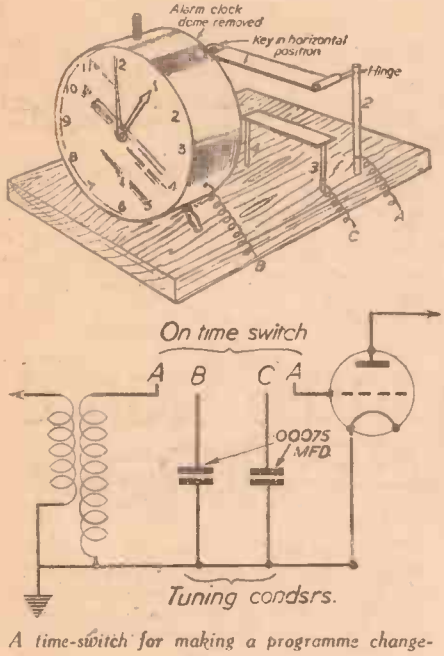
Hull: Member 6732, 18, Rowley Grove, Cottingham Road, Hull, Yorkshire, is particularly desirous of hearing from other members interested in general short-wave work.

Practical Hints

Time Change-over Switch

HAVING seen, of late, many hints about time-switches in PRACTICAL WIRELESS, I am submitting here a very simple multi-purpose time-switch which I have been using for some while.

It consists mainly of an alarum-clock (dome-removed) and a length of metal strip. Looking at diagram 1 strip 1 is



A time-switch for making a programme change-over.

connected, by means of a hinge, to support 2. Two uprights, 3 and 4, support between them the length of metal strip upon which strip 1 will fall when the key of the alarum-clock turns at the time for which it was set, so making contact between A and C and breaking between A and B. Strip 1 is balanced on the alarm key which is turned to a horizontal position as in diagram. I use this device in conjunction with diagram 2 to change from the B.E.F. to the Home Service in order to hear the news.—D. FINN (Glos).

Indoor Aerials

WHEN experimenting with indoor aerial arrangements I have found ordinary elastic brace ends most useful for keeping the aerial wire taut, and keeping the wire clear from the walls of the room. As also the brace ends are quite good insulators they are ideal for the purpose. In the case of a single wire across a large room, the wire should be cut just short of full length so that the brace ends need stretching to loop over the hooks in the picture moulding.

In the case of the aerial extending round the four walls of the room, the wire may be threaded through the brace eyelets, being merely fixed at the down lead stretcher. It may be found preferable however to extend the wire round three sides only of the room. In this instance a cord (picture) can be used to link up the three sides as shown.—R. L. GRAPER (Chelmsford, Essex).

THAT DODGE OF YOURS!

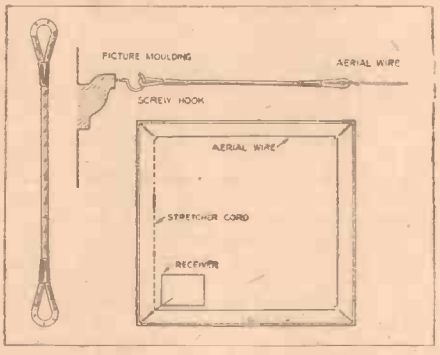
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

Soldering Iron Improvement

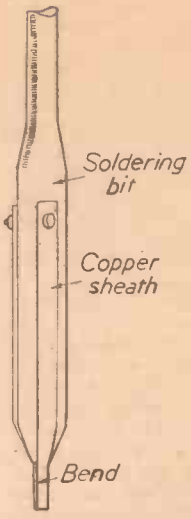
IT is often found when making soldered connections in a wireless set, that the ordinary soldering bit is too broad for delicate work in inaccessable places. The



Elastic brace-ends for indoor aerial supports.

following simple dodge will overcome this difficulty.

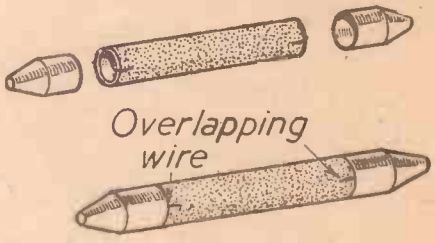
Obtain a piece of copper tube about half the width of the soldering bit and roughly double the length, beat it flat with a hammer, bend it in the centre and hammer it again until flat. Open out the ends with a screwdriver, fit this copper sheath over the soldering bit (which should be quite clean), leaving about ¾in. protruding beyond the end of the bit; bore a small hole through the copper sheath and the bit, and fasten together with a nut and bolt. Shape the end of the flattened tube left protruding beyond the bit to the most convenient shape, heat and tin in the normal way. This sheath can be removed when the ordinary bit is required, and various shaped sheaths can be made for different jobs.—R. V. HARDY (Porchester).



Mr. Hardy's suggestion for modifying a soldering iron for small work.

Simple Fuses

RECENTLY, when I was rewiring a power pack, I found that I had omitted the fuses. The best type to use for that purpose was the tubular type, because



A replaceable fuse hint.

of their compact size. Being a Sunday I could not buy any, so looking in the junk box I picked out a couple of old type grid leaks with holders. I dismantled the leaks by taking off the two metal caps. Inside the tube was a carbon resistance which I took out and replaced with fuse wire overlapping slightly, so that when the caps were replaced they secured the fuse wire. I have since used this type for many different purposes.—K. ARCHER (North Harrow).

PLEASE NOTE!

Will readers please adhere to our request that all Notions sent in *must be original*. Apart from the dishonesty of copying out an idea from another magazine or even from an early issue of this paper, considerable time has to be spent in comparing not only the sketches but also the text. It should be remembered that awards are only made for wrinkles which are *original* ideas.

Temporary Connections

DURING experimental and testing work, it is often necessary to try another condenser or resistance in some part of the circuit. It is not always possible to make quick good connections, and so I now make use of two leads, fitted at one end with crocodile clips, and with the other ends soldered to two telephone terminals mounted on a small strip of ebonite. The terminals allow either a condenser or resistance (or both) to be wired into the circuit easily while the clips ensure firm and safe connections in the receiver.—G. BUNGBY (Dundee).

Recommission Those Old Receivers

Now is the Time to Recondition and Bring Back Into Active Service those Sets which have been Idle for So Long

THE majority of amateur radio enthusiasts have already had practical proof of the demand for receivers capable of, say, receiving the Home and Service broadcasts. The demand has been created by the strong desire to have a "stand-by" receiver for emergency work, the inclusion of radio in the A.R.P. shelter and, finally, by the many appeals received from those Units of the Forces to whom even a simple receiver will often make all the difference between complete isolation and boredom and being in touch with the rest of the world through the medium of the broadcast news and programmes.

In such times as these, it is not possible for everyone to think in terms of purchasing a new receiver, especially if it is for gift purposes or to form a "stand-by" emergency installation. The obvious alternative is to make use of one's constructional abilities (and it is worthy of recording here that the amateurs have risen nobly to the occasion and have been the means of satisfying many an appeal) either to construct a complete receiver or modify some existing model to suit the new conditions.

Judging by the greatly increased demands for blueprints of simple two and three-valve receivers, chiefly of the battery-operated type, it would seem that quite a number of our readers are adopting the construct-a-new-set idea rather than convert something which has been on the shelf for a year or two.

Modernising Old Sets

There must be some thousands of sets of the pre-superhet-all-wave age stowed away in odd corners of constructors' shacks or dens. Sets which have been forced into the background not necessarily because of their inability to work or give reasonable performance, but because their owners have progressed with the times and have built, possibly each season, the "last word" in modern specifications. The time is now ripe for those veterans to be taken down off the shelves and put once again into commission, as it will be found in the majority of cases that very little time or money will have to be spent to enable them to give most satisfactory results under the existing broadcasting conditions.

Cabinets

It is highly probable that the first thing which will discourage the constructor from modifying one of the old timers is the design or state of its cabinet work. While appreciating that this does most certainly date a receiver, one must not overlook the fact that the cabinet is, after all, a very minor consideration for the type of receivers mentioned in the opening paragraphs. One point in the favour of some of the early cabinet work is that it is well constructed, solid and, therefore, well suited for use under conditions where the handling might not be of the most gentle kind. If the original wood-work is a shade too bulky or heavy, it is not a difficult matter to knock up a very presentable clean-looking case out of five-ply or, on the other hand, visit some of our advertisers who deal in surplus radio material and secure a suitable modern cabinet for a matter of a few shillings.

Coils

Quite a number of receivers were placed on the reserved list when the Lucerne Wavelength plan came into force in 1934, when worth-while stations started transmitting on wavelengths below those covered by the coils then in use. For example, such coils usually covered a wave-band of 250 metres to 550 metres approximately and would not, therefore, tune down to some of the transmissions which were allotted wavelengths below 250 metres. Apart from this defect, the coils were quite satisfactory, even if they were not quite so selective as their modern counterparts.

With the present British broadcasting system, the lowest wavelength with which the listener is concerned on the medium waveband, is now 296 metres; therefore, the tuning snag mentioned above no longer applies. This fact eliminates the necessity of removing and replacing coils, assuming, of course, that those in the set are still serviceable, from the point of view of insulation, etc. It will, no doubt, be found advantageous to short-circuit permanently any long-wave section which might be provided. This will dispense with unwanted switching and remove possible causes of trouble which could be introduced by old switches having corroded contacts or weakened springs.

Valves

All problems relating to valves will be governed by the age of the set and the actual condition of the valves. If they are of the 4-volt or 6-volt types, then it would be advisable to replace them with modern products of the 2-volt class and examine the receiver for any of the L.T. rheostats, which used to be so widely employed, and remove them from the circuit. If the receiver embodies a stage of S.G. H.F. amplification and a replacement valve is called for, one has the alternative of cutting out the stage altogether or using a modern S.G. *straight* valve similar to the Cossor 215 S.G. which has a four-pin base.

Circuit Modifications

Because the set is of old design, it does not necessarily follow that the circuit must be altered to suit the new conditions under which it will be operating. However, there will be no harm done by giving it sufficient attention to allow a test to be made, and then judge from actual reception whether it is worth while putting in some work more along the following lines.

If two L.F. transformers are incorporated in the circuit, and the output valve appears to overload, which is quite a possibility bearing in mind the increase in output of the transmitters since the early days, then it would be advisable to replace one or both of the L.F. transformers by simple resistance-capacity coupling. Most of the parts for this modification will be found in the "spares box." Particular attention should be paid to the output valve. If it should be of the early pentode type, having its auxiliary grid brought out to a terminal on the side of its base, it would be good policy to replace it with one of the standard five-pin type and fit the appropriate valve-holder. The anode circuit should be examined to see if any form of tone control or pentode corrector is provided. Many early circuits did not include a 10,000 ohm resistance in series with, say, a .01 mfd. fixed condenser across the loudspeaker terminals to eliminate surges and the high-pitched tone so often associated with pentode valves.

All unwanted components should be removed and the panel controls made as few as possible. All wiring and connections demand a systematic examination, as it is very probable that some of the contacts will be corroded, wires may be fractured and the insulation perished.

Should it be found that the selectivity is on the low side, a marked improvement will be obtained, without making any alterations to the layout of the set, by introducing a variable condenser having a value of .0002 mfd., between the actual aerial and the aerial terminal on the set.

Audible Radio Frequencies

More Discussions on Rectification Problems

By D'ARCY FORD

IN the article "Is Full-wave Detection Impossible?" a description was given of the general principles of detection of radio frequencies.

Detection is, of course, a fundamental necessity in all wireless receiving apparatus where reproduction of the received signals is required. Whether we hear a true reproduction of the original sound waves depends on many things. Electrical reproduction of gramophone records can be made to give a really faithful reproduction of the original, which we hear as sound waves from the loudspeaker. They do not require detection, because they already *are* audio-frequency currents, and as such can be heard and reproduced. A detector to them is an unnecessary evil.

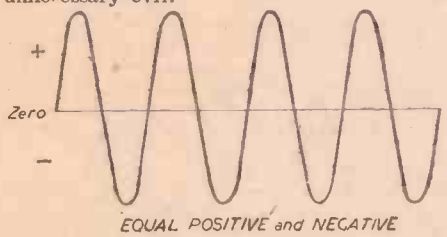


Fig. 1.—Curve of a radio-frequency wave representing an unmodulated signal.

In the generally accepted view, the audio-frequency modulations of the received signals are separated from the radio-frequency wave at the detector; whilst the wanted audio frequencies are passed on to the L.F. portion of the set; and the unwanted radio frequencies are by-passed to earth by means of condensers and via the reaction coil, if any. In addition to this, one or more H.F. chokes or H.F. stoppers are sometimes placed in convenient positions in the L.F. portion of the receiving apparatus to "make assurance doubly sure" that no stray radio frequencies can possibly pass through the final output stage. That, undoubtedly, has its advantages in many sets, as it is an aid to stability. In such sets the *unmodulated* carrier during an interval in the programme may be prevented entirely from passing through the final output stage.

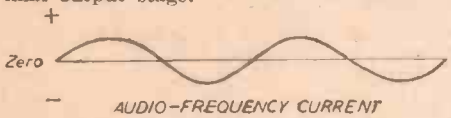


Fig. 4.—Curve of the A.F. current.

The Unmodulated Carrier

In the new theory it is not agreed that the audio frequencies are separated from the radio frequencies at the detector. What passes through the final output stage is a composite radio-frequency wave *varying or rising and falling at audio frequency.*

It is necessary to consider the unmodulated carrier first, as this forms the basis not only of the radiated signals, but of the reproduced signals. The received signal when unmodulated is in the form of a radio-frequency wave of equal positive and negative amplitude. See Fig. 1.

After detection the base or zero voltage line (or the "point" of zero voltage) will be found in considerably varied positions between the maximum negative value and the maximum positive, depending on the method of detection in use. A method of detection which has an output so "top heavy" that its negative voltage is 50 per cent. of its positive is shown in Fig. 2, which is unmodulated and is, of course, not audible.

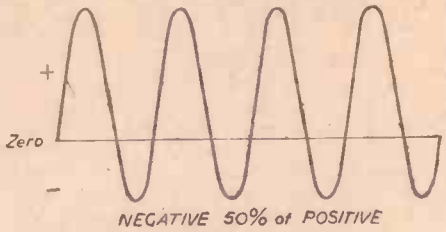


Fig. 2.—This curve represents a signal which has a negative voltage 50% of the positive.

The unmodulated output from another method of detection which is not quite so "top heavy" as Fig. 2 is shown in Fig. 3. The negative amplitude in this instance is 75 per cent. of the positive, and if it were modulated it would not give such a powerful output from the loudspeaker as Fig. 2 would.

Let us go back to the starting point in the transmitting, receiving and reproducing chain. Sounds in the transmitter studio are allowed to modulate the transmitter, and the modulated radio-frequency wave is radiated through space from the transmitting aerial to the receiving aerial. The signal is tuned in at the receiving aerial-and-earth system, and is reproduced in the receiver.

Two Components Only

In the generally accepted view it is considered that there are three current components in a wireless receiver—the radio-frequency currents in the H.F. stage, the D.C. current in all stages and the audio-frequency currents in the L.F. stages which operate the 'phones or the loudspeaker. Actually (but this is explained in the new theory only, and is not generally accepted) there are only two components—the D.C. current from the H.T. battery or other source, and the composite radio-frequency current. This, however, needs a little explanation. The output from the detector consists of a wave, current or voltage which has been made "top heavy" by a greater positive than negative value, and, of course, all sections of a receiver are voltage operated. The rather remarkable thing about this is that when a radio-frequency signal has been made "top heavy" by the detector, it generally assumes the characteristics or some of the characteristics of ordinary audio frequencies, and passes through the low-frequency portion of the set as if it were quite natural so to do. It is, therefore, a radio-frequency signal with audio-frequency characteristics, and it behaves in many respects as audio frequencies behave. It is still a radio-frequency signal, although of *unequal* positive and negative values.

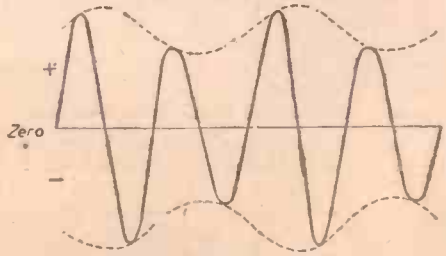


Fig. 5.—The curve of a modulated R.F. signal.

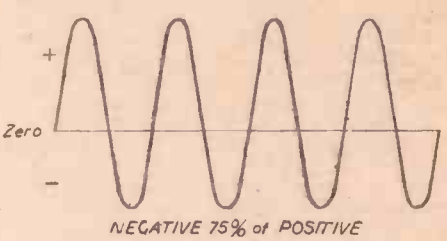


Fig. 3.—In this curve the negative voltage is 75% of the positive.

Fig. 4 represents an audio-frequency current or voltage which may be at any frequency within the audible range. If allowed to pass through the low-frequency stages of a wireless receiver it would be reproduced by the loudspeaker. Detection is not necessary and would distort the note.

Fig. 5. represents a modulated radio-frequency current or voltage in agreement with the accepted view of modulation. The signal is in the form of a modulated radio-frequency wave oscillating at the frequency of the transmitter, but varying in amplitude at the frequency of the audio note represented. Owing to the fact that this radio-frequency current is oscillating at radio frequency, the loudspeaker cannot respond either to the carrier wave or its variations, and it is therefore necessary to be passed through the detector stage.

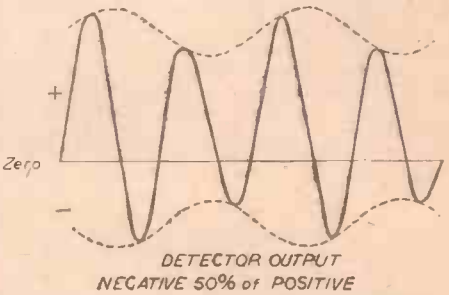


Fig. 6.—Rectified signal curve having a component as shown in Fig. 2.

Fig. 6 represents the detector output of the same modulated wave, which rises

and falls at the same modulation frequency, but according to the method of detection used, the zero line will have been displaced so that the negative amplitude is 50 per cent. of the positive. See also Fig. 2. When this passes through the loudspeaker the diaphragm cannot respond to the radio-frequency current representing the carrier wave, but because the current is "top heavy" and varying at audio-frequency, the rise and fall of the current at audio frequency causes a motion of the diaphragm of the loudspeaker, and the modulated note is reproduced. The writer is open to correction, but it seems clear that the loudspeaker diaphragm is vibrated by forces which are unequal.

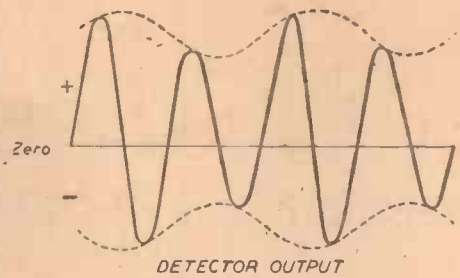


Fig. 7.—Curve of the detector output with a 75% negative voltage.

Fig. 7 represents the detector output of the same modulated wave, but by a different method of detection which has a positive/negative ratio in which the negative amplitude is 75 per cent. of the positive. See also Fig. 3. The volume of output from the loudspeaker from Fig. 7 would not be as large as that from Fig. 6.

The output which passes through the loudspeaker would probably not be exactly the same as the detector output, owing to the smoothing effect and sometimes the distortion caused in the low-frequency stage.

Is Reaction Essential?

An Interesting Discussion on the Possibility of Dispensing with the Reaction Circuit

MODERN receivers still employ reaction, although many "quality" receivers do without this control. Ever since the ganged condenser came into more or less general use in 1929 the same old story has been heard every year about sets having less knobs; leaving out such things as switches, which are inevitable and anyway are not really controls, and the idea of making one knob do the work of two by turning as well as pushing and pulling which does not simplify control, we are forced to the conclusion that the modern straight set has three knobs, and the modern superhet has two knobs as bare essentials.

The superhet can be dismissed as, obviously, it must have two controls, one to select stations and the other to control volume. In the average three-valve set there is some means of selecting stations and, in addition, volume control and reaction; now, if the volume control were dispensed with the selectivity would necessarily be bad on loud stations, as reaction could not be advanced without shouting the house down, while really loud stations would be unbearable with reaction at zero. Since it is scarcely practicable to put automatic volume control on a three-valve set, or to prescribe a volume level to suit all tastes and all types of programmes, it is quite definite that the volume control is indispensable.

Sufficient reasons have been given why the volume control cannot be dispensed with, and one alternative is left, viz., to abolish reaction. Reaction is far more complicated than is generally supposed, its influence is wide and far reaching, and without it there are many obstacles to be overcome.

Dynamic Resistance

The influence of reaction starts in the screen-grid stage, as the actual amplification developed is controlled by the dynamic resistance of the anode coupling. Dynamic resistance is simply the coil resistance offered to the particular frequency to which the coil is tuned. By careful design and the use of suitable iron in the core the dynamic resistance of a coil can be high, say, 500,000 ohms, to choose a round figure. The grid leak of the detector valve is effectively in parallel with the anode coupling, and assuming that the grid leak is 1 megohm, then the figure of 500,000 becomes 333,000 (neglecting odd figures). This is not the end, as the grid damping of a power-grid detector is very considerable, and an average figure would be equal to a parallel resistance across the coil of 50,000 ohms, lowering the effective anode impedance of the S.G. valve to only 45,000 ohms (approx.). Unless the detector is a screen-grid valve there will also be anode damping, but it is scarcely necessary to go into this as it may be avoided by using such a valve.

Next let us see what the fall from 500,000 ohms to 45,000 ohms has done to the amplification of the screen-grid valve having, say, an amplification factor of 1,000 and an impedance of 500,000 ohms under working conditions. The fall in amplification will be from 500 times to 55 times, which is very serious, while in addition the selectivity curve of the coil will have suffered even more. Now, reaction when applied will remove all this damping without being pushed, so that the amplification of 500 can be realised quite easily.

Eliminating Damping

By pushing reaction a little beyond that point where the damping above referred to is exactly cancelled out, it is possible to remove nearly all the damping in the coil itself due to various losses, so that an amplification approaching 1,000 times is obtainable.

Even so, when the reaction reaches the point where all damping is cancelled out oscillation begins. It is interesting to note the places where damping exists to a greater or lesser extent. In the coil, insulation of tuning condenser, insulation of anode connector (if screened), grid leak, detector valve damping, detector valve base, detector valveholder; quite a formidable list!

We can now profitably reverse the line of inquiry and see what would have to be done to build a successful set without variable reaction. Starting with the coil, great care in design would be the basic essential, using Litz wire on glass, or even quartz, formers and a core of iron in dust formation finer than face powder. The screening-can would be a real problem, as if placed close to the coil it would cause too much damping. There would be two possibilities; to use screening boxes about 12in. square (somewhat impracticable?), or to use a toroidal coil (a cylindrical inductance bent back on itself in the shape of a ring). Although the original Voigt iron-cored coil was of this formation, British manufacturers have fought shy of it, possibly due to patent difficulties or the difficulty of manufacture.

The next item would be a nearly perfect tuning condenser with a minimum of very carefully chosen insulating material.

Obstacles to be Overcome

Having paid due attention to details, such as screened leads and chokes, preferably by eliminating them altogether, we come to the grid leak. Obviously this cannot be tolerated, so recourse must be made to anode-bend detection which, in turn, necessitates that the anode "coil" be a transformer so that the grid leak can be left out. H.F. iron-cored transformers are expensive, and the switching is both complicated and likely to give more trouble than the simple type used with anode or tuned-grid coupling.

It has been decided that anode-bend detection is necessary, which in turn brings a train of problems. It is questionable whether it gives good quality on very small or comparatively large inputs, and is likely to cause accentuated fading. By the discreet use of an H.F. pentode this trouble will not be serious.

The obstacles presented are considerable, but even if all those outlined above could be dealt with, the net result would be a set as good as one using reaction only to a limited extent. The great selectivity that results from pushing reaction close to oscillation would be lost; in fact, the user would be rather helpless. In a nutshell, it can be said that a set without reaction will not equal a set equipped with reaction, and that the difficulties are so heavy that it is unlikely that it will be seriously attempted, particularly as the selectivity problem is getting more and more acute. Finally, it is only those backed by a first-class laboratory who could attempt the problem on any but a local station receiver.

Comment, Chat and Criticism

Outline of Musical History—8

The Romantic Movement is Dealt With in This Article by Our Music Critic, MAURICE REEVE

JUST as Bach was the greatest of contrapuntists, so was Beethoven the greatest of classicists and symphonists. Just as the one marked the beginning of an age, so did the other terminate one. Beethoven had few successors, so completely did he occupy Mount Parnassus. It would seem that, after opening the discussion, he said all that was to be said on the subject, leaving his successors the unenviable task of having to accept his dictate, or go their own way. So powerful was his word and so gigantic his contribution, that only one man since has succeeded in working in the same mould with a result that could in any way be considered comparable. Johannes Brahms, 1833–1897, is the only really significant classicist to follow in the great Beethoven's footsteps.

Early Results

The romantic movement, which so powerfully affected every branch of art, would naturally be expected to find in music an exceptionally favourite field for self-expression. Beethoven was rather like Walter Scott, inasmuch as that, whilst both masters achieved almost their entire output in the first quarter of the century, their roots were rather of the preceding era. They were both mature men with their characters moulded, for better or worse, when the year 1800 dawned on mankind. But whilst they were approaching the Elysian fields after completing their great work, an amazing galaxy of geniuses, the true spirits of the new, romantic, nineteenth century, were either shortly coming into the world or were already playing about in it as tiny tots.

In scarcely one instance did any of them achieve success by following in the footsteps of the great tone poet whom they either found reigning or of whose passing they were to be told. All struck out on the new and exotic quest. In music it was truly remarkable how almost all the giants of the century were born within those few years that coincided with Beethoven's maturity. Mendelssohn, 1809; Berlioz, 1803; Schumann, 1810; Chopin, 1810; Wagner, 1813; Liszt, 1811; Glinka, 1803; Verdi, 1813; Heller, 1815; Henselt, 1814; Gounod, 1818; Offenbach, 1818; Franck, 1822; Bruckner, 1824; Smetana, 1824; Johann Strauss, 1825; as well as a host of lesser luminaries.

What is this romantic movement and how did it achieve such miracles as were to go to its credit in the immediate future?

Some Causes

Many were the causes that gave rise to it. Among them may be mentioned the unrest in the social and political world. The dissatisfaction that men found with almost everything around them. Everywhere they were seeking out new paths and new ways of doing things. Nowhere was a thing accepted merely for its venerable age or the thickness of the dust of respectability that lay upon it. It was to be an age of escape—escape from fetters and bondage, rules and regulations. Yes, and even from Beethoven himself—for a while. "Man is born free, yet everywhere he is in chains."

But like all reformers, they could not see that they were to forge new chains. Musicians, too, were born free, and they did not see why they should be tied to any chariot wheels, not even if the chariot came from Leipzig, Salzburg, or Bonn itself.

If music was to justify itself along with the other arts it had to strike out new paths for itself, and seek new means of self-expression. It would have to give voice to the spirit of the age. And the fact that the mighty works of Beethoven seemed to leave nothing more to be said in their own particular road must have helped considerably to divert the stream as a river is diverted when it comes against a great natural obstacle.

Use of Tones

The romantic movement marks the great rise and development of the art of portraying scenes and impressions through tones, comparable to the great impressionistic works in the other arts. The mere imitation of sounds such as of a cuckoo or a drum beat goes back a long way, and Couperin—already discussed—is famous for such immortal little masterpieces as "Les Barricades Mystérieuses" and "Le Carillon de Cythère."

But the nineteenth century romantic masters were to go very much farther. With them the mood, or the programme, came first. Such colossal large scale works as Berlioz' "Symphonie Fantastique" (episodes from an Artist's Life), Schumann's "Carnival," Liszt's "Faust" Symphony and "Dante" Sonata, and Mendelssohn's "Midsummer Night's Dream" music, to name but five supreme examples, portrayed emotions and scenes which had never before been attempted through the medium of tone poetry. In result they were to rival the works of Hugo, Tennyson and Turner.

In order to achieve this, new forms were invented and existing ones torn up by the roots. Beethoven's symphonic framework would not have permitted such freedom of self-expression as they indulged in.

Sometimes, as in the case of all Chopin's work, much of Schumann's and Liszt's exotic "sonata," it was the mood that governed the inspiration; they were the products of incurably romantic imaginations which placed self-expression first and logical and philosophical inquiry after. But as those and similar works have no "programme," and are written to a very definite form (structurally Liszt's sonata bears no relation to any of Beethoven's whatever, whereas Chopin's are "according to Cocker"), they come under the grouping as "absolute" music, but absolute romantic, not classical.

Why Romantic?

Although these masters are fully as "classical" as Bach or Beethoven, using that term in its meaning that anything is classical that is of a sufficiently high quality to give it immortality, it is by the character of their work that we style them "romantic." Very much as one cathedral may be "gothic" and another "renaissance," though both are "classic" examples of architecture. Schumann's piano concerto, and Mendelssohn's for the violin, are "classics" inasmuch as their perfections have been manifest for over a hundred years and will continue to be acknowledged for all time. In that sense they are classics just as much as are Beethoven's and Mozart's. But in spirit and conception they are essentially products of the great romantic upheaval which surged in men's minds throughout the century. Although written to the same pattern and owing allegiance at many points, they are as different in character and thought as two things well can be.

Perhaps it was that the "classicists" wrote with their heads and the "romantics" with their hearts, which, of course, does not mean that the one did not use the other, and vice versa. If the man who wrote the "Moonlight Sonata" and the slow movement from the "Archduke" Trio did not write with his heart, then I should like to know very much what he did use! But that distinction might be used, in a very liberal meaning, to explain the two schools.

All great writers pay meticulous care to construction and form, and the Schumann and Mendelssohn concertos are as perfect, here, as any in the repertory. But we frequently miss such things as fugue and counterpoint—of the Bachian brand—in romantic works. The development section of a first movement lacks the extraordinary inventiveness and the dramatic climaxes of Beethoven, whilst such a movement was the Passacaglia movement from Brahms' 4th, is not indulged in. The classical masters never let their hearts run away with them: their heads were always in complete command.

Miniatures

Many of the biggest triumphs of romantic music have been scored in the realm of the miniature and small piece, of which Schumann was such a master. His collections, "Album for the Young," "Scenes from Childhood," "Forest Scenes," "Butterflies," etc., are perfect representations of what they set out to portray. Everyone knows "Träumerei," and what could be more beautiful than that little picture of the child asleep, dreaming as only children know how?

As harmonic range and colour blending increased, and more daring minds came along, some marvellous things were done, and are being done, with musical portraiture, scene painting, and piquant suggestiveness. Would Ludwig have approved of "Bolero" or "Tintagel"? We know not! But if not, then neither would he have countenanced the Venusberg Music or the "Blue Danube."

To us, possessing all, music seems big enough for both schools to live in, in amity with each other, and to march together in, side by side.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Super One-valvers

SIR,—I have noted in your pages extensive logs and elaborate stations regarding the performance of one-valve receivers. I have been experimenting in radio now for a considerable time and have not yet succeeded in building a one-valver which can give anything like the results which some listeners claim to get. What is the secret of their success? I know you have told us to handle the set properly, etc., and I have done all this. It would be a good idea if one of these lucky readers would send in details of his set and operating data so that others could share in his enthusiasm. I should be glad, therefore, if you could insert a request to this effect in your correspondence pages, when I am sure that others like myself will only be too glad to try out the circuits or receivers described.—L. MAYNARD (Beaconsfield).

Station CR7BE (Lourenço Marques)

SIR,—I should like to report that station CR7BE (Lourenço Marques) has, owing to heavy QRM on the 31-metre band, abandoned transmissions on this wavelength, and is now testing on 30.88 metres. The station, the address of which is "The Radio Club of Mozambique, Caixa Postal 594, Lourenço Marques, Mozambique," requests reports, for which a verification card is issued. I quote the manager of CR7BE.—P. JACKSON (Ramsgate).

Gas-mask Box Receiver

SIR,—Perhaps the accompanying illustration will be of interest to other readers. It shows myself with the original Gas-mask Box Receiver in use up on the Shirley Hills, near Croydon.

Signal strength was quite good, using the aerial suggested, but was improved with the addition of a few feet of wire lying on the ground.

Would you kindly let readers know how they stand with these receivers under the new regulations?—S. E. JANES (Croydon).

Mr. Janes listening to a broadcast through his Gas-mask Box Two.

The Short-wave Den

SIR,—Having seen many photographs of other readers' dens in PRACTICAL WIRELESS, I enclose one of mine. The receiver is an o-v-2 built on the lines of "The Prefect Short-wave Three."

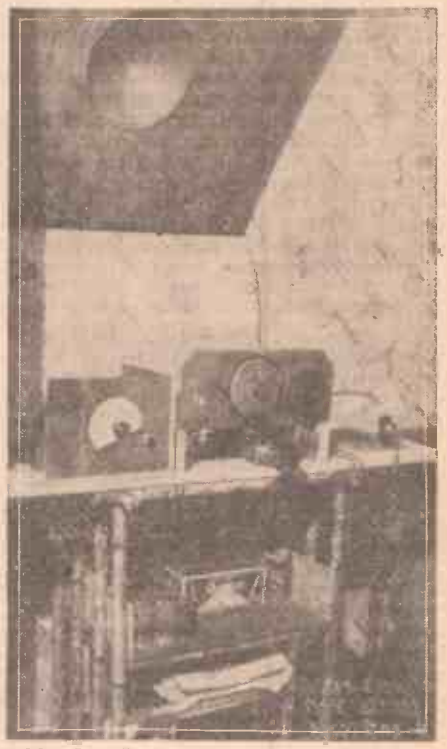
In front of this can be seen an experimental H.F. unit which definitely improves both sensitivity and selectivity. Since becoming interested in short-wave radio, at the end of last year, stations have been received from all parts of the world, quite a few coming in on the speaker.—F. G. STROUD (Surrey).

H.T. Battery Problems

SIR,—I wonder if any readers have attacked the problem of providing cheap and simple battery replacements. Some time ago it was possible to buy small jars and accessories to build up an H.T. battery which only needed sal-ammoniac for recharging. These do not now seem obtainable, and I have tried one or two dodges to recharge ordinary H.T. batteries but have been unsuccessful. I am having difficulty in getting ordinary batteries and apart from that increasing costs of living necessitate economies and I should like to effect one in the line of H.T. batteries. Perhaps other readers may have tackled the problem and would be prepared to pass on the results of their efforts.—S. PEACH (Penzance).

Microphone Construction

SIR,—Whilst I have seen very satisfactory articles in PRACTICAL WIRELESS, describing the operation and construction of transverse-current microphones, I have not yet had the pleasure of reading any descriptive matter relating to the construction of simple but efficient moving-coil types. As I am keenly interested in this particular section of radio work, I am wondering if you could let us have an article in the near future showing, for example, how one could convert a very powerful horseshoe magnet into a compact moving-coil microphone. I have carried out several experiments but, so far, I have not met with much success. Perhaps some of your readers have had better luck.—S. SEXSTONE (Bournemouth).



Mr. Stroud's short-wave receiver. Note the effective speaker mounting.

Aerial Overhaul

SIR,—I feel that thanks are due to PRACTICAL WIRELESS for the reminder about the necessity of overhauling one's equipment during the summer months. Perhaps I am not so energetic as all readers, as I must admit that I had been content to leave my aerial system alone for some time, but on reading the recent article I began to wonder if all was as well as it should be.

On examining the wooden mast, I had the shock of my life. The foot of the pole was rotten; just an outer shell left, whilst higher up, where the main vertical support is fastened, I found the metalwork in such a state that a really strong wind would have brought it crashing down with disastrous results.

Needless to say, I have now rectified matters and made a resolution to be more thoughtful in the future. Again many thanks.—L. PARKINGTON (Bromwich).

Prize Problems

PROBLEM No. 408

MARSHALL built a battery quality amplifier for gramophone reproduction. He connected his pick-up and found that results were very good although quality was not up to the standard he aimed at. After one or two circuit modifications, he decided that perhaps his pick-up was responsible for the quality and therefore purchased a piezo-crystal type of instrument. He plugged this in but could obtain only the very weakest of signals. He found, however, that his original pick-up still worked in the circuit and he therefore returned the new pick-up as faulty. It was returned, marked in good condition. Where had Marshall gone wrong? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2, and entrants should express their choice of a book selected from the list published on page 358. Envelopes must be marked Problem No. 408 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, July 15th, 1940.

Solution to Problem No. 407.

The components which Jelves found in his spares box were of the older inductive type, and accordingly failed in their function to act as efficient decoupling components. These must be non-inductive to act effectively. There were only two successful entrants for Problem No. 406 and books have accordingly been forwarded to:

J. D. Morrice, 55, Jasmine Terrace, Aberdeen.
R. Haigh, New House, Oundle, Northants.

Commercial Set Efficiency

Efficiency and Reliability of the Commercial and the Home-made Set Compared

EVERYONE who has been intimately connected with radio receivers, both of the home-built and factory-made types, since the very beginning of broadcasting, is ready to admit, and even to wonder at, the very high standard of efficiency which has been attained by the commercially built article. This high standard, which shows itself in range, selectivity and output, almost amazing in their degree, is often put forward as an argument to belittle the value of home construction as applied to radio receivers.

While not for one moment admitting that anything which can be produced in a modern mass-assembly factory cannot be reproduced, and even excelled, by the knowledgeable amateur who possesses in addition good craftsmanship and a reasonable outfit of tools and instruments, it is probably true that a large proportion of home constructors, by reason of lack of experience and limited equipment, must inevitably content themselves with a somewhat lower standard of initial efficiency than that observed in many commercial receivers.

Please note the stress placed upon the word "initial" in the last paragraph. Signs are not wanting that, at any rate so far as some set manufacturers are concerned, the high efficiency achieved by the sets on the test bench and experienced by the ultimate purchaser when the instrument is first installed in his home, is due to a careful "hotting up" of each receiver during the final stages of manufacture and adjustment, and there is no assurance that this high efficiency is likely to be maintained over a lengthy period of service.

Individual Testing of Components

That each individual component should be separately tested and, if need be, especially designed for the receiver of which it is to form a part is good and perfectly legitimate practice; and that each completed set should be lined up and adjusted to maximum efficiency before dispatch is also reasonable. But it appears to be the practice of many set manufacturers to adjust their sets with the particular valves which will be sold with them, and, in cases where two valves of the same type are employed in one receiver, to mark each of these two valves with the number of the valve-holder in which it is to be placed. Thus, in a set employing a vari-mu H.F. pentode as radio-frequency amplifier and another as intermediate-frequency amplifier, or in a set having two identical intermediate frequency valves, one will be marked No. 1 and the other No. 2.

A set adjusted to maximum efficiency with these valves in their correct positions may give sensitivity, selectivity and overall performance of a very high order. But what will happen in a few months time, or in a year's time, when it is found necessary to replace the original valves? Will new valves taken at random from the stock of the local radio shop give the same performance as the selected valves with which the set was originally adjusted?

Now consider the position of the amateur constructor. Whether he produces a set of his own design, or whether he follows one of the designs published by PRACTICAL WIRELESS, he will be dealing with major components, and also valves and other renewable units obtained from stock in the ordinary way. It is well known that what are called "manufacturing tolerances," that is to say, the limits of accuracy either in dimensions or characteristics which products must not exceed if they are to pass the standard factory, are, in some cases, fairly wide. But experience has shown that in no case will a reputable manufacturer allow tolerances so wide that reasonable efficiency is imperilled. Moreover, the law of averages will usually see to it that errors on the low side in certain components are more or less balanced out by errors on the high side in others, with the result that the home constructor can rely upon a pretty high standard of overall efficiency in the set he builds. That efficiency will not materially alter if and when, for any reason, he finds it necessary to make replacements.

"Practical Wireless" Sets

It is, of course, on this basis that the PRACTICAL WIRELESS sets are designed and published, and that the above arguments are substantiated is proved by the fact that performance guarantees can be given for these designs.

Coil Conversion

"I am making up a small set for the reception of the two B.B.C. stations and I have dug up an old dual-range coil from my spares box. There is just one point which I am not quite certain about and that is the restriction of the coil to one waveband. Is it quite in order to short-circuit the long-wave section? I ask this as the coil is interwound, having primary and reaction windings between the long-wave and medium-wave sections. Will these be affected by shorting the long-wave section?"—A. S. T. (Croydon).

IF you remember that when the coil is used in the normal manner the long-wave loading-coil is short-circuited, you will see that it will be quite in order to do this in order to use the coil on medium waves only. The section must, however, be earthed, not merely short-circuited and left "in the air." The reason for this is that the lower end of the long-wave section is generally joined to the earth terminal and thus the medium-wave section will not be earthed and the circuit will be incomplete unless you make certain that the short-circuit also completes the earth connection. If, of course, the primary also was switched, this must also be short-circuited in the same way as the grid coil.

Loudspeaker Tone

"I recently tried to modernise an old loudspeaker of the moving-coil type. After trying one or two different cones I found it impossible to cut out a 'comb and paper' effect. I wonder if you can tell me how to get rid of this objectionable feature in the speaker. Modern speakers sound so deep and round in tone that I should like to try and get a similar effect on this model."—L. E. R. (Harrogate).

IN the majority of cases the effect you mention is due to the use of a paper or material which is too thin. It may, of course, also be obtained with a material which is split in its thickness. However, we think in your case that you have used too thin paper. In modern commercial speakers the majority of cones are made from a moulded or a cloth-like material which is doped or otherwise treated. You could try the same effect by using a thin linen and starching it, or painting it with shellac, but a good quality Bristol board, say 4 sheet, should give a clean, non-coloured tone which would suit the majority of receivers having good quality reproduction.

Small Fixed Condensers

"I have noted on several occasions the use of artificial condensers made up either with twisted leads or with leads laid side by side. Is there any particular advantage in this type of condenser, or is it merely done for cheapness or simplicity of construction? If there are any details which could be passed on, I should be glad to have them as I am often experimenting with different receivers and need small condensers."—T. W. (Finchley).

THE type of condenser referred to was very common in receivers of the neutralised type, and to-day it is often employed as a series-aerial device. There is nothing outstanding in the idea, the capacity merely being formed by the two wires or leads with the air-spacing as the dielectric. It is impossible to give any formulæ in view of the variation in the thickness of the leads and in the spacing which may be adopted. You can use ordinary lighting flex, twisted to form the condenser; thick copper wire run through insulated sleeving; or even thin glass tubing of the chemical-laboratory type with the wires inside them. Capacities are best ascertained on test.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

Reaction Control

"I recently had a small midget receiver given to me for inspection and there is a small point in it which makes me think a bit and that is the reaction control. So far as I can trace there appears to be a resistance of the variable type straight across the reaction coil. The arm of this resistance appears to be earthed through a small condenser. I cannot remember seeing anything like this before and wonder if I am right in my surmise or whether I have wrongly followed out the circuit. Are you familiar with the arrangement and what is its novelty or application?"—S. C. (Preston).

THE scheme is quite standard and if you trace out the arrangement you will see that when the arm of the resistance in question is brought down to the anode of the valve you have the ordinary anode-bypass condenser effect. When taken to the other end of the resistance you have the reaction coil taken to earth through the condenser and this acts just as a variable condenser in the usual arrangement. There is, however, also an arrangement whereby the variable resistance or potentiometer is used in conjunction with the screen of an S.G. or H.F. pentode valve and this acts in a similar manner. You do not state what type of valve you are using and therefore we cannot state which type of circuit the receiver employs.

Condenser Replacement

"I have a commercial set being serviced in which the large block condenser has gone. I have been trying to get a replacement, but am told it will be weeks before it can be done. I thought of replacing with separate condensers, but have been told that this should not be done. I do not see why not and should be glad if you would give me the O.K. on this procedure."—J. E. T. U. (Penarth).

IT would normally be quite in order to use separate condensers in place of standard block units. The only point to be watched is in the method of connection. For instance, some block units have all condensers connected to one common terminal on one side, this terminal being earthed (H.T.—) and all others are brought out to separate terminals. On the other hand, you may find that only two or three of the separate units are "commoned," whilst others may be separated for use—for instance, on some mains sections where a field winding may be on the negative side and a smoothing choke on the positive side. Therefore, you should first check the connections on the block unit and use your separate condensers with exactly the same connections, when everything should be in order. In the case of electrolytic condensers, of course, polarity must be attended to.

"All-dry" Valves

"I was interested in the recent article on all-dry valves, but I wonder if it is essential to use the special H.T. and L.T. combined batteries. I have a set of this type and thought of trying to use separate batteries. Would this be feasible?"—K. E. (Oswestry)

WHEN making a portable receiver fitted with all-dry battery valves it is sometimes found convenient to use an ordinary H.T. battery and to obtain the L.T. supply from a 1½-volt bell cell or from a single cell from a cycle battery. This arrangement is not ideal, but it sometimes permits of a more compact layout since the L.T. cell can be placed in an odd corner. The filaments of three of these valves take a good deal less current than an ordinary cycle bulb, so it will be seen that even a small cell will have a moderately good life when the set is not used for long continuous periods.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

C. M. Peach. You omitted to enclose coupon, stamped addressed envelope or your address.

H. F. (Westbourne). The circuit is incorrect in many details, therefore we are unable to pass any opinion. Perhaps you would care to submit a corrected circuit or give us more details of your actual ideas.

M. G. (Prestatyn). The component is no longer obtainable. You could use the arrangement suggested providing you make quite sure that the condensers employed are capable of operating at the voltages involved.

H. O. (Balham). No, we would not advise you to use the circuit. Perhaps you could improve the efficiency of the receiver by paying attention to the aerial and earth system and making quite sure that the valves are above suspicion.

L. D. (Leeds). The valve connections are incorrect. A volume control could be fitted across the transformer secondary.

P. H. (Boscombe). It would seem that the screen voltage is far too high. Try lower values and make sure that the H.F. choke is in order.

R. W. (Croydon). The circuit is quite satisfactory. We feel that Class A push-pull would be the better.

The coupon on page iii of cover must be attached to every query

Loudspeaker Repairs

Details and Data for the Rewinding of Loudspeaker Field Coils

ONE of the commonest queries we receive is for details of the gauge and turns of wire necessary to rewind the field coils of moving-coil loudspeakers. Some of these loudspeakers are of the six- and twelve-volt type, others of high-resistance types, it being required that they be rewound for use direct on D.C. mains or via a rectifier on A.C. mains, or require a different resistance value so that they can be used in place of the usual smoothing choke in an eliminator.

We give the method by which the turns and the gauge of wire can be found for all these changes, but it should be noted that in some of the earlier types of loudspeakers where the "pot" is very much larger than the present-day constructions, the original watts can be increased by two or three times, due to the fact that ample iron was invariably employed, but for reasons of economy, especially on those driven from accumulators, the current was kept low. As the class of iron varied considerably, as well as the size, and as it is not possible for the amateur to determine which class of iron was actually used, it is not intended to give details for working out the watts necessary for saturation, although some remarks made at the end of this article will be useful in this direction.

There are three figures which must be known before an attempt is made to rewind the coil. They are the resistance of the new coil, the window area or "window," and the length of an average turn of wire. The first is found by working out the watts of the original coil, which will be the product of the volts and current. Having found this figure it is then necessary to reconvert the watts into current using the new volts, and then finding the resistance. The whole of the foregoing can be worked out from the formula:

$$R = \frac{V^2}{v \times I}$$

where V is the new working voltage, v the original working voltage, and I the original current. If it is desired to increase the watts the resistance must be divided in ratio with the watts increase desired.

It should be noted that the present-day field coil usually has a dissipation of 7 to 10 watts, and this should not be increased, these field systems being designed to the maximum economical limits. If any doubt is felt, the manufacturer's advice should be sought. The second can be found by actual measurement of the length of the bobbin, and the depth of the winding taken from the rim of the end cheek to the core, and multiplying these two together, the answer being in square inches. The third, the length of an average turn is found from the formula D1 – D2 × 3.14, where D1 is the diameter of the core. Some allowance should be made when measuring D1 and D2, to allow for insulation and for covering the outside of the coil.

It is not possible in a simple formula to work out both wire size and turns, even knowing the above data, and it is best to "try" a gauge of wire and to make alterations if things do not work out quite right. This can be done in two ways. The first is to work on the wanted resistance and find out how much space a certain gauge of wire will occupy, and the other is to find out the nearest resistance that a certain wire will give by filling the available space. Both are just as good as one another, but the latter will be used in the following example, which explains how the best gauge of wire is found.

Simple Calculations

Taking a loudspeaker whose "window" has an area of 3.5 square inches, with an average-turn-length of 7.5 inches and a required resistance of 4,500 ohms. For the first calculations a wire is chosen which it is anticipated will be near the mark, so No. 30 S.W.G. enamelled wire is taken. Looking at the accompanying table it is seen that the minimum number of turns of this wire which will go into one square inch is roughly 5,500. As 3.5 square inches are available for winding it should be possible to get 19,250 turns on the coil. It should be noted that the turns per square inch column in the table is for carefully

Use this table for working out your loudspeaker windings.

Wire S.W.G. En.	Turns per sq. in.	Resistance per yard	Current
30	5,476	.119	.12
31	6,241	.227	.106
32	7,225	.262	.092
33	8,281	.305	.078
34	10,000	.361	.066
35	12,000	.433	.055
36	14,400	.529	.045
37	18,225	.661	.036
38	22,800	.849	.028
39	30,500	1.130	.021
40	34,000	1.327	.018

wound coils, not necessarily "turn by turn," but in a reasonable orderly manner. This figure is then multiplied by the average turn length and then reduced to yards, which in this case gives 4,010 yards. Referring to the table again for the resistance per yard, it is found that the total resistance would only be 477 ohms, which is very wide of the mark. Some considerable increase is required, so No. 36 S.W.G. is now tried. In this case the total turns would be 43,400, the total length of the wire 9,040 yards, and the resistance 4,682 ohms, which is quite near enough for practical purposes.

A column is also given in the table showing the rating for each particular gauge of wire, and this should be referred to finally to make sure that the wire chosen can be safely used without overheating. In the example above, the current according to Ohm's Law would be .055 amp. The rating is, however, conservative (1,000 amps per square inch) and, provided that there was ample room round the loudspeaker and a free flow of air, this gauge of wire could be safely used.

It would be possible by using the current rating column to arrive at the watts for an unknown "pot," but not for saturation current.

Radio in the A.R. Shelter

A Brief Discussion on the Methods of Providing Reception in the Shelter and of Arranging Extension Speakers. By THE EXPERIMENTERS

WE are often asked how best radio reception can be provided in the air-raid shelter, or in a cellar used for this purpose. It is not possible to give a general answer, however, since a good deal depends upon individual circumstances. If a room of the house is used as a shelter the position is generally straightforward, for an extension speaker can easily be "laid on." Alternatively—and in many respects this arrangement is better—the receiver can be placed in the refuge room and an extension speaker run to the drawing-room or any other room in the house.

The chief advantage of this arrangement is that the receiver can be used in the usual manner when refuge is taken. Thus, should one programme not be suitable for the mood of the moment, it would probably be possible to tune to the alternative programme. At other times, a single programme is generally all that is required, at least for some time at a stretch, and therefore there is no great difficulty in going to the refuge room to switch on and tune the set. It is, of course, possible to fit a remote control whether the receiver is in the living-room or in the shelter, so that operation could be carried out from the other point.

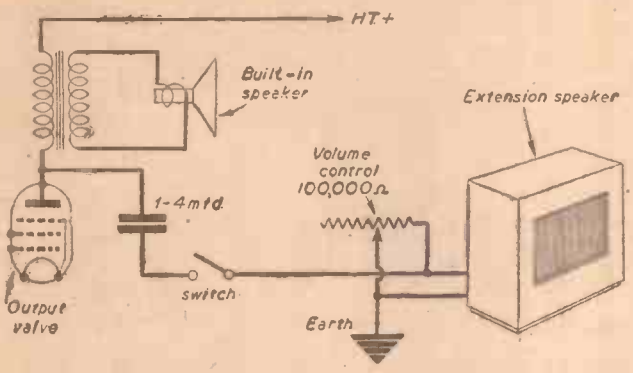


Fig. 1.—How to wire an extension speaker and fit a volume control.

Remote Switching

In any case it is important that means should be provided for switching on the set from the shelter, because it is unlikely that there will be time to run to another room for this purpose after the warning has been given. The method of remote switching will be referred to later. When two receivers are available it will generally be found more satisfactory to have that which is the more sensitive in the shelter. This is because there may be some local peculiarity or screening effect due to the shelter surround. To obtain satisfactory reception under these conditions it will thus be necessary to use a fairly sensitive set.

Portables

It may be argued that a portable receiver is most suitable for use in the shelter, and there is much to support this argument. Provided that the shelter is satisfactorily free from dampness the portable may be kept there, but batteries should not be stored in a damp place. When it is feared that battery deterioration might occur as a result of dampness, the portable can well be kept in a convenient place in the house so that it can easily be picked up when going to the shelter. No matter what arrangement is used it is a good plan to use the portable occasionally to make sure that the battery is well "up" and so that the accumulator is not overlooked. When the set is of the all-dry-battery type it is necessary only to make sure that the battery is in good condition and that the set is kept in a cool, dry place.

Screening

There is another point to be considered in connection with a portable set if it is hoped to use it in a steel shelter: the metal forms a very good screen and therefore the built-in frame aerial may be insufficient to ensure reception at sufficient volume. A few tests should be carried out in this respect before the shelter has to be used. For the receiver to be fully effective in the event of a raid, it should bring in the B.B.C. programme at good strength with the volume control no more than "half-on." A really effective volume control should, of course, be regarded as essential with any modern receiver.

If reception cannot be obtained in these circumstances it would be wise to provide an aerial, which can be placed outside the shelter. The lead-in can be taken through the entrance, taking care that it will not be in the way if the shelter has to be entered hurriedly during the night. This also applies when an ordinary receiver is to be used, but in that case it is often sufficient to make a connection from the metal of the shelter to the aerial terminal, leaving the earth terminal disconnected.

A number of people have a temporary lighting system in the shelter, operated from an accumulator. When that system is used it might well be convenient to fit a car-radio receiver in the shelter, feeding this from the lighting battery. It should be remembered, however, that the radio will increase the current drain to an appreciable extent, and therefore that the accumulator should be of fair capacity (a car-type battery is best), and should be kept in good condition by regular charging. It is very important that no attempt should be made to run electric mains leads to the shelter except under the guidance of an electrical engineer and with the permission of the supply authority.

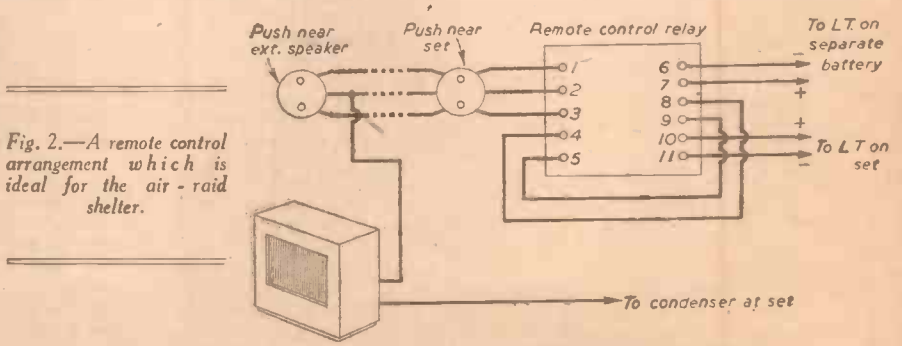


Fig. 2.—A remote control arrangement which is ideal for the air-raid shelter.

Speaker Connections

And now we can return to the question of using extension speakers. Methods of connection have been given in these pages on a number of occasions, so it should not be necessary to deal with the matter in close detail here. If extension-speaker terminals are not provided on the set it will be found in nearly every case that the best method of connecting the extra speaker is as shown in Fig. 1. The built-in speaker transformer is used as an output choke, and a fixed condenser having a capacity of between 1 and 4 mfd. is used to feed the speaker. The second speaker terminal is earthed to any convenient earthing point near the speaker. This general arrangement is satisfactory whether the receiver is in a living-room or in the shelter.

Volume Control

It will be seen that a simple form of volume control is fitted to the speaker, this being additional to any control in the set itself. This method is not altogether ideal when there is a long lead to the extension speaker, especially if the lead is run out of doors and along the ground. It will then have an appreciable capacity to earth, and therefore quality and volume may suffer. Quality will not be considered important in an emergency, although it will at other times. It is therefore a good plan to fit a switch in the lead to the speaker from the feed condenser. This can be mounted on the set, and switched on whenever the set is switched off; it will then be ready when the extension is needed.

Extension Leads

Any kind of insulated wire may be used for the extension lead if both set and speaker are under the same roof, but if the lead has to be taken across the garden, for instance, it is best to use good cable. Vulcanised india-rubber cable is satisfactory if of good quality, and if it can be run

RADIO IN THE A.R. SHELTER

along a fence to which it may be attached with insulated staples. Some forms of insulated aerial wire are also suitable for this purpose. If it is proposed to run the cable underground one excellent plan is to take it through lengths of electricity conduit piping. Another method is to use lead-sheathed cable, but in both cases the capacity to earth will be fairly high if the lead is more than 20 ft. long. It is therefore wise to carry out a few tests before making the arrangement permanent.

Switching from the remote point can be carried out by using some form of relay, of which there are a few examples on the market. One well-known type is the Bulgin. All are sold complete with wiring instructions, which are simple and need not be given here. A similar form of cable can be used for connection between the receiver and the relay as is used for the speaker.

The control referred to can be operated from the mains, the L.T. battery in the set or a small dry battery kept near the control. For the purpose under consideration the first two are probably the most suitable, and the necessary connections for a battery set are given in Fig. 2. One push switch is mounted near the set and another near the speaker; the receiver can be switched on or off by operating either of these, regardless of the position of the other. It is also possible to wire additional push switches and speakers up to any reasonable number.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., price 1s. weekly (annual subscription, £2 10s.)

Latest Patent Applications.

10440.—Crowley, D. J.—Combined lamp and radio receiving-set. June 15th.

10496.—Crowley, D. J.—Apparatus embodying radio receiving-apparatus. June 17th.

10372.—Hirshman, C. L., and Metropolitan-Vickers Electrical Co., Ltd.—Gas-filled discharge tubes adapted for use in time-base devices for cathode-ray tubes in television reception. June 14th.

10557.—Philips Lamps, Ltd.—Radio-receivers with remote switching control. June 18th.

10593.—Philips Lamps, Ltd.—Wireless-receivers. June 19th.

Specifications Published.

522248.—Cole, Ltd., E. K., and Shackell, A.—Tuning of radio-receivers.

522258.—Murphy Radio, Ltd., and Noxon, L. A.—Control of selectivity in radio receivers.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1/- each.

Short Cuts for the Constructor

Rule-of-thumb and Other Simple Calculations for the Non-mathematical Experimenter

THERE is no doubt that the average constructor and experimenter dislikes his wireless mixed with "maths." and carefully avoids calculations and formulæ whenever possible. For this reason any short cuts for arriving at values of resistances, number of turns on coils, sizes of condenser, etc., are always welcome. In the following paragraphs are given a number of simple facts and formulæ which every serious constructor should know. They are expressed in a form which can be easily remembered and so can instantly be applied when needed, thus saving the need for referring to books while in the middle of set-building.

Rules Regarding Tuning Circuits

Let us first deal with some elementary facts concerning the aerial circuit. We are all familiar with the use of a condenser connected in series with the aerial and used as a selectivity device. Now variations in the capacity of this condenser not only affect the selectivity of the receiver, but also its sensitivity and its wavelength range. It is worth while remembering that a decrease in the capacity of this condenser means: (1) An increase in selectivity; (2) a decrease in sensitivity; (3) a lowering of the wave-range of the receiver. An increase in its capacity, or its removal from the circuit (aerial joined direct to coil), gives the opposite effect.

If you are designing your own tuning coils much calculation can often be avoided by remembering the simple rule that the wavelength of a coil is very roughly proportional to the number of turns. For instance, if a 60-turn coil tunes the receiver to a wavelength of 300 metres, then a similar coil with three times as many turns, namely, 180 turns, would tune to approximately three times this wavelength, that is to 900 metres. In the case of a short-wave coil the same rule applies; thus, if a three-turn coil tunes to 20 metres then a coil of six turns would tune to 40 metres, and so on.

Length of Wire for a Frame Aerial

If you are building a receiver using a frame aerial there is a very easy method of determining the amount of wire necessary. Naturally, the number of turns varies with the size of the frame, but the total length of wire remains fairly constant. Thus the length required for the medium-wave band is approximately 75ft., while for the long waves a total of about 210ft. is required. This is assuming, of course, that the frame is tuned with the usual .0005 mfd. variable condenser. With a knowledge of the length of wire required it takes but a moment to determine the number of turns for any size frame. For example, you may decide on a frame 12in. x 14in. The total length for one turn round the frame is clearly 52in. This length, divided into 70ft. and 210ft. respectively, will give the turns necessary for the two windings, namely 16 and 48 turns.

Frequency and Wavelength

Nowadays the radiations of broadcasting stations are usually recorded both by their frequency and by their wavelength. However, it sometimes happens that you may know only the wavelength of a certain station when you wish to know its frequency, or vice versa. The key to the conversion lies in the number "300,000." This is worth remembering, for to convert wavelengths into frequency, all you have to do is to divide 300,000 by the wavelength, while to convert frequency into wavelength you divide 300,000 by the frequency. Example: What is the frequency of a station whose wavelength is 250 metres?

Answer: $\frac{300,000}{250} = 1,200$ kilocycles.

Example: On a receiver calibrated in frequencies a station is received at approximately 950 kilocycles on the tuning scale. What is its wavelength? Answer: $\frac{300,000}{950} = 315.8$ metres.

Selectivity and Number of Tuned Circuits

Regarding the selectivity of a receiver a rough guide is provided by the number of tuned circuits. Thus, a receiver with two tuning coils will be more selective than a set with only one similar coil. Similarly, a set with three tuned circuits will be proportionately more selective than one with only two tuned circuits. This is assuming, of course, that similar types of coils are used in each case. For instance, the rule does not always hold good when comparing air-cored coils with iron-cored ones, since the latter are usually more selective.

It does not matter very much what is the position of the tuned circuits. Thus the selectivity of a two-coil set is approximately the same, whether the two tuned circuits are placed both in front of the first valve, as with a band-pass input circuit, or whether one is used as the input circuit and the other as an inter-valve coil.

Another useful point to know regarding selectivity concerns band-pass tuners. If the two coils of a band-pass filter are coupled by means of a condenser, then the tuner will be more selective but less efficient at the short-wave end of the tuning range than at the long-wave end, while the opposite characteristics are manifested when the two coils are inductively coupled.

Transformer Ratios

Turning our attention to the low-frequency stages of the receiver, there are one or two useful rules regarding coupling and decoupling.

When an L.F. transformer is used for coupling, the ratio of the transformer is chiefly dependent upon the impedance of the preceding valve. A high-impedance valve should be followed by a low-ratio transformer, and a low-impedance valve by a high-ratio transformer. This rule does not apply in the case of class B amplification.

In determining the values of decoupling condensers and resistances, remember that the higher the resistance which is used, the smaller may be the condenser, and *vice-versa*. Thus, if sufficient decoupling were provided by the use of a 2 mfd. condenser in conjunction with a 20,000 ohm resistance, then an increase in the value of the resistance to, say, 40,000 ohms would enable a smaller condenser, such as a 1 mfd., to be used. It is useful to know this, since sometimes it is quite permissible to use a large decoupling resistance.

READERS' BARGAINS

STENTORIAN Speaker, 1937 Senior Model, good condition. What offers? Also sundry components, including Battery Valves. Write for list.—Blewett, "Penare," Penzance, Cornwall.

N.T.S. S.G.3 (All-world Chassis) with 10 B.T.S. Coils, 35/-.—M. Macpherson, 11, Friars Street, Inverness.

RECEIVERS AND COMPONENTS

NEON Transformers. 200/240 volts input, 5,000 and 7,000 volts output; useful for all Test work. All new, boxed, 6/6 each, post 1/3.

MAINS TRANSFORMERS. 200/240 volts input, 12 and 24 volts 4/6 amps. output, 15/- each, post 1/6. Another 200/240 volts input, 50 volts 8 amp. output, 15/- each, post 1/6.

EX-G.P.O. GLASS-TOP RELAYS. Type with Platinum points break at approx. 1 m/a, 7/6 each, post 1/-.

EPOCH P.M. Speakers, 10in. cone, 10 ohm speech coil, handle 10 watts, 32/6 c./forward.

D.C. MOTORS, 50 volts, 1/16 h.p., 1,500 r.p.m., 6/6 each, post 1/-. D.C. motor blowers, 2in. inlet and outlet, aluminium body, laminated fields, ideal for dug-out ventilation. 100 volt 25/-, 220 volts 30/-, c./paid.

VOLTAGE CHANGER TRANSFORMERS (Auto Wound), 100/110 volts to 200/240 volts, or vice versa. 250 watts, 25/-, post 1/-; 500 watts, 32/6, post 1/6; 1,000 watts, 50/- c./f.; 1,500 watts, 62/6, c./f. Delivery 7 days from date of order.

EX-G.P.O. PEDESTAL TELEPHONES. Complete with automatic dials, 8/6 each, post 1/-. Without dials, 6/6 each, post 1/-.

BELL BOXES, complete with A.C. bell mike transformers, 3/6 each, post 9d.

HAND COMBINED TELEPHONES, with finger press switch, 4/6 each, post 6d.

PHILIPS' PRE-STAGE AMPLIFIERS, consisting of 4 x 4 mfd. 750v. wkg. condenser, 400 volt transformer, smoothing choke, etc., less valves. 10/- each, c./f.

MOVING-COIL METER Movements for recalibrating into multirange instruments, low milliamp. deflection, 2½in. dial. Makers Everett-Edgcumbe and other good makers, 6/- each.

GALPIN'S ELECTRICAL STORES, 75 Lee High Rd., Lewisham, London, S.E.13. Telephone: Lee Green 5240.

SPECIAL OFFER.—K.B. 6-valve chassis, 8 press button A.C. mains superhet, 3 wave bands (S.M.L.) magic-eye tuning indicator, manual tuning, less valves, in perfect condition, price 35s. carriage paid. See also previous issues for other bargains.—London Central Radio, 23, Lisle Street, London, W.C.2. Gerrard 2969.

BANKRUPT Bargains. Brand new 1939/40 models, well-known best makes, makers' sealed cartons, with guarantees, at less 30%-40% below listed prices; also Midgets, portables. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

COULPHONE Radio. Change of address to Station Road, New Longton, Preston. Goods previously advertised still available. Crystal Pickups, 18/6. Rola G12's with transformer: Energised 52/6, P.M. 65/-. 40 per cent. discount on valves. Stamp for lists.

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163A, Strand, W.C.2.

DENCO.—Ultra low loss S.W. components, receivers, polystyrene insulation. Send 2d. for Catalogue.—Warwick Road, Clacton, Essex.

FREE ADVICE BUREAU

COUPON

This coupon is available until July 20th, 1940, and must accompany all Queries and Hints.

PRACTICAL WIRELESS, 13/7/40.

RECEIVERS AND COMPONENTS

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.

5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.

15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.

21/- Small Trader's Parcel of Components. 150 Articles comprising all types Condensers, Valve Holders, Resistances, Chokes, Coils, Wire, etc. Value 85/-, 21/- the parcel.

5/- 100 Wire-end Resistances, assorted capacities, ½ and 1 watt, 5/- per 100.

ORMOND Loud-speaker Units, 2/6. Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d. "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.

2/- Tool or Instrument Carrying Cases, ex Government Stock. Wood 9" x 7" x 7", 2/-.

SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

RADIO CLEARANCE, LTD. See previous issues for full list of bargains.
RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. Holborn 4361.

TUITION

YOUNG MEN (15-20 years) urgently needed to train as Radio Officers for the Merchant Navy; short training period; low fees; boarders accepted. Write or call for full particulars—Wireless College, Calmore, Southampton, or Wireless College, Colwyn Bay.

WANTED

WANTED.—Mazda QP240 valve.—A. Hamilton, 165, Cambridge Road, Kilburn, N.W.6.

WANTED URGENTLY.—Pair Medium Long-wave Coils for "Triband A/W Three." State price.—Harmer, 1, Heronden, Tenterden.

RADIO TRAINING MANUAL 14 P.W

Published every Wednesday by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rates including postage: Inland 23s. 10d. per annum, 11s. 11d. for six months; Abroad 21s. 8d. per annum, 10s. 10d. for six months. Registered at the General Post Office for the Canadian Magazine Post.

IMPROVING HEADPHONE RECEPTION— See Page 374

A NEWNES PUBLICATION

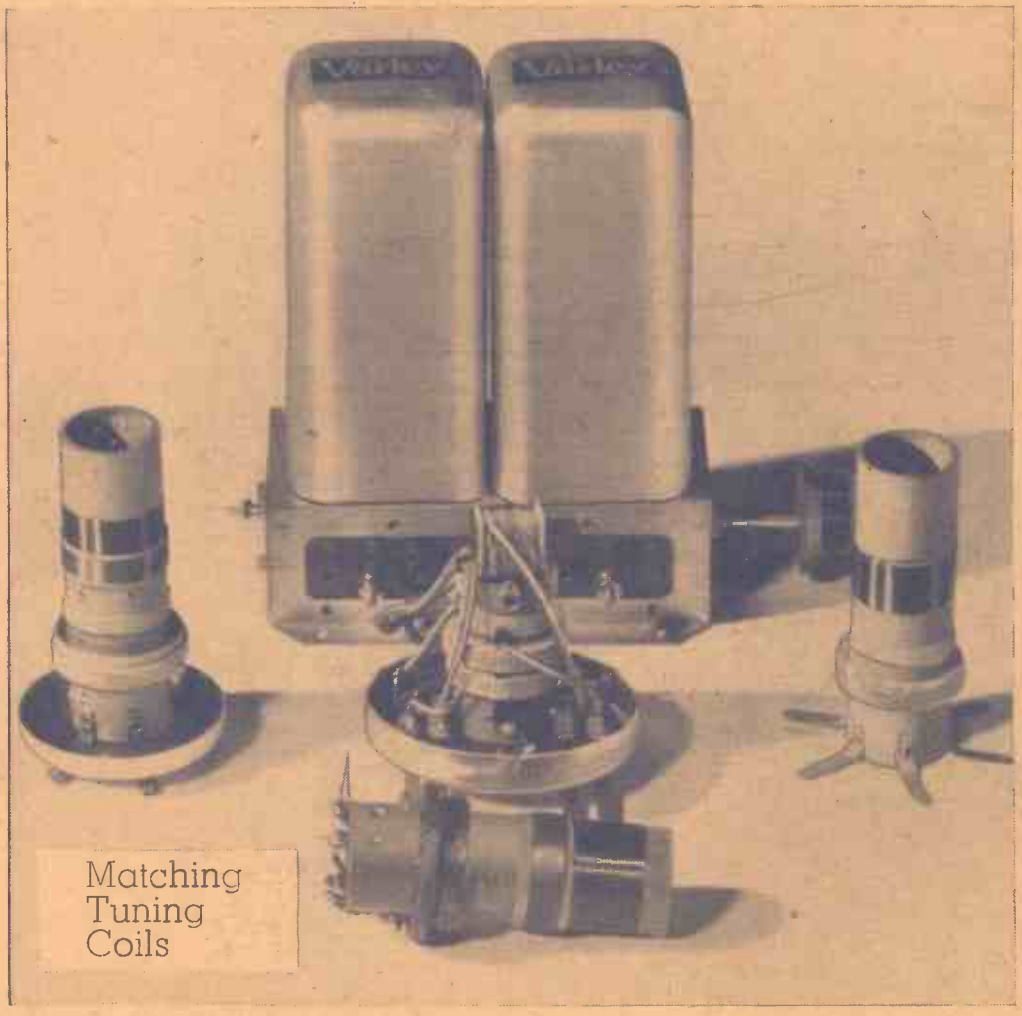
Edited by F. J. CAMM

Vol. 16. No. 409.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY July 20th, 1940.

Contents



Matching Tuning Coils

Practical Wireless
BLUEPRINT SERVICE

These Blueprints are drawn full size.
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint*. A dash before the Blueprint Number indicates that the issue is out of print.
Practical Wireless (Issues dated prior to June 1st, 1940). 4d. Post Paid
" " **(Issues dated June 1st, 1940, and after) 5d. Post Paid**
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/4 " "
The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.
Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

PRACTICAL WIRELESS	*Date of Issue*	*No. of Blueprint*
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen),	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans)	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW40
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.0.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated		
Two-valve: Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve: Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW30A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW60
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve: Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.		
Battery Sets: Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets: Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW56
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
Four-valve: Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve: Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve: Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve: Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68
PORTABLES.		
Three-valve: Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve: Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A
AMATEUR WIRELESS AND WIRELESS MAGAZINE CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det., Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM400
Three-valve: Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve: Blueprints, 1s. 6d. each		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve: Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.		
Two-valve: Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve: Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve: Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386
SUPERHETS.		
Battery Sets: Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets: Blueprints, 1s. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM360
PORTABLES.		
Four-valve: Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve: Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve: Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve: Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve: Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet: Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397
Mains Operated.		
Two-valve: Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve: Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve: Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* 36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW402
Short-wave Adapter (1/-)	—	AW450
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
Vol. XVI. No. 409. July 20th, 1940.
EDITED BY
F. J. CAMM
Staff:
W. J. DELANEY, FRANK PRESTON,
H. J. BARTON CHAPPLE B.Sc.

ROUND THE WORLD OF WIRELESS

Matched Components

THE question of matching various parts of a radio receiver is not one which normally troubles the home constructor. The manufacturer supplies condensers of the ganged type with sections correctly matched, and coils and other units of a similar nature are also properly matched. This does not mean, however, that they may be used without any modification, as stray circuit wiring can modify the matching of tuned circuits. Trimmers on the condensers, however, enable this to be carried out easily, and thus there is little difficulty. Coils, however, can be wound by the experimenter, and then some form of correctly matching them is required. Alternatively, commercial coils may be obtained in single units and be required for use in pairs or other sets, and then some arrangement for matching these is needed. In this issue we give a short description of a simple method by means of which the desired matching may easily be carried out. Although this is not obviously a laboratory method of matching, it only utilises apparatus which is in the hands of every listener and thus does not call for any outlay or expensive gear.

Illegal Transmitter

AN 18-year-old youth was recently fined £50 for using an unlicensed transmitter. He was traced by official detectors whilst sending messages to friends, using a call sign which had been allotted to the R.A.F. It should again be emphasised that it is illegal to own or use any transmitting equipment.

Air Conditioners

AN increasingly popular sideline among radio dealers in America is the air conditioning unit. This is a self-contained device made to fit on a window-sill or table and provides de-humidified, fresh filtered air in summer and fresh filtered air (warm) and ventilation in winter. This device is taking its part with room-to-room communications devices.

Re-allocation of Stations

IT is announced that the Federal Communications Commission will re-allocate a number of broadcasting stations in America during the autumn. This is the first general shift since the present scheme was inaugurated in 1928 and has been rendered necessary in order to conform to the provisions of the North American regional broadcast agreement, now ratified by Canada, Cuba and Mexico, as well as by the U.S.A.

Elsie and Doris Waters

THIS popular sister act will broadcast twice during next week. On July 22nd Ron Ronald will present them in a 45-minute revue entitled "Still Waters," and they will top the bill in a cabaret from a West Country hotel on July 26th.

Jimmy James, popular young radio maestro, heard from WLW in the "Rhythm Against the Strings" programme.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Guest Night

THE next relay of Guest Night, the popular Henry Hall stage feature, will be on July 17th, and will be relayed from a Scottish theatre. As usual, Henry will introduce guests who have achieved success in various walks of life, most of them being radio personalities.

A Veteran

GEORGE PALMER, known locally as Dr. Palmer, is a 99-year-old resident of Tenbury. The B.B.C. recently sent out their Mobile Unit to record his singing of five songs of the mid-Victorian period and listeners will hear these on July 22nd. Mr. Palmer claims to be the oldest singer to face the microphone.

Superintendent N.P.L.

MR. R. S. J. SPILSBURY, formerly principal scientific officer of the Electricity Department of the National Physical Laboratory, has succeeded to the post of Superintendent, vacated by Dr. E. H. Rayner, retired.

Radio Courses

WRUL, in Boston, recently broadcast a series of instruction courses in all phases of radio. The courses were divided into elementary and advanced, and we should be glad to hear if any of our readers succeeded in picking up any of the transmissions. The advanced course was to include a section on Frequency Modulation apparatus.

DX Ban

THE F.C.C. has now suspended all rules and regulations regarding amateur communication with foreign stations. Accordingly, American amateurs are now prevented from communicating with amateurs abroad and may only work other U.S.A. stations. The reason given for the ban is an attempt to guard against "Fifth Column" activities.

Portables Banned

ANOTHER ban reported from the U.S.A. concerns all portable or mobile amateur stations. Excepted from the ban are stations operating on or above 56 mc/s.

"Go To It!"

THE fourth programme in the "Go To It" series will come from the North-East. Armaments workers from some of the big factories are to come to the microphone under the direction of Cecil McGivern to tell listeners of the progress they are making in the great arms drive.

Meter Mechanisms

A Simple Explanation of the Principles Involved in Modern Measuring Instruments

NO experimental station would be complete without one or more reliable meters included in its equipment, and it is usually the desire of the genuine enthusiast to secure one of these vital instruments during the early days of his radio activities. Unfortunately, however, he is usually faced with two problems, first finding a suitable meter within the range of his purchasing powers and secondly, deciding on what type of meter or movement will prove most useful and most universal.

In answer to the first problem, one cannot do better than follow the advice so often given in these pages, namely, let the first meter be a good one of reliable make; learn how to use it and finally, look after it, as there is no reason why a first-class instrument should not last for years. The question as to which type of movement or meter will prove the best investment is a shade more involved, but as the amateur's activities will hardly be as comprehensive as the technician's in a laboratory, it is possible to limit the range of selection.

Radio Measurements

If a study is made of the various meters available, it will be found that they can be classified into groups, depending on the purpose for which they are designed. If, then, when the time comes for selecting one, these groups are examined the purchaser will be saved much time and worry.

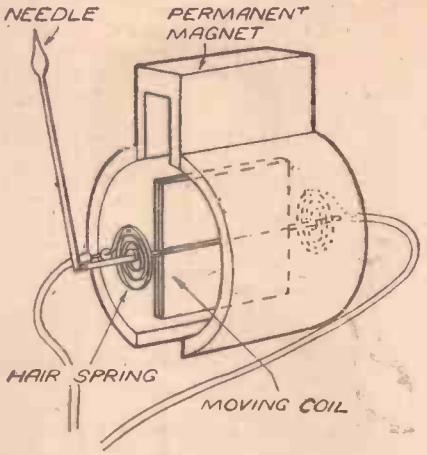
With radio work, the measurements involved will cover the following rather wide range: D.C. voltages from low values up to, say, 500 volts D.C.; current from 0-1 mA up to 150 mA's; mains voltages, both A.C. and D.C., the former at normal supply frequencies; A.C. voltages and currents, at frequencies varying between those which come within the L.F. band and those which have to be classified under H.F. or radio-frequency. These requirements tend to indicate that several meters would be necessary for serious experimental work and thus bring the complete equipment outside the scope of the average amateur, but owing to the fact that many of the measurements are more closely connected with the laboratory rather than the constructor's den, the practical requirements can be brought down to more reasonable limits. Recent articles have shown how it is possible to use a reliable low-reading milliammeter for securing many of the above-mentioned measurements, but as every enthusiast should know the main differences in the various types of meters, thus allowing him to be able to recognise to what use any particular movement can be put, a brief description of each is given below.

Moving Iron

This term is given to one of the cheapest forms of meter construction and, as the name implies, the movement depends on a small piece of iron, so located and pivoted that it actuates the meter pointer, moving with relation to a separate fixed piece of iron which is situated within the effective magnetic area of a small coil, the coil being connected to the external circuit under examination.

In addition to its cheapness, this type of meter is robust and can be used in both A.C. and D.C. circuits, but against these points must be set the facts that it is not suitable for *accurate* work on D.C. circuits. Its resistance is usually low enough to impose an appreciable load on the circuit, the needle deflection obtained is roughly proportional to the square of the voltage or current being measured and on A.C. circuits it is only really suitable for the usual mains frequencies, i.e., rather low.

The question of needle deflection is one of great importance when considering a meter movement as, for example, the statement above about the deflection being proportional to the square of the current or voltage (square-law scale) indicates that the low readings will be condensed into a very small space compared with the higher



The essential parts of a moving-coil meter are shown here. Note hair-spring connections to coil.

values, thus making it very difficult to read accurately the bottom part of the scale.

Moving-coil Movement

Meters embodying this form of movement are, undoubtedly, the most popular as they are much more accurate and the pointer follows a linear law, or in other words, the movement is directly proportional to the current or voltage being measured. In actual construction, they are not so robust as the previous type but they offer sufficient advantages to outweigh any considerations of that nature and the higher price which their precision construction necessitates.

The movement is shown above. The small coil is usually wound rectangular in shape and supported in the magnetic gap by very accurate pivot bearings, the connections to the coil being made through the small hair-springs located near each pivot. These springs also serve the purpose of maintaining a steady movement of the needle and returning it to its zero position.

The moving-coil, in a good make of meter, usually has a reasonably high resistance, thus allowing it to be placed across a circuit without imposing an appreciable load which would tend to produce inaccurate readings. This applies in particular to voltmeters.

One of the great features of this type of movement is its adaptability. Its normal current reading range can be increased by the simple addition of shunt resistances and, similarly, its voltage range can be varied over a very wide range by the use of suitable series resistances, as previously explained in the article dealing with the Twelve-Range D.C. Meter. Unlike the moving-iron method, the moving-coil movement can only be used for measurements on *D.C. supplies* unless certain modifications have been made.

A.C. Supplies

For A.C. supplies of normal frequencies, i.e., mains and L.F. work, the moving-coil movement can be used in conjunction with a suitable type of metal rectifier which can be connected inside the meter case or arranged as an external unit. This combination produces a very satisfactory meter for the work mentioned and is another example of the universal application of this particular form of movement.

For A.C. supplies of much higher frequencies, i.e., audio to H.F. or radio-frequencies, a further modification of the original moving-coil assembly can be used. In place of the metal rectifier, for the conversion of the A.C. to D.C., a thermal-couple is substituted. This unit consists of a heater element which controls the temperature of the thermo-couple, the latter consisting of two dissimilar metals which have the property of producing a minute current when subjected to heat.

Electrostatic Movements

This type of movement hardly comes within the scope of the average constructor, but its operation is worthy of note. The movement consists of two sets of delicate metal vanes, one set being fixed whilst the other is free to move between the first in a practically identical manner to the moving vanes of a variable condenser. It operates on the principle of mutual attraction of unlike charged bodies, as the connections from the external circuit are taken direct to the plates.

It is widely used for measuring high voltages, A.C. or D.C., and owing to its method of construction, it does not impose any load across normal D.C. circuits, thus allowing a very accurate reading to be obtained. Conversely, when it is used on A.C. supplies it is more satisfactory on those of low-frequencies owing to the fact that the movement is virtually a condenser.

Matching Tuning Coils

Some Simple Methods of Carrying Out Tests with the Minimum of Equipment and Test Gear

ONE of the greatest difficulties in connection with home-made tuning coils is that of matching two or more of them so that they can be used with a gang condenser. It would appear to be a simple matter to ensure that all are physically the same; this could be done by making sure that the corresponding windings on all coils were in the same relative positions, and that they consisted of precisely the same number of turns. Thus it would seem that the question resolves itself into one of mechanical accuracy.

The fact that it does not is clearly shown in the case of many tuners made by reputable manufacturers. Despite the fact that they are wound by means of precision machinery it is often necessary to make slight adjustments after completion, to match them up. Even if the coils themselves are not altered it is often necessary, in order to obtain a matched set, to choose two or more which have been found to have similar characteristics when bridge-tested.

Inductance and Capacity

As most readers are aware, for two coils to be matched they should have similar values of both inductance and self-capacity. Whilst it is possible to measure the values of these properties, the measurement calls for the use of fairly elaborate and expensive test gear; in addition, of course, a certain amount of skill is necessary to use it, even when the meters are calibrated in the most simple manner.

One very simple method of matching, which can be used by the amateur not in possession of complete test gear, is to connect one of them in a receiver, note the condenser setting for a given frequency, replace the coil and again note the condenser-setting for the same frequency. From this it will be known that if the condenser reading is lower with one coil, that coil has too many turns or its self-capacity is higher than that of the other coil.

A very simple test of this kind may be of some use if the coil is of the single-circuit type, but if there are both primary and secondary windings false conclusions may be drawn. This would be because any variation in coupling between the two windings would give a similar effect to that produced by variation in the numbers of turns on the secondary or tuned windings.

A Test Circuit

One method which can be adopted very easily, and which is reasonably accurate, is to make a unit with the circuit shown in Fig. 1. It will be seen that there is simply an anode-bend detector valve, and that a variable condenser is wired across the grid circuit; to each end of the condenser is attached a short lead with crocodile clip. The clips are used to make contact with the ends of the coil winding under test. In the anode circuit of the valve there is an H.F. choke (which is not strictly necessary) and a milliammeter, reading up to about one mA, or a pair of 'phones.

In passing, it may be mentioned that it will often be found better to use an H.F. pentode instead of the triode if a valve of this type is available. The screening grid may be taken to an H.T. + tapping and bypassed by means of a .1-mfd. fixed condenser in the usual manner.

Comparing Condenser Readings

Using this simple circuit the grid or tuning winding of one of the coils to be compared should be connected to the

by The Experimenters

tuning condenser, and to an aerial lead, as shown in Fig. 2. After that, the local station can be tuned in and the tuning condenser very carefully set until the highest reading is shown on the milliammeter scale. At that point the tester is tuned exactly to the station being received, and a careful note should be made of the condenser setting. When making this test it is best to include a very small fixed condenser (a .00005-mfd. component is shown) between the aerial lead-in and the top of the tuned winding. It is also desirable to use a

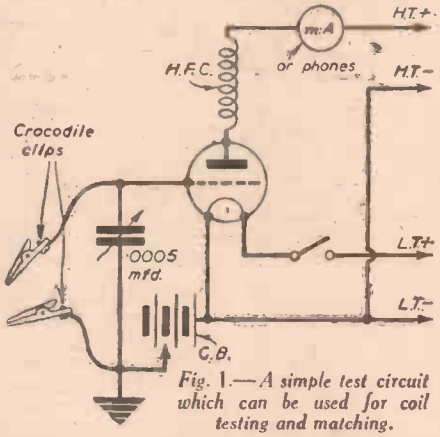


Fig. 1.—A simple test circuit which can be used for coil testing and matching.

short aerial, provided that the signal input is sufficient to cause the needle of the meter to move sufficiently as the tuning condenser is brought toward the resonant point.

Necessary Precautions

When the setting has been noted the coil should be replaced by the other which is to be matched to it, and the condenser setting for highest meter-needle reading again noted. There are various minor precautions to be taken if this test is to be conclusive. One of these is that the tuning must be as sharp as possible to avoid mistakes in reading the meter and condenser. This can be ensured by using the smallest aerial and/or the smallest series condenser with which a clear needle movement can be observed. When this is impracticable there is an alternative method. This is to note the range of condenser-scale movement over which the needle remains steady at the highest scale point reached, and to take an average between the highest and lowest condenser-scale readings. Thus, if it were noticed that the needle remained at, say, .75 mA between condenser readings of 80 and 110 degrees, the average reading of 95 degrees would be taken.

Another point to consider is that of the optimum values of high-tension and grid-bias voltage applied to the valve. These should be chosen so that the valve is working as nearly as possible on the tip of the bend in the anode current-grid volts curve. The voltages will vary, of course, according to the particular valve employed. Should it be found that the movement of the needle is insufficient for a clear indication of the maximum point to be noticed, and if variations in voltages have proved unavailing, the meter may be replaced by a pair of 'phones and tuning altered until maximum volume is obtained. It should be remembered, however, that the ear is very deceptive and therefore that accurate readings will be very difficult to obtain, even when the tests are made on speech.

Coil Modifications

Should it be found that the two coils differ to a noticeable extent—represented by more than about 5 degrees variation in condenser readings—it will be necessary to modify one of them. The most convenient method will probably be to remove one half-turn, or even a complete turn, from the coil which requires the lower condenser reading. After that has been done, the test will have to be repeated on that coil. Another method which is often fully effective and more easily carried out is to slide about a dozen of the turns at one end of the winding away from the others, as shown in Fig. 3. This should produce an effect similar to that of removing a part of a turn. After matching in this manner it is advisable to give both coils a very thin coat of shellac varnish to hold the windings in position.

Having checked the tuned windings in this manner the coils should, in turn, be connected in the usual way to the grid circuit and to the aerial lead. The tests can then be repeated. Variations now disclosed will be due to differences in coupling between the primary and secondary windings. The coil requiring the small condenser capacity should be altered by moving the windings rather farther apart or by taking a turn off the primary.

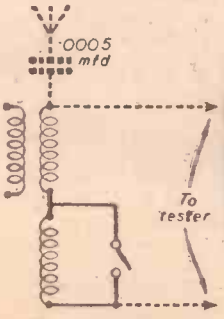


Fig. 2.—Method of connecting the coils to the test circuit.

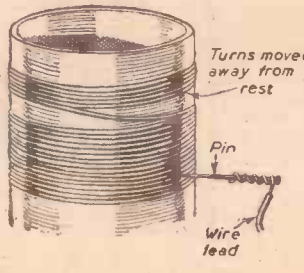


Fig. 3.—A simple method of varying the inductance by moving a few turns and of making contact to intermediate turns on the coil by means of a pin.

Superhets for the Short Waves

How to Build a S.W. Superhet from Standard Parts

A VERY efficient superhet for operation on all wavelengths down to 12 metres or so can be made by using perfectly standard components, and without going to a great deal of expense, and many of the standard components employed in a simple type of "straight" circuit can be utilised without any sacrifice in efficiency.

It is not generally known that standard short-wave coils—either of the single-range or multi-range type—can be used for both the input and oscillator circuits, even when it is desired to make use of a two-gang condenser. The fact is that an ordinary tuned-grid or aerial coil with reaction can be used with every satisfaction in the oscillator tuning circuit of a short-wave superhet, due to the fact that the percentage difference between the signal

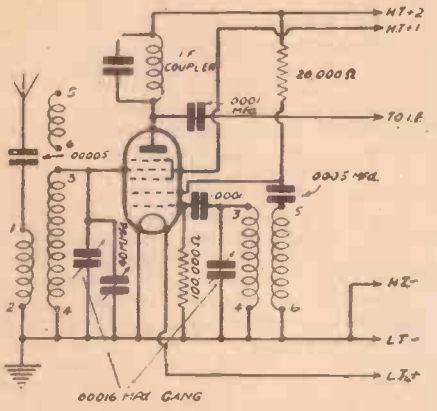


Fig. 1—Frequency-changing stage utilising a pentagrid valve for battery use.

and oscillator frequencies is quite small. Moreover, the characteristics of a plain tuned coil with a reaction winding are similar in nearly every respect to those demanded of a special oscillator coil; after all, the oscillator section of a frequency-changer is only the same as a regenerative detector stage.

Suggested Circuit

This matter will more readily be understood by making reference to Fig. 1, which shows the first two stages of a short-wave superhet employing a pentagrid valve. The aerial and oscillator coils are identical although the reaction winding is not used in the former, and the loose-coupled aerial winding is not used in the latter. The terminal numbers indicated are not those relating to any particular make of component, but are given simply to show the correspondence between the two components. A double .00016 mfd. tuning condenser is shown, and there is a wide variety of components by most of the better-known manufacturers which are suitable for the purpose. Of course, separate condensers could be used if preferred.

In order to enable the full wavelength range of the coils to be obtained, a 40 mmfd. variable condenser is wired in parallel with that section of the two-gang condenser which is used to tune the aerial circuit. It will be understood that, since the wavelength of the oscillator circuit must be lower than that of the aerial circuit (it would be better to say that the frequency of the former must be higher than that of the latter), the lower part of the scale of the oscillator condenser and the upper portion of the scale of the aerial condenser would not be of any use if this compensation were not provided. This remark really applies only when separate condensers are used—as they may be if desired—for when a gang condenser is used as suggested it would be impossible to obtain accurate tuning of both circuits at the same time, and thus efficiency would be impaired.

It might even be imagined that it would be impossible to receive any signals when using a gang condenser without the trimmer, but this is not the case, however, because in practice it is found that the tuning of the aerial circuit is by no means critical; in fact, the difference in efficiency when using an aperiodic aerial circuit is not particularly great.

Component Values

When operating the set it is possible to control the gang condenser alone until a signal is received, after which final tuning can be accomplished by means of the trimmer. This not only gives an increase in signal strength, but also has the effect of increasing selectivity.

Values of the principal components are given in Fig. 1, but it will be noticed that the type of intermediate-frequency coupler is not specified. The reason is that a coil such as the Bulgin I.F. coil may be used with a .0003 mfd. fixed condenser in parallel, a 150 or 465 kc/s I.F. transformer may be employed, or a really good H.F. choke could be substituted. In most instances I.F. transformers will prove most satisfactory, but in that case it is necessary to have a complete superhet, whilst if one of the other components be used the circuit shown can be used as a converter in conjunction with a standard broadcast receiver covering the normal bands of 200 to 500, and 1,000 to 2,000 metres. The equivalent wavelength when using either of the I.F. transformers is outside the ranges mentioned.

Of the two intermediate frequencies referred to, 465 kc/s is to be preferred, and the capacity of the trimming condenser is sufficient to permit of this frequency difference without restricting the wavelength coverage. When using a choke or the Bulgin I.F. coil (the latter is preferable, of course, due to the fact that it is definitely tuned) the intermediate-frequency amplifier can consist simply of the H.F. stages of any broadcast receiver of the "straight" type, in which case the lead marked "To I.F." should be joined to the grid of the first H.F. valve.

For Mains Operation

When building a mains S.W. superhet, or superhet converter, it is worth while

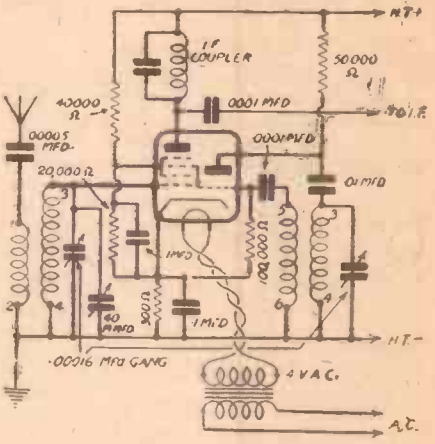


Fig. 2.—A triode-hexode frequency-changing stage for A.C. mains use.

to use a triode-hexode frequency-changer, when the connections in the oscillator circuit are slightly modified, as shown in Fig. 2, so that the anode circuit of the oscillator is tuned, instead of the grid circuit. Otherwise the arrangement shown in Fig. 2 is in every respect comparable to that indicated in Fig. 1, whilst having the extra advantages conferred by the mains type of specialised valve which is particularly suitable for short-wave use.

When using a battery type converter, H.T. and L.T. can be taken from the batteries used for the broadcast set, but the question of power supply is not quite so easy of solution when an A.C. outfit is under consideration. Very often the mains transformer is designed to supply sufficient output for the set alone, and has insufficient "reserve" to permit of its use for the extra valve. In that case, it is a good plan to have a separate 4-volt L.T. transformer for the valve of the converter, as shown in Fig. 2; the primary winding of this should be wired in parallel with the primary of the other mains transformer. The amount of H.T. required can invariably be taken from the power-supply unit in the set, so there is no difficulty in that respect.

ON YOUR WAVELENGTH

By Thermion

Faith!

I WAS amused at the story told last week by a cleric. He had asked a boy what his religion was. The boy replied that his mother was a Protestant, his father a Roman Catholic, whilst he was Wireless! Fortunately, or unfortunately, wireless is not yet a religion. You observe that I play for safety by leaving you to decide that point for yourself. There can be no possible doubt, however, that, even though not in a religious sense, it is a faith to many tens of thousands of us. What is faith? Its definition occupies nearly a half a column of my dictionary. As a transitive verb it means to believe, give credence to, credit. We can certainly give credence to our broadcast but very little to those of our enemies. My dictionary, however, goes on to say that faith is a firm belief in what another states, affirms, or testifies, simply on the ground of his truth or veracity. Therefore, we cannot have faith in the broadcasts of our enemies.

However, I like the reference to wireless as a faith, and I hope that it will develop so that our English motto, "Nation Shall Speak Peace Unto Nation," will be understood by our adversaries. At present they are merely using it to speak hate to us.

Register of Experimenters?

ONE of my readers, J. B. Rudkin of Hoylake, refers to the paragraph in which I detailed the adventures of one of my readers who was an enthusiastic experimenter, but was suspected by his neighbours as being a spy merely because he thought more of his hobby than gossiping over the garden fence about such subjects as the rate of growth of spring onions, silver leaf, and blight. Mr. Rudkin thinks that the local police in all districts should keep a register of experimenters. He thinks that all that would be necessary would be that each enthusiast should send a postcard to the police station stating that he was an enthusiast.

There is something in his idea, but it would not be sufficient merely to send a postcard, as the very object of the register would be defeated, because such a system would leave the door wide open for the very people against whom the register is designed, namely, the fifth columnist, and the spy. The police, in my view, are not competent bodies to analyse the qualifications of one claiming to be an enthusiast. If such a register is compiled I suggest that the bona fides of the applicants should be investigated by a competent engineer from the Post Office.

The register would also have a further use in that the country would have a list of people with a first-class knowledge of radio. I pass the suggestion along, however, to the Government for their consideration.

Myth Columnists

UNFORTUNATELY, there are thousands of people suffering from the "I know something which you don't" complex. They have either heard it on the radio when they were listening to Timbuctoo, Tokio, or some other remotely situated station, to give the impression that they have a wonderful set, and are thus *au fait* with all of the world's news. Such a trifle as the various languages involved does not seem to worry them. Thus, the rumours they spread cause damage. One or two of them have been caught, and then have been compelled to admit that they have invented the story. These are the myth columnists, and they are just as dangerous as the fifth columnists. There are also the columnists without numerical coefficient who write letters to the press telling us how to win the war. There are even those who broadcast simple stuff in a didactic tone as if we were a collection of nitwits. For this reason I do not like some of the broadcasts of Professor John Hilton, who seems to talk and talk on the most elementary subjects without saying anything. I have no doubt, of course, that this is due to my dim intelligence, but I do not like his didactic schoolmaster style. He should presume that his listeners have at least some knowledge of the elementary subjects on which he speaks. A great deal of it, I know, is purely statistical, and is common knowledge.

National Service

IT is worthy of record that I have received large numbers of letters from readers who are now engaged in one of the branches of the radio service thanking this journal for the fact that they have been able to place their technical knowledge at the services of the country. All of these readers paid grateful tribute to the fact that they have obtained their entire radio knowledge from our wireless books, and from this journal. They were all able easily to pass the tests.

Contrast Contractor

IN a recent issue we gave a circuit for an Ideal Radiogram containing a stage called a contrast expander. A reader says that he finds that what is really necessary in listening to B.B.C. orchestras is a contrast contractor. He thinks that if a set is tuned so that the pianissimo is audible at all, even at close range, the crescendos are unbearable; even the neighbours don't like them. That is bad broadcasting, he thinks, and is probably the cause of so much of the unnecessary blasting that one hears.

Our Roll of Merit

Our Readers on Active Service—Fourth List.

R. Rowland
(Sgt., Royal Welch Fusiliers),
Wrexham.

R. W. Walker
(Signalman, R. Signals),
Newcastle-on-Tyne, 2.

R. P. Atkinson
(Observer Corps, R.A.F.),
Boroughbridge, York.

"Be Advised—Join a Wireless Club"

Congratulations, Thermion!
Your suggestion's really good:
"To prove one's not a Nazi spy
Just join a wireless club."
Then when some local "Sherlock" calls
On us in this regard,
We'll prove to him his "clue" is false,
And show our member's card.

We realise the need just now
For constant supervision,
And for due care and vigilance
From us no rude derision;
But the fact that we are radio fans
Must really not imply
That p'raps we are Fifth Columnist,
Or secret Nazi spy.

The war won't last for ever,
And when at last we've won,
Then our amateur transmissions,
To our joy, can be begun.
So haste the day when "on the air"
This message we can loose:
"We're free from foul suspicions, for
THEY'VE COOKED OLD HITLER'S GOOSE."

"TORCH."

B.B.C. Polish Refugee Service to Cease

SHORTLY after the occupation of Poland, the B.B.C. introduced in its Overseas programmes daily announcements of the names of Polish refugees. Now, for various reasons, this service has had to be suspended, and the B.B.C. can no longer undertake to broadcast personal messages in Polish or in any other language.

Before the war it was a standing rule that no S O S or personal message of any kind should be transmitted to listeners overseas. But when the brutal invasion of Poland occurred, the B.B.C. could not disregard the plight of the thousands of Poles who were forced to seek sanctuary from Nazi vengeance in Allied and neutral countries and who were completely cut off from their native land. So at the request of the Polish Embassy, the B.B.C. began a service of broadcast messages—the Poles called it a "letter-box"—by which refugees were able to communicate news of their safety and whereabouts to their friends and relations who had no other means of knowing what had happened to them.

The B.B.C.'s Polish Refugee Service has been the means of banishing grief and anxiety from countless homes. Since it was introduced on October 7th of last year, an average of 131 names has been broadcast daily and the grand total has reached 34,000. It is, of course, impossible to estimate exactly the number of Polish families the B.B.C. has helped to re-link by its "letter-box," because few listeners in German-occupied Poland are able to get in touch with the world outside. But even so hundreds of appreciative letters have reached Broadcasting House.

SHORT-WAVE SECTION

IMPROVING HEADPHONE RECEPTION

H.F. Filter Circuits added to Standard Short-wave Circuits to Remove "Head-capacity" Effects. By W. J. DELANEY

ONE of the main difficulties experienced by listeners on the short waves is the critical adjustment which is often called for in the tuning or reaction circuits. In the majority of cases, however, it is found that these troubles are not experienced if a loudspeaker is being used. When, however, headphones are worn the capacity to earth which exists through the body results in a leakage of H.F. currents and these in turn affect the operation of controls, owing to the presence of the body or hand. It is often recommended that screening be employed to overcome this trouble, but many experimenters have tried screening, in some cases most comprehensive schemes, all without result. A long extension rod controlling both tuning and reaction condensers, and the interposition of a sheet of metal behind the panel (such metal being soundly earthed) will often afford an improvement, but will not in all cases completely remove the trouble. Let us examine the usual arrangements employed in a standard short-wave circuit and see how we can overcome these troubles.

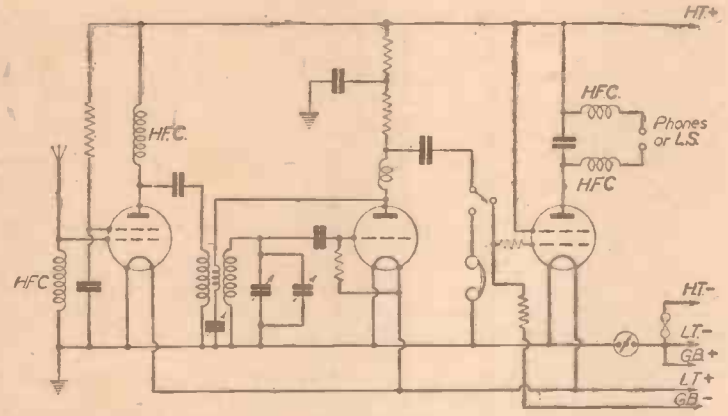


Fig. 1.—Suggested circuit of a short-wave 3-valve battery set. Components not marked will be of standard values.

'Phone Connections

In the simplest circuit the headphones will be included in the output stage, direct in the anode circuit. In the detector anode circuit we usually find an H.F. choke, the main purpose of which is to deflect the H.F. currents through the reaction circuit. If a simple reaction condenser (as distinct from a differential condenser) is employed, however, the H.F. will not be taken to earth unless the condenser is set to maximum capacity—a position which is not often used. Consequently, it would appear that it is in the detector anode circuit that we must introduce our H.F. stoppers in an endeavour to remove the capacity effects. A by-pass condenser from anode to earth will prove effective on the higher wavelengths, but when going down below 30 metres it will be found that this condenser will result in some signal loss. If, however, we are dealing with a circuit employing an H.F. stage we may be able to introduce an effective H.F. stopper in the grid circuit of the output valve, the simple series resistance then proving quite effective. It will not, however, remove all of the H.F. and thus we must still try and eliminate it from the 'phones themselves. An effective way of doing this is to use an output filter of orthodox design, namely an L.F. choke feeding the anode direct, with the 'phones connected between the anode and earth through a fixed condenser. This will, in many cases, be found perfectly satisfactory. In the event of trouble still being experienced, however, we must take more elaborate steps and a scheme which has been found very effective is to connect the 'phones in the anode circuit through series H.F. chokes, connecting a fixed condenser in parallel as shown in the full circuit of Fig. 1.

Alternative 'Phone Positions

The chokes in this case should be standard short-wave components and these and the condenser should be mounted as close to the valveholder as possible. In that case the 'phone leads may not be critical so far as concerns their length. Next comes the question of using the 'phones in a circuit of this type, where good volume is available, or where, for reasons of economy, it is desired to eliminate the output stage. In that case the parallel-fed method of connection may be adopted, and a change-over switch may be included as shown in the circuit. Here a similar filter to that already described may also be employed, the arrangement then being as shown in Fig. 2. In both of these cases the capacity of the by-pass condenser may be found critical and various capacities should therefore be tried out in order to find the most suitable one for the particular conditions being experienced. In general a large capacity will be found to cut the higher frequencies, but this may not be of great importance in the reception of code signals which are very weak as any tendency to oscillation or atmospherics may thereby be eliminated.

If we take the full circuit we may consider one or two arrangements which will assist in removing H.F. from the detector or output stages, the most important point being always to remember effective decoupling and sound earth connections throughout. The shortness of earth leads does not need emphasis in short-wave work as it is already well known that all such connections should be as short and direct as possible.

Tuned or Untuned?

Examining the complete circuit in Fig. 1 we can see that the arrangement depicted should answer the requirements just set out. Firstly, an untuned H.F. stage is suggested, the use of a choke (or if preferred a resistance) in the aerial circuit will reduce the risk of a large field and thus take away some of the problems of screening. Secondly, the use of an H.F. transformer coupling the first two stages will permit the anode circuit of the H.F. valve to be more or less directly earthed, using a fairly large coupling condenser in association with the small primary winding found on short-wave transformer coils. At this point the wiring should be of heavy gauge wire and connections made from point to point in the most direct and shortest manner. A test would perhaps be advisable if a circuit of this nature is being made up to see whether it is worth while introducing normal anode decoupling in the first stage. Sometimes this is not essential, especially with a simple three-valve circuit where the detector may be efficiently decoupled. In the detector stage more or less normal arrangements are suggested, but the inclusion of a good H.F. choke in each filament lead of this valve may be found worth while. Such chokes should, of course, be of low resistance to avoid voltage drop in the filament circuit, and should be capable of carrying the normal filament current. When using headphones it is possible, if the circuit is properly arranged, to obtain improved results by the use of critical reaction control, and therefore it may be found worth while in the set to include some form of filament potentiometer to which the grid leak is returned. Adjustment of this will control the smoothness of the reaction control and very weak stations may thus be picked up which would otherwise not be heard.

Finally, the point to remember when using 'phones is that should there be any H.F. present in the 'phone circuit this will automatically be fed into the body and therefore unless a good earth return is provided externally it will be bound to try and get back to earth through the easiest circuit, which will invariably be via the tuning controls when these are manipulated. A separate earth lead to the metal screen behind the panel may also be found more effective than the mere connection of the screen to the normal earth circuit in the receiver.

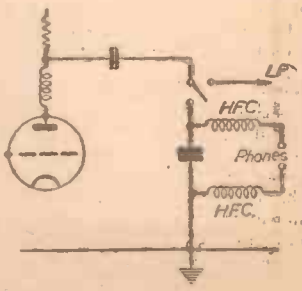


Fig. 2.—The phone circuit of Fig. 1, following the detector, may be arranged as shown here to improve stability.

Two-stage H.F. Amplifiers

Details of Variable Bias Volume Control Systems are Discussed in this Article

THE advantages of a two H.F. stage receiver are already well known, and it is interesting to consider the design of such a two-stage amplifier. The degree of amplification which can be obtained from such an amplifier is tremendous, and the difficulties which are experienced in its design do not concern the matter of efficiency nearly so much as of stability; the step-up provided by two

Selectivity

The one objection to this form of circuit is that the degree of selectivity is so high that there is a danger of introducing distortion due to the sharp response of the three circuits in cascade. Nor would the use of a band-pass filter in the aerial circuit confer any great advantage because this would still be followed by two sharply-tuned stages. This difficulty can most easily be overcome by placing the band-pass filter between the first and second valves as shown in Fig. 2. The advantages of this are that the band-pass circuit is not damped by the aerial, and that the two "sharp-peak" circuits are isolated, and that the arrangement becomes completely asymmetrical since all three tuning circuits are of different form. This is probably the best method of using two H.F. stages when ease of control and high-quality reproduction are required. Where high fidelity is not considered

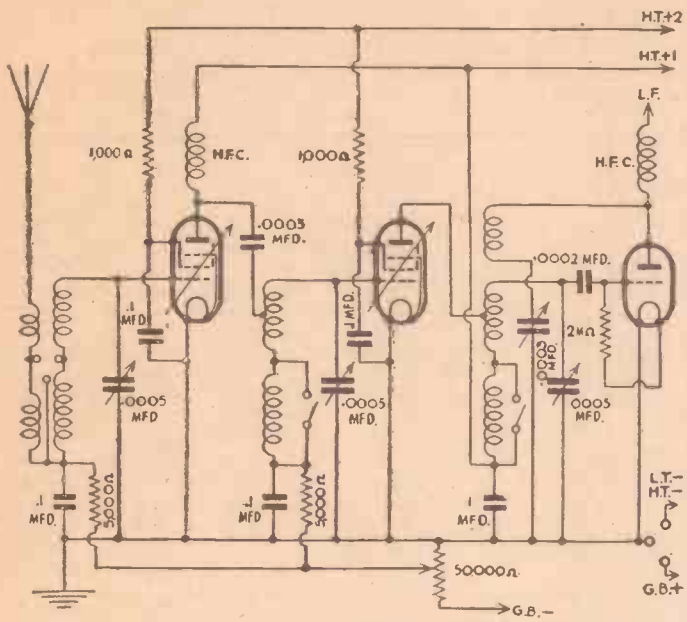


Fig. 1.—Skeleton circuit of a 2 H.F. amplifier with asymmetrical tuning circuits.

modern H.F. pentode valves is so great that the least amount of carelessness in design is certain to lead to uncontrollable reaction and unwanted oscillation of all sorts. It is mainly for this reason that it is nearly always best purposely to arrange that the valves shall not be operated at their full efficiency. This may sound wasteful, but the true range of a moderately efficient stable receiver is greater than that of a highly-efficient set which cannot be operated except by the expert.

"Asymmetrical" Tuning Circuit

Generally speaking, the tuned-anode circuit is most efficient and the tuned-grid circuit is least efficient; from this it would appear that the latter would be most suitable in the case under consideration. In practice, however, it does not work out quite like that, and it is nearly always found to be easier to make the two inter-valve circuits "asymmetrical," because by so doing there is less fear of feed-back between the two stages. Thus, it is found an excellent plan to use tuned-grid coupling between the first and second valves, and tuned anode between the second and third, the general circuit being rather as shown in Fig. 1. Here the circuits are arranged so that a three-gang condenser can be used to give single-knob tuning, it being understood that the characteristics of all three coils are similar.

essential, or if prime cost is an important consideration the circuit first described will fill the bill. Even when good reproduction is desired, a fair compromise can be effected by the use of tone control in the low-frequency portion of the set; this matter must be left for consideration until later.

S.G. Voltage Supply

The circuit shown in Fig. 1 is for battery operation, but the alterations required in designing an A.C. receiver are quite simple, as can be seen from Fig. 3. The chief point to observe in the mains version is in respect of the method of feeding the screening grids of the two high-frequency pentodes. In the A.C. circuit a single fixed potentiometer is used to provide the correct potential, and the screening grids are decoupled by means of 1,000-ohm non-inductive resistances, but in the battery circuit a separate H.T. tapping supplies the screening grids through decoupling resistances. With all variable-mu valves it is important that the S.G. potential should remain constant regardless of the setting of the volume control, and it is this fact which makes it necessary to use an apparently rather complicated resistance system in the case of the A.C. circuit.

When the matter is first considered, it would appear that the required condition could be satisfied simply by connecting a fixed potentiometer between H.T. + and H.T. −, and taking leads from the tapping of this to the S.G. terminals. But it must be remembered that the current passed by the screening grids when the volume control is set to increase the bias on the grids of the valves (to reduce volume) is automatically reduced; and as the current becomes less the voltage increases. The resistance network shown is typical of that required for most valves, but the values of the resistances vary according to the exact characteristics of the valves chosen, and, therefore, with their make. For this reason it is best to refer to the makers' instruction leaflet with regard to this point.

It will suffice to mention that the combined effect of the resistances is to maintain the S.G. voltage constant. This is because a movement of the slider of the volume control towards the negative end reduces the screening-grid current, and at the same time tends to reduce the voltage provided by the potentiometer by increasing the resistance of the lower "arm." These two effects, combined with those of

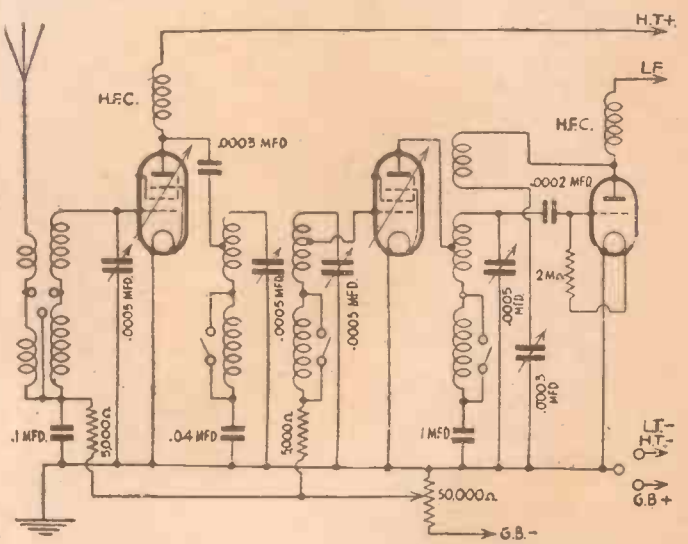


Fig. 2.—Band-pass tuning is here incorporated between the H.F. stages.

the decoupling resistances of providing a lower voltage drop when the current is reduced, balance out and maintain the S.G. voltage at a reasonably constant figure.

Simpler Methods

The rather complicated system just described can be avoided fairly easily by

(*Continued on next page*)

TWO-STAGE H.F. AMPLIFIERS

(Continued from previous page)

applying a variable bias voltage to the first valve only. In this case the second valve should be of the "plain" H.F. pentode type, and it simply receives a fixed bias voltage. This system is not a bad one,

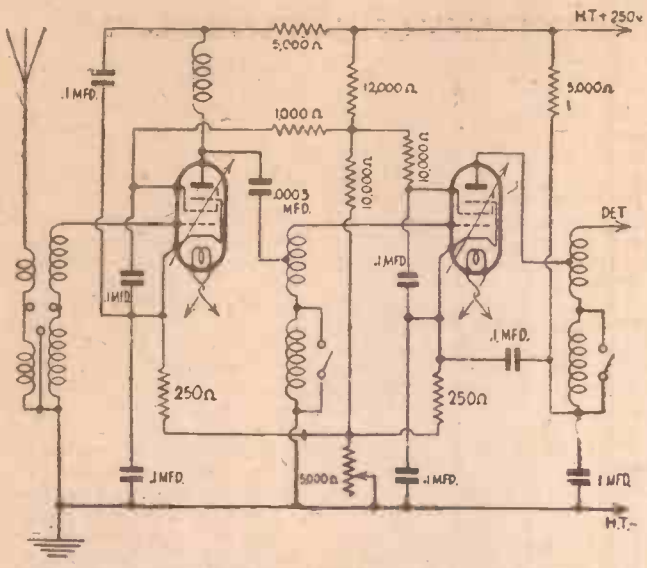


Fig. 3.—S. G. and Variable-bias controls. Values shown are average.

although it does not, of course, give quite such a wide range of volume control, but it does limit the amplification provided by the first valve and thus the input to the second. When using this arrangement it is generally preferable to use a separate fixed potentiometer to supply the screening grids of each of the two valves, and it is possible to simplify the variable-mu control by using the circuit shown in Fig. 4, in which it will be seen that the connections are very straightforward and that the anode circuits

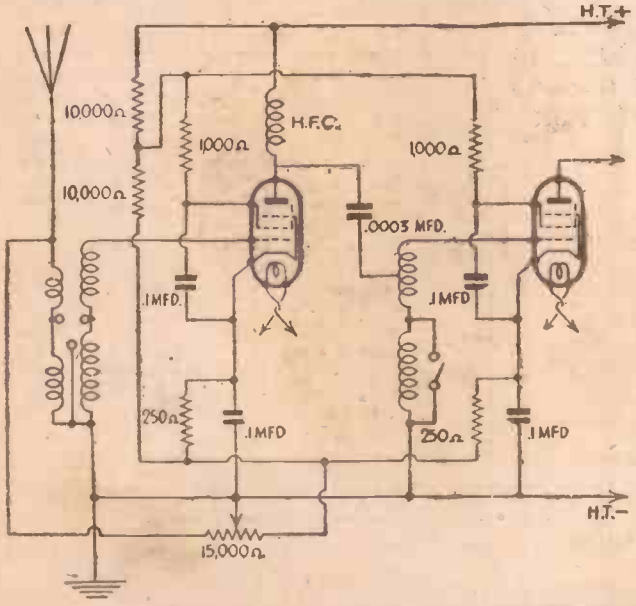


Fig. 5.—A dual form of volume control, reducing signal input and increasing bias voltage.

are not decoupled. The variable-mu volume-control potentiometer is wired in series with the lower "arm" of the fixed potentiometer, the slider being connected to the anode of the first valve through a 250-ohm "minimum-bias" resistance; the object of the latter is, of course, to maintain a certain bias voltage on the grid of the valve when the volume control is full on.

A Dual-function Volume Control

Another method of control which is extremely successful, although not widely used, is that shown in Fig. 5, where a single potentiometer is made to serve the double purpose of varying the bias voltage and also of imposing a variable "load" on the aerial circuit. Theoretically, this system is open to criticism, but in practice it is frequently found to be very valuable. The volume-control resistance has a much higher value than usual, because if it were of only about 2,000 ohms, say, it would tend to flatten the tuning of the first coil to a considerable extent. Being of about 15,000 ohms it does not produce this effect in any objectionable degree. The advantage is that as the amplification factor of the valves is reduced the signal input to their grids is also limited. Provided that the variable potentiometer is of good design and smooth in operation, it will provide a very well-graded control over volume, but it is desirable that the valves chosen should be of types which take a bias voltage up to 40 or so—in other words, they should be of the "long-base" variety.

Voltage Change

The fixed S.G. potentiometer is connected directly between high-tension positive and negative, so that the voltage which it supplies must vary to a certain extent according to the setting of the volume control and, consequently, according to the current passed by the screening grids. So long as "long-base" valves are employed, however, and provided that these are not normally required to function with less than about one quarter of the maximum bias voltage, the voltage change is so slight that it can generally be ignored. In any case, losses in this direction are adequately compensated for by the other more important advantages which have been enumerated above.

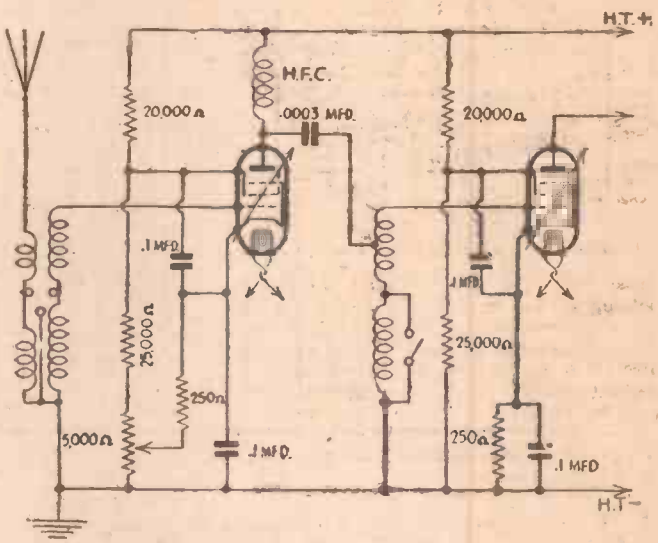


Fig. 4.—An alternative scheme with control of the first valve only.

NOTES FROM THE TRADE

Cossor Valves

MESSRS. COSSOR announce the release of some new 6.3 volt A.C. mains valves with octal bases. These valves are of the miniature type, and accordingly are known as the O.M. series. Seven types are available, and they include an octode, a triode hexode, two H.F. pentodes, a double diode, and a double-diode-triode. Full characteristics of these and the entire range of Cossor valves may be found in the new leaflet No. L370, which may be obtained on application to Messrs. Cossor. This leaflet also gives the base connections of all the Cossor range.

Westalite Rectifier

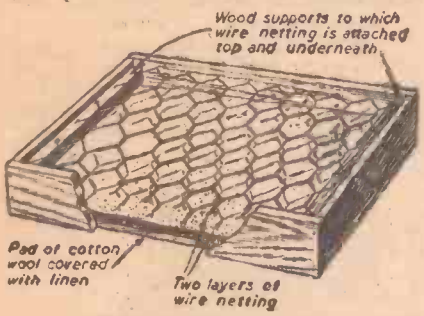
A new type of rectifier is announced by the Westinghouse Brake and Signal Co., Ltd. This rectifier, the result of six years' research, is of the selenium compound type, and is intended primarily for power rectification. It is not intended to replace the copper-copper oxide rectifiers, but for a number of applications the new rectifier will be substituted. Priority at the moment is being given to Government requirements, and in future the term "Westinghouse Metal Rectifiers" will include both the copper-copper oxide and the new "Westalite" types.

The Westinghouse Company also inform us that they have now arranged for their representative, Mr. E. R. Rogers, to be available for any assistance that may be required in Scotland in connection with their metal rectifiers. All communications for Mr. Rogers should be addressed to the offices of their Scottish Agents, Messrs. J. E. Robson and Co., 11, Bothwell Street, Glasgow, C.2.

Practical Hints

A Handy Valve-rack

I WISHED to make a valve rack for the valves (battery) which I am continually using. I obtained a box about 3in. high and covered the bottom with a pad of cotton wool about ½in. thick and covered this with a piece of linen. Any sort of pad would do, probably the best being one of sponge rubber. Then I placed at the ends of the box two pieces of wood about 1in. square running the length of the end, and about ½in. down. On to the underside of

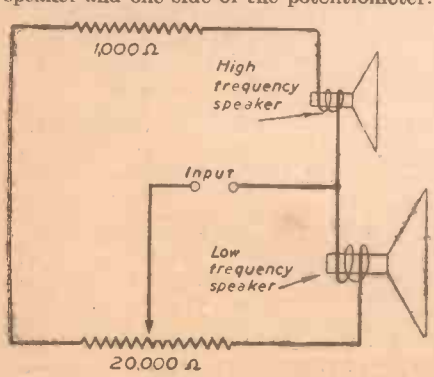


A valve-rack made with pieces of wire netting.

these pieces of wood I fixed some wire netting so that it covered the box. On the top of the bars of wood I fixed another piece of wire netting so that the holes came directly over the holes in the other piece of netting. Now the rack is complete, and it will be found that a valve rests nicely in the holes of the two layers of wire and on to the pad.—P. HALL (Ross-on-Wye).

Novel Tone Control System

THE accompanying circuit diagram shows a tone control arrangement which does more than merely subtract the unwanted frequencies when "highs" or "lows" are to be stressed. With this system high notes are "boosted" in one speaker, and low notes in another. Two speakers are employed, the low frequency one a 9in. to 12in. dynamic speaker, and the other a high frequency unit, preferably of the magnetic type, and 3in. to 5in. diameter. The two speakers are connected in series, and the input is "faded" between them by means of a 20,000 ohms potentiometer in the input circuit. To prevent blasting, a 1,000 ohms fixed resistor should be connected between the high frequency speaker and one side of the potentiometer.



A tone control circuit for two loudspeakers.

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

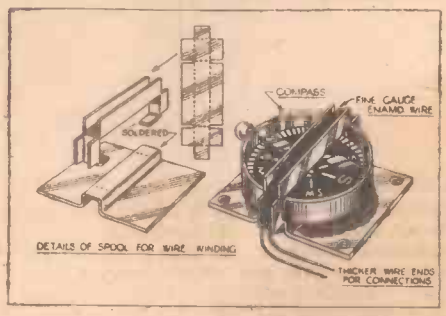
SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

I have found this installation to be highly satisfactory.—L. BLAGBROUGH (Brighouse, Yorks).

An Easily-made Galvanometer

QUITE a neat and handy testing instrument (actually it is the simplest form of galvanometer), can be quickly made by fitting a winding of wire to an ordinary pocket compass. A few turns of enamelled or silk-covered wire, wound round the compass casing, will be found quite sufficient



A simple galvanometer made from a pocket compass.

for rough tests of current flow of a volt or so pressure.

An arrangement on a more ambitious scale is shown in the drawing, which is self explanatory. From this it will be seen that the spool for the coil is made from sheet brass, and is made in such a form as to also serve as a stand for the finished instrument. The spool is made of such a size as to allow of a close fit for the compass, which can be slipped in, as shown, to form the complete galvanometer, and can be removed when normal use of the compass is required. Dimensions of the spool have been purposely omitted, owing to the large range of sizes of these pocket compasses.

The gauge and number of turns for the coil is a matter for experiment, but approximately 150 turns of about 40 gauge enamelled wire will be found to give quite good sensitivity. To facilitate easy connection, the two ends of the winding should be soldered to light flex leads.

In use, the complete instrument is turned bodily, until the needle of the compass is parallel with the coil; in other words, the coil will be pointing north and south. When a current is passed through the coil the compass needle will turn at right angles to the coil.

The instrument described will be found to indicate the current flow of a few milliamps, although, of course, no actual check on the number of milliamps passing would be possible. Such actual readings are possible only with one or other of the many excellent commercially made milliammeters. However, for rough checking purposes, the home-made instrument described will be found quite useful, and is certainly of interest for the experimenter.

A point worth noting is that certain components in a receiver, such as L.F. transformers, chokes, and speakers will deflect the compass needle, if brought into close proximity, so in rough tests of anode current flow, it is best to fit leads of 3ft. to 4ft. in length, in order to keep the instrument clear of the receiver. Experiments might be tried of using tin plate in place of brass for the spool. This metal being magnetic, would automatically draw the compass needle in parallel with the coil, but would possibly affect the instrument's sensitivity on small currents.—R. L. GRAPER (Chelmsford).

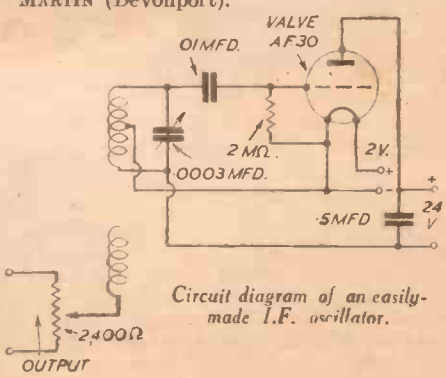
An I.F. Oscillator

BEING chiefly interested in superhet work, I was badly in need of an oscillator, and the accompanying circuit is one I constructed out of components from a "spares box."

It consists of a 175 kc/s I.F. transformer, centre tapped, with 50 turns removed from one end; the side with the smaller number of turns was made the plate side. To calibrate connect the output terminals to the A and E of a broadcast receiver tuned to a known frequency, and then tune the oscillator to the same frequency, keeping the signal just audible. Note the reading on the tuning dial. This operation has to be repeated several times and from the results a graph is drawn.

From the graph drawn, the dial settings for a required frequency can be determined and by reversing the process of calibration the receiver can be adjusted.

The oscillator was housed in a wooden box measuring 10in. x 5in. x 6in. x 4in., and lined with perforated zinc. It is important that once the oscillator is calibrated, nothing be moved.—ROY C. E. MARTIN (Devonport).



Circuit diagram of an easily-made I.F. oscillator.

ELECTRONIC BREVITIES

Details of Modern Electron Multipliers, Cathode-ray Tubes and Associated Apparatus

By H. J. BARTON CHAPPLE, B.Sc.

Increasing Length of Life

IT is well known that when an electron multiplier is built with electrodes of caesium on silver there is a high ratio of secondary emission for every primary electron bombardment. On the other hand, experience has shown that these same surfaces have the disadvantage of relatively high vapour pressures and low melting points. When used in an electron multiplier, therefore, in which the degree of vacuum is made as high as possible, there is a tendency for these surfaces to release a quantity of free ions. Not only do these ions interfere with the normal stream of electrons in its passage from cathode to final collecting anode, but there is the greater danger of bombardment of the target electrodes themselves. When this happens it brings about an additional strain on those surfaces and causes the coating to disintegrate and thereby reduces the useful working life of the complete multiplier. Steps have, therefore, been taken to overcome this defect and the most successful idea at the moment consists in shaping the electrodes to a special design. This shaping is of such a character that the positive ions are deflected away from the normal flow path of the main negative electron stream. They leave the electrode at an angle and are collected by a separate electrode before they have had any chance of doing damage to the target electrode surfaces.

A Screen Problem

There are many important problems associated with the fluorescent screen of a modern high vacuum cathode-ray tube and no matter for what purpose it is used the geometrical image or television picture built up on this surface should be sharp and clear cut. Experience has shown, however, that due to the accumulation of casual electric charges on the screen there is a repulsion or diversion of the main impacting electron stream and this produces a blurring effect, particularly if the tube is being employed for television picture reconstitution. Any scheme which introduces a conducting material to equalise or dissipate these spurious charges is satisfactory, provided the fluorescent powder of the screen is deposited on this material. One very effective method is to use a screen backing covered with a thin but continuous layer of platinum. This is then cut to make a metal grid whose meshes are at least ten times as wide as the remaining metal ribs. On this open mesh grid the fluorescent material is laid and it is found in practice that the opaque metallic ribs of this support produce a negligible effect on the overall luminescence, but all blurring is removed because of the effective leakage path provided for the stray electric charges.

Reducing Tube Length

One of the fundamental drawbacks of cathode-ray tubes, especially the earlier models, was the very long length of glass container required in order to obtain a screen face of reasonable diameter. This was due in no small measure to the fact that the initial larger faced tubes were based on the design of the laboratory C.R. tubes of 5 to 6ins. screen diameter having a narrow angle conical taper and a long cylindrical neck housing the deflector plates, electron emitting cathode and one or more focusing anodes. Due to the demands for compact designs both in monitoring equipment, laboratory oscillographic apparatus and television receivers, designers at once set to work to reduce the overall length without cutting down the fluorescent screen diameter. This introduced many unexpected complications, for in the case of a television picture reproducer a limit is set between the distance separating the final anode, deflecting system and screen due to questions of scanning voltages, line curvature, etc. Some designers resorted to pyramidal glass envelopes instead of the more conventional conical ones, and as an example of the success which could be achieved in this connection reference can be made to the accompanying illustration. Here the tube

A chassis of a modern television receiver in which a short-neck television tube is used.

is at least a foot in diameter, yet its length does not exceed the depth of the receiver chassis and so avoids that annoying rear projection cover which characterised so many of the sets put on the market last year. Another very effective suggestion which has been put forward, however, is to avoid the neck length which normally accommodates the cathode, pinch, and terminal cap. This is done by placing the pinch section in a right-angled projection to the neck a few inches remote from the end. The cathode only is then housed at the end of the shortened neck and from then onwards focusing and deflecting equipment is normal and an effective reduction in overall length is brought about.

Caught in Its Own Mesh

The much lauded American television service which came into being over a year ago and which the authorities claimed would make that country the leading one in the world has, quite frankly, proved a big failure. This seems to be attributable to the fact that the official R.M.A., the Federal Communications Commission and the leading television manufacturers themselves all had different ideas on how the service should be run and the picture standards that should be employed. The F.C.C. constitute the body in whom is vested authority for allowing commercialised broadcasts to take place, and they refused to issue licences until there was an agreed opinion as to the standards adopted. Public interest with its protection against early receiver obsolescence was at loggerheads with those visionary companies who stood out for a higher picture definition than 441 lines, and a stalemate was reached. The whole problem is once more under review in an endeavour to come to some compromise and it seems certain that the 441 lines 60 frames interlaced to give 30 pictures per second will be dropped. A single set of standards will obviously have to be agreed upon, but the receiver manufacturers will not only have to be prepared to make changes to meet picture improvements, but assurances will have to be given that set alterations can be undertaken simply by the purchaser or by service engineering personnel at nominal charges. If this compromise can be effected there is every hope that the industry will make satisfactory progress, but whether this condition will be reached in the winter of 1940 or the spring of 1941 is a factor on which no one seems prepared to voice an authoritative opinion.

A Novel Meter

The modern forms of meter can be relied upon for making measurements of most things whether they depend upon electrical or photo-electric phenomena. A new device has been produced, however, which by an ingenious arrangement of two photo-electric elements enables the reflection factor of an illuminated screen to be read off directly from a calibrated scale. In so far as a cinema or television screen is concerned the first consideration is the illumination or the total light reaching the whole of the available surface from the combined lamp and optical source. This factor is measured close to the screen itself. The next is brightness, which in screen parlance is regarded as the power of the screen to reflect the incident light back to a point—say the middle of the stall seats—which is a measurable distance from the screen. This measurement will naturally be confined to a comparatively narrow beam of light and so differs from the main illumination mentioned earlier. The meter itself is therefore arranged with its sensitive elements in such a way that one unit responds to light from a narrow angle (brightness) and the other to light from a wide angle (illumination). The ratio of these two quantities is the reflection factor which is shown clearly on a scale.

Oscillator Tuning

The Merits of the Standard and the Shaped-plate Tuning Condenser are Considered and Compared in This Article

CONSTRUCTORS sometimes desire to build a superhet, but are undecided which type of ganged tuning condenser to employ. In other words, shall it be a condenser of standard plate shape, as used in the tuned radio-frequency receiver, or shall it be one which has a special plate-shape section for tuning the oscillator circuit of a superhet?

Most constructors are familiar with the principle of the superhet receiver; how the locally generated oscillations are mixed with the incoming signal, and a new frequency—the intermediate frequency—is produced and passed on to the grid of the second detector. This principle applies in all cases, whether a separate oscillator valve be used or one of the newer single-valve frequency changers. It is also common knowledge that the oscillator frequency should differ from the signal frequency by an amount which is equal to the peak frequency of the intermediate-frequency amplifier which is now standardised at 465 kc/s in this country.

A transmitter can be tuned in by adjusting the frequency of the oscillator circuit either 465 kc/s above or below the signal frequency, providing, of course, we are not employing ganged tuning control for the oscillator circuit.

Now it has to be borne in mind that, although no difficulty is encountered in obtaining this frequency sum or difference, when the circuits are only tuned to one wavelength or frequency, the position is vastly different, since when on the medium waveband alone we have to tune in stations on frequencies from 500 to 1,500 kc/s representing 200 to 550 metres.

Frequency Difference

When the signal frequency circuits are tuned to any one station on the medium waveband, the tuned oscillator circuit must be so arranged that the frequency generated by it is either more or less than the signal frequency by 465 kc/s, irrespective of the frequency of the station being tuned in within limits mentioned.

In practice, designers arrange the oscillator circuit to tune to a frequency higher than that of the incoming signal (that is, to a lower wavelength), consequently the inductance of the oscillator coil must be lower than that of the inductances in the signal-frequency circuits. This gives us the required frequency difference at one point, but unfortunately does not permit of a constant frequency difference being maintained over the whole of the tuning scale.

Our object, therefore, is to devise some means whereby this frequency difference is maintained at all positions of the tuning condenser if we are to obtain satisfactory results.

Two methods are actually employed in practice to achieve this result, and these will now be discussed. An appreciation of their advantages and disadvantages will enable us to determine which system is the most suitable for the particular receiver we have in mind.

Matching Frequencies

With the padding condenser method a ganged tuning condenser is employed in which the capacity of each section is equal at all points in the tuning scale, and it has a maximum capacity in each section of 0.0005 mfd.

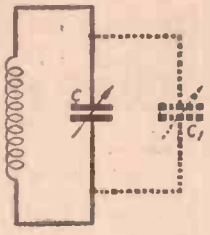


Fig. 1.—The standard signal-frequency tuned circuit.

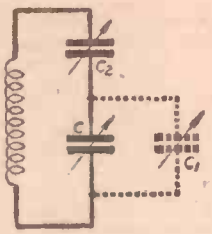


Fig. 2.—This is the equivalent oscillator tuned circuit.

Let us examine the circuit arrangement shown in Fig. 1.

This shows the standard arrangement employed for tuning the signal-frequency circuit of either a tuned radio-frequency receiver or a superhet receiver. The tuning condenser in each instance is represented by C, while C1 represents the usual trimming condenser in parallel with it.

The padding condenser in the oscillator circuit is represented by C2 (Fig. 2) and usually has a maximum capacity of 0.0025 mfd. It may be a fixed or semi-variable condenser.

This arrangement is quite satisfactory and will give quite good results, but, theoretically, accurate ganging over the whole of the waveband cannot be achieved. In practice the mistuning amounts to only about 2 or 3 kc/s, and as this is only about 0.2 per cent. it is not appreciable.

To align the circuits for accurate ganging, proceed as follows: First of all tune in a station transmitting on a wavelength of about 200 metres (1,500 kc/s) and adjust the trimmers in parallel with the oscillator tuning condenser. As the tuning condenser is at its minimum capacity any adjustment of the padding condenser, therefore, will not have any appreciable effect. This condenser is in series with the tuning condenser, and its capacity is many times that of the minimum capacity of the latter.

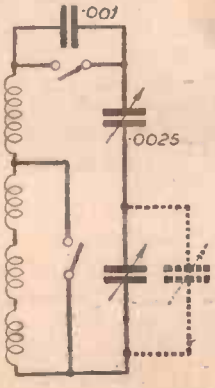


Fig. 3.—This is an oscillator circuit employing a standard tuning condenser.

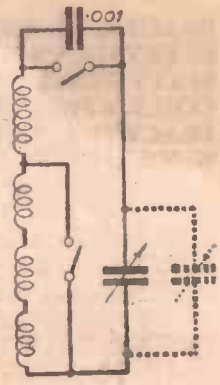


Fig. 4.—The oscillator circuit when a special shaped-plate tuning condenser is used.

Now adjust the tuning condenser until a station at the top end of the medium waveband is received, say, 600 kc/s (500 metres). At this point the moving vanes of the tuning condenser will be nearly fully enmeshed and consequently near their maximum capacity. Do not touch the trimming condenser; its capacity is very small in comparison with the maximum capacity of the tuning condenser. At this point we adjust the series condenser C2 in the oscillator circuit; this will alter the maximum capacity of the tuning condenser. At the same time a slight adjustment of the tuning condenser should be made in order to maintain maximum sensitivity.

To obtain the best results it may be necessary to repeat this process several times; returning to the lower waveband, adjusting the trimmers, returning to the top end and adjusting the padding condenser.

Eventually it will be found that ganging will hold quite satisfactorily over the whole of the tuning scale. When coils are accurately matched, no adjustment is usually necessary on the long waveband. It is, however, necessary to employ an additional padding condenser to maintain accurate ganging on the long waves. This condenser is switched out when receiving medium-wave stations, and Fig. 3 shows the final arrangement of the oscillator circuit.

Special Condensers

With the special plate-shape ganged condenser system only one padding condenser is required—for the long waveband. Theoretically perfect ganging can be obtained over the whole of the tuning scale. The inductance of the oscillator coil has now been standardised at 126.5 microhenries for the medium waveband when the coils in the signal-frequency circuits have an inductance of 157 microhenries.

If you examine a triple gang tuning condenser, which has specially shaped vanes for tuning the oscillator circuit, it will be noticed that the fixed vanes of the oscillator section have been cut away so that it follows a different law and so maintains a constant frequency difference over the whole of the waveband.

Practically the same methods should be adjusted to ensure perfect ganging as described for the standard plate shape system:

Tune in a station on the lower medium waveband, and adjust oscillator trimmer so that about a half of its capacity is used. Then turn to the trimmer in the signals-frequency circuits and adjust for maximum response. Next tune in a station, as before, at the top end of the medium waveband, but as we have no series condenser to adjust, in this case we slightly adjust the oscillator trimmer.

In both cases discussed it will be noticed that the oscillator trimmer is the critical one, and the other circuits will appear relatively flat in comparison. In carrying out these adjustments it may be necessary to alter the tuning dial at the same time to keep circuits in resonance.

(Continued on next page.)

OSCILLATOR TUNING

(*Continued from previous page*)

When results are satisfactory on the medium waveband, switch over to the long waves. A long-wave padding condenser is necessary, as with the other system, and if this is of the semi-variable type, it may be advisable to make slight adjustment. Tune in a station at the top end of the waveband and adjust padding condenser, at the same time rocking the tuning condenser backward and forward very slightly. This completes the ganging and results should be quite satisfactory. Sometimes, however, it may be necessary to adjust trimmer slightly in the middle of the medium waveband.

Fig. 4 shows the circuit arrangement employed which differs from the previous circuit as no medium-wave series padding condenser is employed.

It is essential to bear in mind that, irrespective of the method employed, unless accurate ganging is achieved, many of the advantages of the superhet circuit will be lost. Second-channel interference and whistles may become very troublesome.

We are now in a position to review the relative merits of the two systems; both have advantages and disadvantages. If the constructor possesses a standard ganged tuning condenser, there is no reason why it cannot be employed in a superhet receiver.

The advantage of this method is that the tuning condenser can be used in either a superhet or tuned radio-frequency receiver. An additional padding condenser is, however, necessary, and it is not quite so simple to adjust the circuits for accurate ganging.

The special plate-shaped method is the ideal arrangement. Ganging is fairly simple to carry out and excellent results can be obtained without complications. Only one padding condenser is necessary for the long waveband.

There is only one disadvantage and this does not affect the operation of the superhet concerned; the condenser cannot be used either in a straight receiver or in a superhet employing an intermediate frequency for which it was designed.

Resistance-capacity Coupling

Facts and Figures Regarding the R.C. Method of L.F. Coupling

A PROPERLY-DESIGNED R.C. circuit usually scores over a transformer circuit inasmuch as the response curve is practically straight, apart from the inevitable tailing off in the extreme bass and treble. There are certainly no resonances which, however slight, are inseparable from even a first-class transformer. The chief requirements of any L.F. stage are good amplification and a faithful reproduction of the original signal.

With an R.C. stage we must remember that there is no transformer step-up; consequently, the theoretical voltage magnification can never exceed the amplification factor of the preceding valve, and in practice it is, of course, very much less.

Standard Circuit

Fig. 1 shows the basic circuit where V1 is the detector valve and V2 the first L.F.

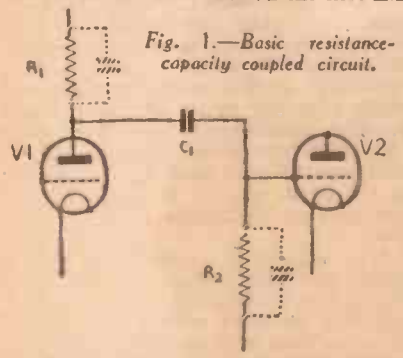


Fig. 1.—Basic resistance-capacity coupled circuit.

In order to obtain the maximum voltage step-up, the anode load R1 must be as high as possible, and theoretically an infinite resistance would give the maximum step-up equal to the valve amplification factor. In practice it is unwise, from a quality standpoint, to exceed 25,000 ohms, even though this may mean a loss. The self-capacity of the resistance, together with the associated wiring, may be considered as a condenser in parallel with it, and if we use a high value of resistance, the reactance of the capacity in the extreme treble may be comparable with the resistance itself. The anode load is thus reduced, and the amplification of the higher audio-frequencies suffers. If, however, we keep the coupling resistance low, the by-passing effect of a small capacity is unimportant, and is only noticeable at a point well outside the audio-spectrum. Similarly, one should never choose a value of coupling condenser which necessitates a high-resistance grid-leak.

Unfortunately, only part of the signal appears at the grid of the following valve. The coupling condenser and grid-leak form a potentiometer, and only the voltage developed across the resistance is accepted by the L.F. valve. At low frequencies the reactance of the coupling condenser increases, which in effect means a lower voltage developed across R2. In order that amplification shall not suffer in the bass, therefore, the grid-leak should be as high as possible and the coupling condenser large, but there are two important reservations. As pointed out above, R2 must be kept reasonably low to avoid high-note loss. The second reservation needs more investigation.

Time Constant

After each successive wave-train the grid potential of the L.F. valve must return to its normal value, i.e., as determined by its normal negative bias. One of the functions of R2 is to allow the charge to leak away sufficiently quickly to attain this desirable state. Unfortunately, the condenser takes a very definite time to discharge, which is determined by its own capacity in microfarads multiplied by the leak resistance in meghoms. The result, the "time-constant" is in seconds, and indicates the required interval for the condenser charge to fall to 37 per cent. of its initial value. The discharge curve is as shown in Fig. 2.

Grid-blocking

In order to avoid the distortion known as "grid-blocking" indicated by a strangling effect, it is important that the time-constant shall be short compared with the shortest interval likely to be experienced between two successive oscillations. As modern amplifiers and speakers often show a good response as high as 12,000 cycles, the problem is not an easy one.

In practice it is customary to tolerate a little grid-blocking in order to preserve the lower frequencies; furthermore, this trouble

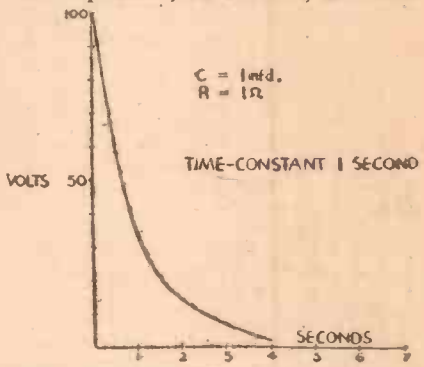


Fig. 2.—Discharge curve of the grid circuit.

is rarely noticeable unless the signal is loud and the time-constant very high. A good rule is to choose a value of leak and condenser which will give 90 per cent. of the theoretical amplification at 50 cycles. Such a combination will have a time-constant of approximately .0066, and any values of leak and condenser may be chosen to give this product, with the reservation as to too high a resistance.

A.V.C. Circuits

Some Interesting A.V.C. Arrangements which the Experimenter Can Try

AS most readers now know, there are various ways of obtaining the A.V.C. effect, the most usual being by means of a diode rectifier associated with the normal detector stage. This diode may form part of a double-diode-triode valve, or it can be separated as, for example, when a Westector is used for this purpose. The H.F. voltage applied to this diode circuit by the carrier is rectified, and fed through suitable filters as a negative grid bias to the grids of one or more pre-detector amplifying valves. For example, in the circuit shown in Fig. 1 the heptode V1 and the variable-mu S.G. valve V2 are controlled by the A.V.C. bias voltage.

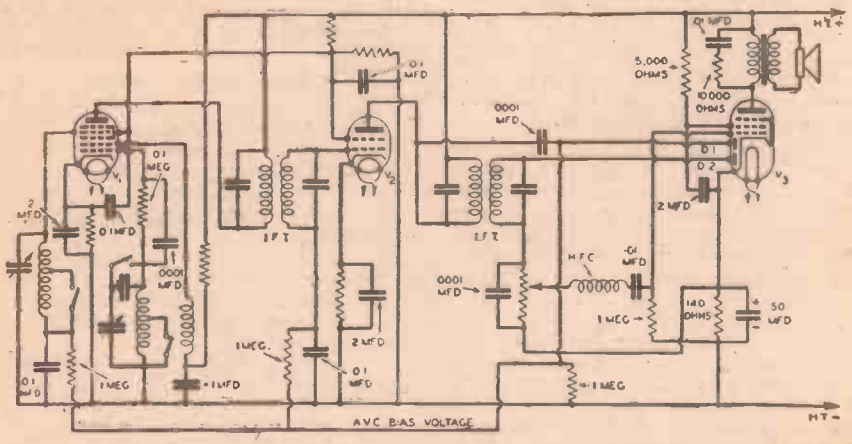


Fig. 1.—An A.C. three-valve superhet circuit with A.V.C.

It will be obvious that the diode rectifier will normally develop a small A.V.C. bias on even a very weak carrier. This is not desirable, as the sensitivity of the receiver would be reduced, and for this reason it is usual to delay the action of the A.V.C. diode so that it does not operate below a certain carrier voltage. This modified arrangement is termed "delayed" A.V.C. and is the form commonly adopted.

Delay Voltage

The delay effect is obtained by applying a negative bias to the anode of the A.V.C. diode. In Fig. 1 it will be seen that the A.V.C. diode anode (D1) is connected through its 1-megohm load resistance to the negative end of the V3 cathode bias resistance. The A.V.C. diode anode is therefore negative with relation to its cathode. In the case of a battery valve bias voltages are adjusted with relation to the negative side of the filament.

When the peak carrier voltage across the 1-megohm load resistance is less than the D.C. delay voltage across V3 bias resistance, the A.V.C. diode does not rectify, and as no A.V.C. bias voltage is developed, V1 and V2 will operate at full efficiency.

When the peak carrier voltage exceeds the D.C. delay voltage the A.V.C. diode will rectify and develop an A.V.C. bias voltage, this voltage increasing as the carrier strength increases. As the A.V.C. bias voltage controls the amplification given by V1 and V2 an increase of A.V.C. bias will tend to reduce the amplification, and also the carrier voltage applied to the A.V.C. diode and the signal diode.

Obviously, if the A.V.C. system has a sufficiently wide range of control, a constant peak carrier voltage will be applied to the signal diode D2 which feeds the L.F. amplifier, and this peak carrier voltage will be equal to the D1 diode delay voltage. When the carrier voltage is insufficient to operate the A.V.C. system the receiver operates at full efficiency.

It should be mentioned that the principle of controlling a diode rectifier by applying a bias voltage should be noted as it is of primary importance in the use of diode rectifiers in general. For not only can the action of a diode be delayed, that is to say made inoperative on weak signals, by applying a negative bias, but by the use of positive bias the diode action can be accelerated and made sensitive to very weak signals.

Increasing Sensitivity

A positive bias equal to the filament

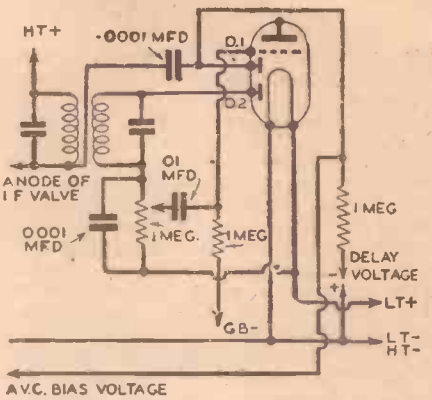


Fig. 2.—This is a delayed A.V.C. circuit.

voltage is applied to the signal diode D2, shown in Fig. 2 by returning the 1-megohm load resistance to L.T.—. This increases the sensitivity of the diode, and of the receiver as a whole to very weak signals. Fig. 2 also shows the method of applying a delay voltage to the A.V.C. diode in a battery receiver. The effect of biasing a diode is the same as that of varying the grid potential of a leaky-grid detector, and can be applied to a Westector as well as a valve-type diode.

It will be clear that the L.F. amplifier of an A.V.C. controlled receiver should be so designed that when the peak input to the L.F. from the detector is equal to the A.V.C. delay voltage, the full output desired is obtained without the L.F. volume control being reduced appreciably. The A.V.C. system will then hold all stations received at the maximum undistorted output, or less. As previously explained, this is the desired effect.

Many receivers incorporating A.V.C. have not fulfilled this requirement, with the result that the A.V.C. action has only been obtained with the L.F. control reduced considerably. As in most cases of this type, only very strong stations are receivable with the L.F. volume control reduced appreciably so that the A.V.C. action has occurred when it is least required.

3-valve Superhet

The combination of a double-diode with a high-efficiency output pentode as one multi-valve makes a three-valve A.C. superhet with a very good A.V.C. characteristic possible. A receiver of this type

(Continued on next page)

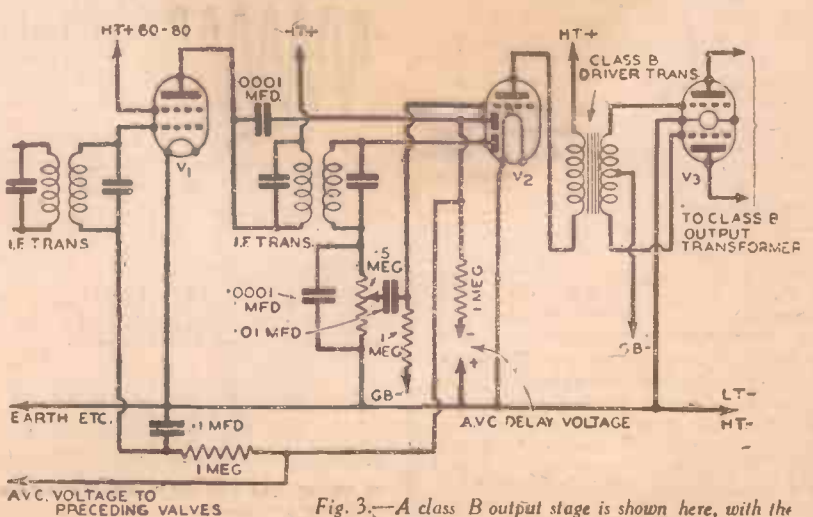


Fig. 3.—A class B output stage is shown here, with the triode section of a D.D.T. valve acting as driver

A.V.C. CIRCUITS

(Continued from previous page)

is shown in Fig. 1, and the pentode section only requires an input of two or three volts to give some three watts output.

Unfortunately, no valve of this type is at present available for the battery user, but a similar circuit could be employed using a steep-slope pentode and two Westectors as the diodes. When Class B output is desired on the grounds of economy the circuit shown in Fig. 3 could be adopted. The first detector and oscillator are not shown, but a heptode could be employed with advantage.

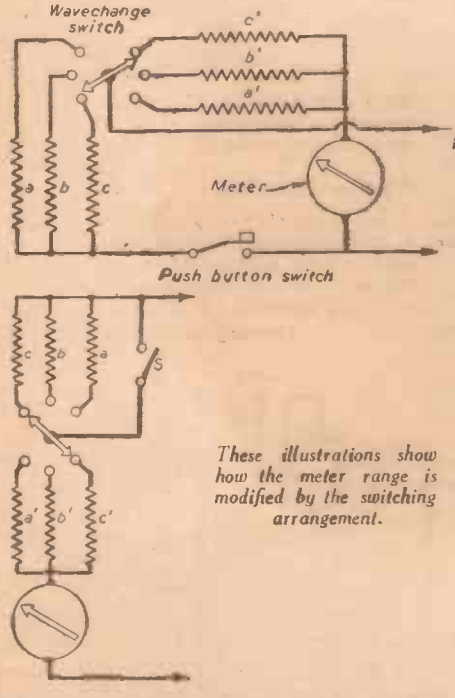
The triode section of the double-diode triode is used as the Class B driver in this circuit. It is usual to use a small power valve as driver for a Class B stage, but provided the smaller type of Class B valve is used with the circuit shown it should give 1 to 1½ watts output.

To obtain higher sensitivity than a four-valve superhet of this type would give, a signal-frequency H.F. stage could be employed with advantage. This stage could be controlled by the A.V.C., and this would improve the A.V.C. characteristic, although two controlled valves in a superhet give a sufficient range of controls for general use.

Both the suggested circuits operate with a high input to the signal diode, which ensures linear rectification and, consequently, very good quality apart from the improved A.V.C. action.

METER COMPENSATING UNIT

IN the wrinkle published in our issue dated June 22nd last, and bearing the above title, the originator of the idea had unfortunately wrongly sketched the arrangement of the switches, and the references to a set of resistors. The two



These illustrations show how the meter range is modified by the switching arrangement.

illustrations should be as shown above, from which it will be noted that in one of these the arm of the switch should be joined to the output lead and in the other illustration the references a, b, c and a^1, b^1 and c^1 should be transposed. The effect of the switching arrangement is to halve and double the effective resistance of the meter in the two circuits shown.

Temperature Effects

How a Modern Set can Introduce "Fading" owing to the Effects of Heat from the Valves

FADING of radio signals is accepted as a necessary evil, but the ever-increasing number of S.W. superheterodyne receivers in use has brought to the fore a type of fading which can, to a great extent, be overcome.

On a number of receivers examined because of complaints of bad fading, it was found that signals tuned in at good strength disappeared completely after the set had been on for anything from ten to thirty minutes, and although they could be brought back by a slight variation of tuning, they disappeared again a little later, necessitating further tuning adjustment. This disturbing effect continued throughout the listening period. Investigation proved the trouble to be due to temperature changes inside the receiving set affecting components in the oscillator circuit, with consequent slight variation or "drift" in oscillator frequency. It may at first sight seem unlikely that these slight changes in frequency would be sufficient to cause serious fading, but that this can be so is clearly shown in the following numerical example.

Compact Design

Assume that it is desired to receive an unvarying signal of 5,000 kc/s on a superhet with an intermediate frequency of 465 kc/s. To achieve this result it will be necessary to tune the oscillator to a frequency of 5,465 kc/s. Now if, for any reason, the oscillator frequency changes by, say, 1 per cent., i.e., to 5,465 ± 54.65 kc/s, it is obvious that the intermediate frequency circuits will be out of tune to the extent of 54.65 kc/s, or roughly 12 per cent. This, in a receiver of reasonable selectivity, if not sufficient to cause a complete fade of the signal, will at least result in a serious drop in level.

Now, lack of stability in an oscillator may be, among other things, due to a poor valve (with unstable values of the constants r_a and g_m), poor design and faulty or unsuitable grid and anode condensers and resistances. In the instruments examined, compact design was the chief cause of the trouble, inasmuch as the proximity of the valves to oscillator components was, by the effect of dissipated heat, sufficient to cause frequency changes. In the majority of cases investigated there was sufficient heat to cause expansion of the oscillator tuning condenser plates, with consequent detuning. In these cases a complete cure was impossible without changing the design of the set, so a compromise was effected by adjusting the oscillator and intermediate frequency circuits for maximum performance *after* the set had reached its normal working temperature. This resulted in stable operation after the initial warming-up period.

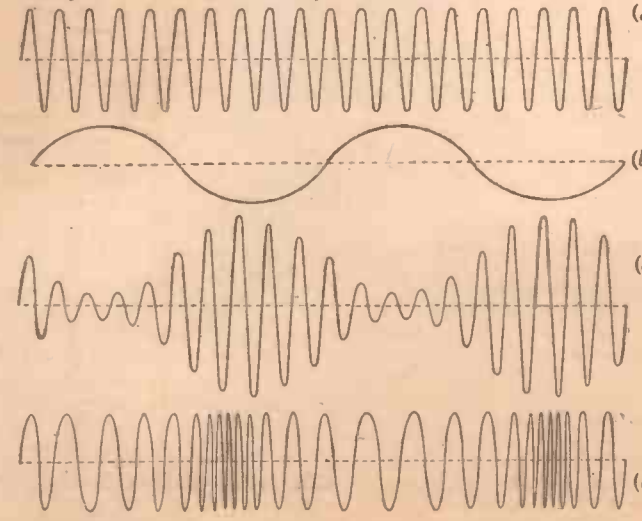
Faulty Fixed Condensers

In two other cases the trouble was due to an "oil-can" effect in small "stamp" type fixed condensers. The plates were apparently not securely clamped together and the valve heat caused expansion and bulging of the outer plates, which, from then onwards being in a state of mechanical strain, spasmodically varied their location, with consequent variation in capacity and, therefore, oscillator frequency. Replacement of the faulty condenser effected a permanent cure.

As it is certain that numerous readers will be experiencing this so-called "fading" produced by oscillator frequency drift, it is hoped that the foregoing notes will give them a line to work on, and help them to effect some improvement.

"How Frequency Modulation Works"

IN our issue dated June 15th last we gave some details of the new transmission system known as Frequency Modulation. In the illustrations accompanying this article, however, two of the curves were transposed. To remove any confusion which may exist the curves are reproduced below, in their correct order. Readers who followed this article by a study of the general article on Modulation in our issue dated July 6th will, of course, have seen that the regular curve is that of a radio carrier-wave of constant amplitude and that the combined carrier and audio wave gives rise to the uneven curve shown as (c) below.



(a) Is a radio carrier wave of constant amplitude; and (b) is a programme or audio wave for modulating (a).

(c) is the carrier and audio wave combined in Amplitude Modulation, whilst (d) is the same combination in Frequency Modulation.

Superhet circuit showing a Q.A.V.C. valve and associated circuit.

Comment, Chat and Criticism

Outline of Musical History—9

Some Leading Figures in the Romantic Movement are Discussed by Our Music Critic, MAURICE REEVE

I HAVE tried to show how music reached a culminating point in Beethoven, and how his towering genius and mighty output were at least partly responsible for the developments which took place after his death. The very exhaustiveness and comprehensiveness of his message, together with the spirit of the age, forced composers into what is now termed the "romantic" school of writing.

I will now offer some brief biographies of the leading figures of the movement, together with short sketches of their work. I propose starting with Mendelssohn and Schumann, as they, though ardent spirits of the romantic movement, were symphonic writers who, one might say, started the symphony off on its new, romantic, course. Whilst Brahms might be styled, musically, Beethoven's son, Mendelssohn and Schumann might be his nephews; and they, in their turn, could be considered the fathers of Dvorak and Tschaikowsky. Liszt, Wagner, Chopin, Berlioz, etc., never handling the symphonic form, come in other groups.

Mendelssohn

Felix Mendelssohn-Bartholdy, born in 1809 at Hamburg, was the son of a Jewish banker who embraced Christianity. Favoured with most things that only money can buy, he here shows an exception to the usual run of the great composers. But the amenities of an opulent upbringing did not stifle his genius; on the contrary. For at the age of seventeen he produced a work which is not only, perhaps, the finest he ever wrote, but one which is a miracle by whatever standards we judge it—the overture to "A Midsummer Night's Dream." The quintessence of programme music, it symbolises the heart and soul of the movement itself. The incidental music, comprising the Scherzo, Notturno, Intermezzo and Wedding March followed shortly after.

His other overtures are "Melusine," "A Calm Sea and Prosperous Voyage," "Fingal's Cave" (almost as good as the "Dream"), and "Ruy Blas." They mark his invention of the concert overture, a movement written on strict sonata form, or first movement lines.

Mendelssohn was a pupil of Zelter, who was deeply attached to Bach's music. Bach always exercised the strongest influence on him, and it is not difficult to account for the "classic" influence in his sacred music—their dignified and contrapuntal character, his use of the chorale and his handling of the narrative in recitative, and the exclamations of a multitude in choruses, as in "St. Paul," on the model of Bach's "Passion." Mendelssohn it is, to whom we are indebted for the practical revival of Bach's works, and his performance of "St. Matthew," in 1829, practically rescued that mighty work from oblivion. It had not been heard within the memory of many then living.

Royal Admiration

He visited England—he was always a great favourite here and was much admired by Queen Victoria and the Prince Consort—and Italy, and then settled in Germany. He founded the Leipzig Conservatoire and took over the direction of the famous Gewandhaus Concerts there. "Elijah," which is probably only second in popularity to the "Messiah" among sacred works, was first produced at Birmingham in 1846.

He wrote four symphonies, two of which are notable. The "Italian" and the "Scotch" were both the result of visits to those countries. Written to the strictest classical pattern, they are imbued with a romantic programme, as their titles would suggest. They are very charming, and have well held their places in the concert repertory.

The Violin Concerto is another masterpiece, and is incomparably superior to those he wrote for the piano. In fact, all his piano music is poor by comparison with such great contemporaries as Chopin, Schumann and Liszt, though a few numbers keep their place in the pianist's repertoire. The "Songs Without Words" were his own invention, and a peculiar one. Very charming, and much more frequently played by all sorts of instruments and combinations than they are on the piano, they are dated "period" music, and have been literally squeezed out by greater piano writers.

Some of his organ music are classics for that instrument, and he wrote many beautiful songs, notably the cycle to Goethe's "Walpurgis Night." The catalogue is completed by some excellent chamber music, chief of which is the famous Octet.

Mendelssohn's fame has suffered the extremes of fortune. At some times nothing derogatory dare be said of him, whilst at others not a good word would be listened to. To-day he has probably reached his equilibrium. "Elijah," the Violin Concerto, and the "Midsummer Night's Dream" music ensure his immortality. The rest probably shine in their reflected glory. It is difficult to imagine much of it being attended to but for the fact that it was "by the author of . . ."

Schumann

Robert Schumann, born at Zwickau in Saxony in 1810, embodies the very heart and kernel of the romantic movement to a greater degree of perfection, perhaps, than any other of its sons. The son of a bookbinder, he inherited a literary taste. Although cultivating music from his earliest years, he received no special training. his parents intending him for the law. But music, together with his strong poetic vein, triumphed in the end, and his very perfunctory law studies terminated in 1830 when he persuaded his mother to let him study the piano with Wieck in Leipzig and composition with Dorn.

His romance with Clara Wieck is one of the tenderest and sweetest to be found amongst the lives of famous people. Herself a brilliant pianist, she made it her mission in life, especially after Robert's death, to "propagate the gospel according to Robert," and she played his works in all the countries of Europe and America.

Robert also wanted to become a pianist, but just as it seemed that he was about to be granted his wish, a merciful providence tempted him into inventing a contraption for improving his third finger. He fatally injured it during the exercises, to the immense benefit of that portion of mankind which follows music.

He married Clara in 1840, after great opposition from her father. He also produced his B flat symphony in the same year. At the time of his marriage he had already produced many of his most famous piano compositions, notably the "Etudes Symphoniques," "Davidsbündler," "Papillons," "Carnival," the F sharp and F minor Sonatas. the Fantasie ("of heavenly length," as Liszt said), "Fantasiestucke," "Kreisleriana," Scenes from Childhood, "The Novelletten," and many others.

New Musical Journal

In 1834 he founded a new type of musical journal called the "Neue Zeitschrift für Musick." Mendelssohn, Chopin, Heller and the young Brahms were all highly praised in its pages, which greatly elevated musical criticism and taste.

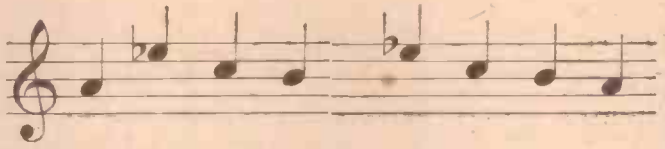
In 1844 he developed a distressing nervous disorder and moved to Dresden. In 1850 he succeeded Heller as director at Dusseldorf. At first things went pretty well, but the malady gained on him and he made two unsuccessful attempts on his life by throwing himself in the Rhine. He then spent two years in a private asylum in Bonn, where he died, in Clara's devoted arms, in 1856.

In Schumann's music the essence of poetry and romance is well up to an even greater degree than in Chopin's. Imagery and Fantasie reign supreme. But whereas in a lot of Liszt's works these elements are

often allowed such an unbridled licence as to make the very atmosphere itself seem overcharged, Schumann always keeps them under the most beautiful control. It was music of an entirely new order, but obviously showing the greatest respect for its classical forbears.

His piano works seem to be built up of an exquisite patchwork whilst the material used is absolutely original. Closely woven and almost continuously contrapuntal, he eschews the extreme compass of the piano in a much greater degree than his contemporaries. In his shorter works the higher and lower octave are hardly called upon at all.

He frequently built his themes up on a remarkable "cryptographic" method, as in the wondrous "Carnival," where we have the presentation of his famous society of the "Davidsbundler," who were genial and artistic spirits banded together to resist the Philistinism of the age. He attaches fancy names to the movements, such as Florestan and Eusebius (which refers to Schumann himself in his dual nature of the gentle and the rough), Chiarina (representing his future wife, Clara), Chopin, Paganini. etc., and the letters ASCH and SCHA called sphinxes. They are taken from Schumann's own name and represent the following notes in German:—



These two tiny themes recur in the course of the work almost as frequently as do the opening notes in Beethoven's "Fifth."

Schumann wrote four symphonies, some splendid chamber music, the music to Byron's "Manfred," a poor Violin Concerto which, conscious of its feebleness, neither he nor Clara allowed to be performed in their lifetime, and some marvellous songs which, in deep sentiment and intellectuality, rival Schubert's.

In all this music Schumann left a treasure-house to posterity, and pianists are especially in his debt for some of the greatest masterpieces in their repertory.

A Simple Mixer

Details of an Add-on Component to Facilitate the Mixing of Two Audio Signals

A FEATURE of most B.B.C. programmes is the novel mixing or fading process, whereby musical items, or music and speech or sound effects are interwoven or introduced. Special "faders" or "mixers" have been placed on the market to enable the amateur to carry out a similar scheme, but it is possible to do this without special components.

The simple method described below enables the amateur to do all the "fading in" and "fading out" stunts in the approved broadcast style, by merely adding an additional potentiometer, either in the receiver itself or externally.

Fig. 1 shows the way in which radio reception may be mixed with gramophone record reproduction, the extra connections, though simple, should be observed carefully.

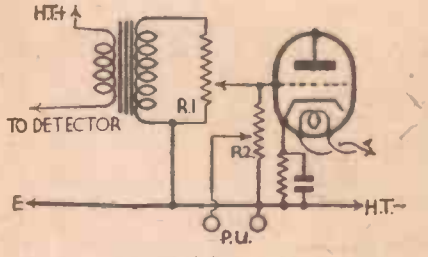


Fig. 1.—A simple fading circuit for radio and gramophone.

R1 is the usual volume control across the secondary of a low-frequency transformer, R2 is the pick-up input potentiometer, having a value of a ½ megohm; other values may be used, but the reason for this particular value will be pointed out later.

One end of R2 is connected to the moving contact of R1, which in turn goes to the grid of the valve. The other side of R2 goes to earth (it is assumed that A.C. valves are being used), though the same connections apply in the event of a battery set, the only difference being that the grid of the valve is biased through the resistance R1.

Switches Eliminated

It must be appreciated that the normal volume control serves the total input to the grid of the valve of both radio and record reproduction, the amount of radio broadcast coming through being adjusted in the H.F. or detector stages, of course, and the amount of pick-up reproduction controlled by the potentiometer R2.

Apart from the amusement that can be had in changing over from radio to gram in this fashion, it is a great convenience over the more conventional way of switching. It might be as well at this stage to mention that the input potentiometer R2 will have no effect on the operation of the set in the usual way, provided the value chosen is not less than ½ megohm and the volume control on the set 50,000 ohms. Any other values can be used, but it must be seen that the resistance R2 has a value approximately four times as great as that of the normal volume control.

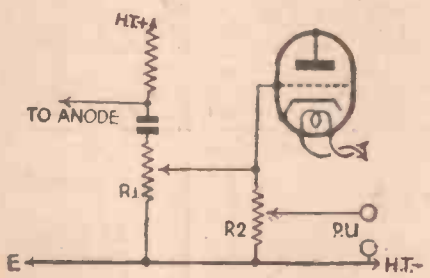


Fig. 3.—In this arrangement signals may be superimposed on those present at the grid.

For those who use piezo-electric pick-ups this is an ideal way of putting the pick-up in circuit as, due to the fact that this particular type of pick-up has a very high impedance, it is necessary that it should have across it a resistance of not less than ½ megohm. It will, however, be seen that in the circuits under discussion the maximum resistance is only across the pick-up when the control R2 is fully open, hence it follows that there is going to be a change in the frequency response as the record is faded in; this is not by any means a serious disadvantage; as the total volume can be altered by R1.

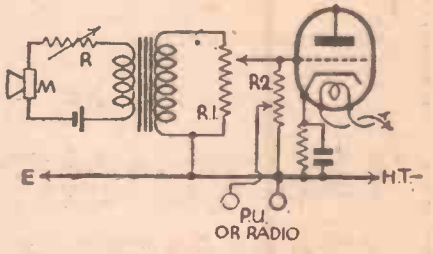


Fig. 2.—This mixer arrangement enables music and speech to be mixed.

For Public Address Work

The versatility of this little scheme will now be obvious, and should have particular interest to the amateur P.A. worker, where a microphone is being used either for announcements or band-repeating where it is wished to fade-in an alternative programme of music, either of radio or gramophone reproduction. Fig. 2 shows the necessary connections to the grid input of the first stage of the amplifier.

Fig. 3 shows the same method of coupling-up the potentiometers, though this time R.C. coupling is assumed between the stages, the volume control R1 is now being used as grid resistance in the particular R.C.C. combination.

There are, of course, various alternative ways of fading and mixing radio and record reproduction through the L.F. portion of the set, the one just described having the merits of being simple, and not needing any alterations in the receiver itself.

Why Use an Aerial?

In this Article the Author Discusses the Utility of the Aerial

SOME time ago much was made in advertisements of commercial receivers which enabled the user to dispense with an aerial. In view of the contraptions one sees desecrating the skyline, I heartily agree with the movement to abolish the aerial, but I still maintain that efficient results, with high quality, demand an efficient aerial and earth system.

Wherever there is a difference of opinion on the subject it is either being viewed from different angles, or there must be sufficient grounds to substantiate the various opinions.

Let us, for clearness' sake, look upon our receiving apparatus as a simple machine having work to do. By the most elementary law of mechanics the output of a machine is dependent on the input it receives, while the comparison between the output and input will denote the efficiency.

Efficiency

Supposing the output is greater than that required for our needs, then it is obvious that the input can be decreased, or, better still, a smaller machine used with greater overall efficiency, owing to the possible causes of losses being reduced. This being so, the running costs will likewise be reduced, together with the number of sources of trouble and possible breakdown.

If the comparison holds good, it would seem that the most logical thing to do would be to make our input as great as possible, design efficient receivers employing fewer valves, and pay particular attention to the efficiency and *appearance* of our aerials.

It is also known that some people, who are not enthusiasts or constructors, only require the local stations, while there are others who have a horror of any outside aerial because of the fear of spoiling the appearance of their garden or residence. These are exceptions, and, if they are content with the results they do obtain, and the apparatus they have to employ, I would not suggest that they make any alterations,

Indoor or Outdoor?

Indoor aerials, of the home-made variety, and many of the commercial types, have their uses, but it can hardly be claimed that their efficiency is comparable to that of a good outside aerial. There are many who will say that an indoor aerial has certain advantages, while others will most emphatically state that an outside aerial is not all that can be desired under the present broadcasting conditions.

To these I would say, make your aerial as efficient as possible, and then pay attention to the design of your receiver. A good commercial indoor aerial is often better than an outdoor aerial, unless the latter is sited high and is of fair length.

An efficient aerial demands low losses, high electrical efficiency, low self-capacity, and low high-frequency resistance. A properly designed outside aerial has all these qualifications, while the average indoor arrangement is notable for the exact opposite features.

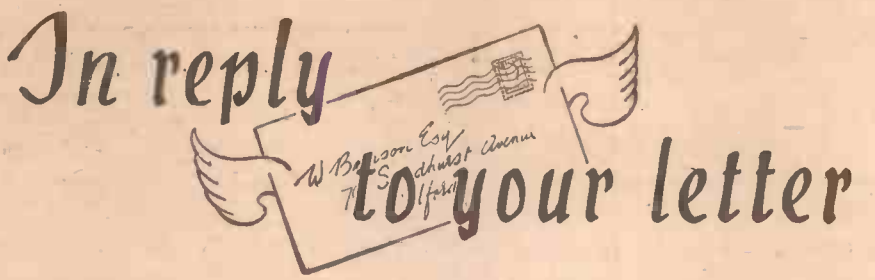
In the first form it is an easy matter to obtain ample insulation, and to obtain a good electrical circuit needs very little care, while the correct self-capacity and low H.F. resistance can be secured by no further trouble than a little attention to the location of the wire and its size or formation.

Now, with the second form low losses will become high losses, for various reasons. Greatly reduced pick-up of the signal, losses through heavy damping and high self-capacity, while it is highly probable that the H.F. resistance will be appreciably higher. Here again there are exceptions.

The resultant effects are obvious; the indoor aerial will sometimes call for greater use of reaction or other boosting effects, with consequent losses to the quality of reproduction. Some receivers are likely to become unstable, owing, in certain cases, to the absence of the correct aerial load across the grid circuit. It will be most unsuited for good short-wave reception, while electrical interferences are likely to be pronounced, and, last, but by no means least, more valves will be used than efficient conditions would require.

Let us now examine the alleged drawbacks of an outside aerial. With regard to appearance there is a strong argument in this point, but there is *no need* for an aerial to be an eyesore. The whole thing only calls for a little care and consideration in the selection and fitting of the necessary gear. It is necessary to pay attention to details, to have everything taut and neat.

The next points are, overloading and selectivity. These can be dealt with in a much more satisfactory manner with an outside aerial than with an inside one, provided the system is properly designed and the receiver is capable of coping with present broadcasting conditions. In these cases, the aerial will help to cover up the inefficiencies in a receiver, but it cannot be expected to give complete compensation.



Home-made Coils

"Could you tell me how to make the following coils: A No. 60X for tuning; a 50 for reaction on the medium waves, and No. 200X and 100 for long waves? They are for a two-valve set described by you some time ago."—J. D. (Oswaldtwistle).

THE type of coil mentioned was of the two-pin type, wound in honeycomb formation, for which a special type of winder is needed. In view of the difficulty of obtaining one of these and to avoid making one up, we suggest that you adopt a standard type of coil wound on a cylindrical former and dispense with the two-pin plug-in system. It would, of course, be possible to wind separate coils on lengths of former and fit two-pin bases if you have these or can obtain them. You can adopt the rule that the number of coil indicates the number of turns on a 3in. diameter former. For the larger coils you will, of course, have to adopt a pile-wound formation, either separating the total coil into four or five sections, with cardboard discs, or similar method of keeping the sections separate, and enabling the wire to be piled up without occupying too much space on the former. The reference X in the coil indicates that the winding is tapped, the tapping points being made at the centre and at a point one-third of the distance from the earthed end of the coil. When using the coils make certain that all windings run in the same direction.

Crystal Set Selectivity

"I have a crystal set I have built (circuit enclosed), but I find that when one station is received the other station is heard in the background. The stations are the Home and Forces. Being a newcomer I am unable to cut out the unwanted station and would like your help. The crystal is an old one. Does this make any difference?"—F. B. N.13).

THE use of a single-circuit tuner with a simple crystal set generally introduces selectivity difficulties, especially in your locality. The most effective way of obtaining the desired station separation, without loss of signal strength, is by means of a wavetrap. This is a coil exactly the same as the one you are now using, with a .0005 tuning condenser across it. The aerial is joined to one of the tappings on the new coil, and the lower end of the coil and condenser combination is then connected, instead of the aerial, to one of the tappings on your present crystal set coil. The crystal set is then tuned to the desired station and the condenser on the wave-trap is adjusted until the interfering station is eliminated. It will, of course, have to be adjusted to each station when changing over from one to the other. The other way of obtaining improved selectivity, but a method which will probably result in some loss of volume, is to wind a coil over the present winding, separating the new winding by placing strips of thin wood or ebonite (matches will do) across the winding. The new coil should be wound over the earthed end of the existing coil, and about 10 turns will probably be found effective. The top of this new winding is joined to the aerial and the bottom of the winding is joined to earth.

Indirectly-heated Rectifier

"I am building the Experimental 6-watt amplifier described in your issue dated March 9th last. Could you give me the type number of an indirectly-heated rectifier instead of the directly-heated valve mentioned? Is there an extra pin on the indirectly-heated rectifier, and if so, to what should it be connected?"—A. F. (Coventry).

IF you obtain the Osram MU/12/14 you can use this without any modification to the circuit. This is an indirectly-heated rectifier of the same rating as the original valve, but has only the same four pins. It is, however, possible to obtain rectifiers of the indirectly-heated type in which a separate pin is provided for the cathode connection, in which case, of course, the cathode is considered as the H.T. positive connection, the heater being separately operated.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

Microphone Connections

"I have a commercial communications receiver and wish to use a microphone with same, but wondered if it could be connected in the usual manner between the grid of the output valve and earth. If so, is the top-cap connection to be removed, or the microphone attached regardless of the top-cap connection (the output valve being a type 41). I have gone back through my copies of "Practical Wireless," but can find no reference to connecting microphones in multi-valve circuits."—R. S. B. (S.E.13).

IN general, a microphone may be regarded in the same light as a pick-up. The only difference is that the pick-up may be joined direct, whereas the microphone has to be fed through a transformer, the secondary then being connected to pick-up terminals and a battery being joined in series with the microphone and the transformer primary. It is generally found, however, that the output from the simpler types of microphone is lower than that from a standard pick-up, and accordingly a greater amplifier is needed. Without details of the circuit of your receiver we cannot give exact connection details, but you will probably find that the secondary of the mike transformer may be joined across the L.F. volume control and this may provide all the volume that is needed. The connection you suggest is not suitable, and even if you included the transformer, the amplification provided would be very low and you would probably obtain only the weakest of signals.

Intermittent Fault

"I am using a superhet with a peculiar fault. The receiver suddenly goes very quiet, sometimes with a plop, but mostly just goes off. If I just release the 60v. lead for a second the receiver is quite all right for a time, but this goes on a lot. I have had valves tested and passed O.K. I have had one I.F. transformer re-wound and the two passed O.K. Coils have been tested, but still no cure."—W. M. (Mitcham).

THERE are many intermittent faults which give rise to a cessation of signals such as that mentioned, but in your case, as the removal of the 60-volt lead enables signals to be restored, we would suggest that the trouble is due to H.F. instability. The lead in question no doubt feeds the screen of the I.F. or frequency-changer stages, and due to a faulty component in one of those stages the set suddenly either bursts into violent oscillation (above audibility) or the oscillator stage ceases to oscillate. Removal of the H.T. enables the stage to settle down, with the result that signals are restored when the lead is replaced. We therefore suggest that you insert a good milliammeter in the anode circuits of the valves in question and watch the anode current. It should be borne in mind that oscillation is indicated by a fall in anode current, and therefore if one stage goes into oscillation the current will fall, and if the oscillator stage ceases to oscillate this will be indicated by a rise in the current reading.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

E. Y. T. (S.W.19). The Listener's 5-watt Amplifier, blueprint WM.392, would be suitable for your purpose, but you must remember that a crystal pick-up needs a parallel resistance or equivalent device to complete the grid circuit.

R. M. (Swindon). We regret that we have no data now available concerning the connections of the coils in question and the makers are no longer producing radio components.

E. V. Q. (Bath). It is sometimes possible to cut out the rectifying section, but the main difficulty is in the heaters of the valves, which will take a very high current from the mains. We have no data of the particular converters you mention, and think the best plan is to follow the recommendations of the makers of the set in question.

S. O. (Lr. Weston). The matter is under consideration and details will no doubt be given at an early date.

D. G. S. (Ebbw Vale). The coil was designed to provide electron coupling, but we have no details now available. We think you will find that the coil is tapped and the tapping is returned to cathode or filament to provide the necessary oscillation.

G. V. F. (Chichester). Sixty volts for the H.T. and not more than 4.5 volts for G.B. should be quite satisfactory.

The coupon on page iii of cover must be attached to every query

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Fleet S.W. Two

SIR,—I was particularly interested in the remarks of Mr. J. Gordon, of Chesterfield, in your issue of July 6th, concerning the Fleet Short-wave Two, as I have also had very satisfactory experiences with this small set. I fully endorse the remarks concerning its efficiency, and had I not been intrigued by the description of the Kestrel 3-4 Receiver, it is doubtful whether I would have made any change.

I do not know whether Mr. Gordon made any alterations to the original circuit of the Fleet, but I did find that a slight improvement could be obtained by reducing the value of the detector anode resistance to 60,000 ohms.

Regarding the Kestrel, I made the three-valve section first, and was frankly amazed at the results obtained, and later, when finances permitted, I added the fourth valve. The results to date have shown me what can be done with a well-designed straight H.F. circuit, and, although I know that a superhet receiver has certain advantages, I think it will be a long time before I forsake my present receiver.—J. HARKLEIGH (Williton).

For the Beginner

SIR,—Might I, as a newcomer to radio, thank you for the articles you include in PRACTICAL WIRELESS from time to time under the heading of "For the Beginner." While I fully appreciate that the majority of your readers are, no doubt, advanced constructors, I feel sure that they will not begrudge a page or two being devoted to those of us who are now passing through the stages which they went through in a similar manner when they were fresh to the game.

Would it be asking too much for you to make a regular feature of a series of articles for the beginner, as I find that I am securing my knowledge in instalments, which are not always directly related; thus at times I come up against something about which I am completely ignorant through not following a systematic study of the subject.—C. BECKFORD (Hull, Yorks).

[*We would recommend to the reader one of the many authoritative books we publish on the subject to enable him to augment his studies.*—ED.]

A 5-valve Superhet!

SIR,—I have recently received your "Radio Training Manual," for which I thank you. If I might make a suggestion on the matter of training, why not publish, say, a 5-valve superhet circuit in which the amateur learns as he builds, starting with making the coils, the I.F.T.s, and so on, and explaining, as the work proceeds, the purpose of each part?—L. J. HUXTABLE (London, W.).

Readers' Favourite Circuits

SIR,—I read with interest the readers' letters under the heading "Open to Discussion," for it gives one a chance to find out what other "hams" are doing and thinking. From time to time many interesting suggestions as to articles for PRACTICAL WIRELESS have been made in these spaces. Now I, in turn, make a suggestion for your consideration.

I suggest that readers' own designs of short-wave gear be published from time to time. Readers could be requested to forward the circuit of their pet receiver, together with a summary of the results obtainable; actual constructional details need not be added, but hints regarding snags found in the construction and operation would be invaluable to others wishing to utilise the information.

Thanking PRACTICAL WIRELESS for helping to keep the "ham spirit" alive until we again hear "Calling test forty"!—P. J. HORWOOD (Abbey Wood).

[*What do readers think of this suggestion?*—ED.]

Back Number Wanted

A READER, H. Ward, of Lea Hurst, Watsons Avenue, Dale View Road, Nottingham, will be grateful if any reader could oblige him with a copy of PRACTICAL WIRELESS containing particulars of the A.C. Twin, also the blueprint for same.

Correspondent Wanted

ALEC L. GODIER, 6, Woodford House, Woodford Road, Snaresbrook, E.18, is anxious to get in touch with a local radio enthusiast who makes his own apparatus.

Prize Problems

PROBLEM No. 409.

BARNES had a small resistance-capacity coupled two-valve battery set which he wished to improve. He found a market stall selling old components, all guaranteed, and amongst them was an old L.F. transformer. He purchased this and added it to his receiver in place of one of the R.C.C. units, but could obtain no signals. He did not know how to test a transformer but a friend offered to do this for him, and he returned it as being quite in order. He again connected it to his set without being able to obtain any signals. Where had he gone wrong? Three books will be awarded for the first three correct solutions opened. Envelopes should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Entries must be marked Problem No. 409 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, July 22nd, 1940.

Solution to Problem No. 408.

The piezo-crystal pick-up needs a resistance shunted across it in order to complete the grid circuit. Marshall overlooked this, as the magnetic type of pick-up which he originally used had its own volume control incorporated and accordingly this was removed with the pick-up.

There was only one correct solution to Problem No. 407 and a book has accordingly been forwarded to:

C. Martin, "Lynton," Pound Road, Bursledon, Southampton.

Impressions on the Wax

A REVIEW OF THE LATEST GRAMOPHONE RECORDS

THIS month the Decca Company have assembled an all-star cast for the making of two records which literally put history on record. On two 12in. discs, this company have recorded all the events that led to the Munich crisis of 1938 and all the world-shattering happenings of last autumn. In a dramatic documentary style they bring into vivid life the sayings of world statesmen in these critical times. In turn you hear Chamberlain, Hitler, Mussolini and Daladier. In fact, all the leading figures of the time speak in their own words and voices. The records thus offer an unparalleled insight into current history not only for people of the present day but for the people of all time. The guiding spirit behind the idea is journalist Dick O'Connor, who is editing what Decca hope to make into a series. The commentator, Mr. Kent Stevenson, has the help of a crew of West-End actors.—*Decca K* 926-7.

Ballads

ONE of the most marked tendencies of the war has been towards a revival of interest in old ballads—particularly among record enthusiasts. Decca have contributed a great deal towards this by bringing such great artists as Alfred Piccaver, who is known as "the English Tauber," out on their two-shilling label. He sings "Thanks for Your Love" on *Decca F* 7492. This month they offer the first record by Margaret Eaves, one of the stars of "Garrison Theatre," a soprano who is rapidly becoming radio's most popular singer. She has chosen "I'll Walk Beside You" for her first record and has coupled it with "I Love the Moon" on *Decca F* 7513. Frank Ryan has two Irish songs on the same label. "Macushla" and "The Lark in the Clear Air"—*Decca F* 7528.

Remember the Insect Play? Well, Billy Mayerl has now written a little suite of insect music. He calls it "Insect Oddities." First we have "Wedding of an Ant" and "Ladybird Lullaby." Then come "Praying Mantis" and "Beetle in the Bottle"—all for 2s. on *Decca F* 7512.

No character has sprung into the public's fickle fancy so rapidly before as has Jack "Blue Pencil" Warner, and yet it is not generally known that Jack is the brother of Elsie and Doris Waters. This ignorance will rapidly lose its blissfulness as the circulation of a new Decca record by "Gert and Daisy" grows. For on one side of this disc, the famous sisters have recorded "Brother Jack—A Message from Mum." The coupling is "Won't We 'Ave a Party When It's Over"—*Decca F* 7503.

Folk Songs

PERHAPS the most important link between the old world and the new lies in the folk music of both continents. Particular stress on this fact is given by a new Decca album of cowboy songs. The majority of people are inclined to the opinion that cowboy songs are represented by what are popularly called hill-billies. Actually, hill-billies are completely different from cowboy songs and, in any event, the majority of them are synthetic products of Tin Pan Alley. This is well displayed in the new album. When you hear the records you may be puzzled, perhaps, by the similarity between the melodies which you know under other names. This need not really cause you wonderment. When the great emigration of a hundred years ago and more started to America, these old English songs were brought over by settlers of those early days, and with new words were adapted as work-songs all over the continent. Eighteen of these songs have been placed on record by The Ranch Boys for Decca in an album.—*Decca F* 7363-7.

Brunswick

THIS company have just released two new albums devoted to George Gershwin which contain a happy mixture of old favourites and tunes scarcely known in this country at all. The first record in the first album is by Bing Crosby, who sings "Somebody Loves Me" and "Maybe"—*Brunswick O* 2986. Then come two keyboard duettists Yray and Braggiotto, who play two tunes from "Of Thee I Sing" and two from "Funny Face"—*Brunswick O* 2987. "Summer Time" from "Porgy and Bess" is sung by Anne Jamison, who has chosen "Looking for a Boy" as a coupling on *Brunswick O* 2988. The Merry Macs go to town with "I Got Rhythm" and "Clap Yo' Hands" on *Brunswick O* 2989, while Shirley Ross has made a recording of "That Certain Feeling" and "Mine," on *Brunswick O* 2990.

Connie Boswell opens up Album No. 2 with "They Can't Take That Away from Me" and "Soon"—*Brunswick O* 2991. Next number contains "Lady be Good" and "Bidin' my Time," by The Foursome, *Brunswick O* 2993 brings us to Judy Garland singing the first big hit ever written by Gershwin—"Swanee." The coupling is "Embraceable You." Finally, there are two sides each by Frances Langford and Tony Martin. Frances has made the best yet recording of "The Man I Love" and on the reverse side is "Someone to Watch Over Me"—*Brunswick O* 2994. Both of the Tony Martin sides are from "The Song of the Flame." One side has the same name and the other is "Cossack Love Song"—*Brunswick O* 2995.

Yet two more of to-day's popular songs owe their main themes to Tschaikovsky melodies. "When Night is Blue" is one of them, sung by George Melachrino on *Decca F* 7523. "On the Isle of May," which is the other one, is by Connie Boswell on *Brunswick O* 3005. This lovely song has been adapted by André Kostelantz from the famous Andante Cantabile which occurs in the great Russian composer's String Quartet in D Major.

RECEIVERS AND COMPONENTS

BANKRUPT Bargains. Brand new 1939/40 models, well-known best makes, makers' sealed cartons, with guarantees, at less 30%-40% below listed prices; also Midgets, portables. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

COULPHONE Radio. Change of address to Station Road, New Longton, Preston. Goods previously advertised still available. Crystal Pickups, 18/6. Rola G12's with transformer: Energised 52/6, P.M. 65/-. 40 per cent. discount on valves. Stamp for lists.

VAUXHALL.—All goods previously advertized are still available; send now for latest price list, free.—Vauxhall Utilities, 163A, Strand, W.C.2.

DENCO "Pocket Two" midget dry battery receiver. £2/15/0. Ideal for present conditions. Send for details.—Warwick Road, Clacton, Essex.

RADIO CLEARANCE, LTD. See previous issues for full list of bargains.
RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. Holborn 4361.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.

5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.

15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.

5/- 100 Wire-end Resistances, assorted capacities. ½ and 1 watt, 5/- per 100.

ORMOND Loud-speaker Units, 2/6. Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.

2/- Tool or Instrument Carrying Cases, ex Government Stock. Wood 9" x 7" x 7", 2/-.

SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

SPECIAL OFFER.—K.B. 6-valve chassis, 8 press Lutton A.C. mains superhet, 3 wave bands (S.M.L.) magic-eye tuning indicator, manual tuning, less valves, in perfect condition, price 35/- carriage paid. See also previous issues for other bargains. Valves required: TH4, TV4, VP13C, DDT13, N31, UU3. Aluminium Screening Box, 3-section, 8½in. x 3½in. x 4in., 1/3 each. Superior Rubber Covered Aerial Wire for S.W. reception, 50ft., 2/9 post free.—London Central Radio, 23, Lisle Street, London, W.C.2. Gerrard 2969.

Special Rate For Readers' 'Wants'!

If you require a special component or a replacement coil—a classified advertisement will probably secure it. Many of our readers have a stock of surplus components. A reduced rate of 1d. per word (minimum 1/-) is charged for readers' advertisements. Try a paragraph for that 'want.'

Send your advertisement with P.O. to:—Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

Connect with CLIX

Cut the crackle—Connect with CLIX, the "perfect contact" plug, 5-amp., 2-pin M type. 4½d. each

Also 2-5 and 15 amp. 2 and 3-pin B.S.S.

CLIX

British Mechanical Productions Ltd.
1, Church Road, Leatherhead, Surrey

PREMIER RADIO

SHORT-WAVE KITS IDEAL FOR OVERSEAS NEWS AND MORSE RECEPTION.

Incorporating the Premier 3-Band S.W. Coil, 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2-volt valves.
3-Band S.W. 1-Valve Kit, 14/9. 3-Band S.W. 2-Valve Kit, 22/6.

DE LUXE S.W. KITS

Complete to the last detail, including all Valves and Coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in Coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adaptor Kit 20/-
1 Valve Short-Wave Superhet Converter Kit 23/-
1 Valve Short-Wave A.C. Superhet Converter Kit 26/3
2 Valve Short-Wave Receiver Kit 29/-
3 Valve Short-Wave Screen Grid and Pentode Kit 68/-

NEW S.W. A.C.4 KIT. H.F. Pentode, Pentode Det., 4-watt Output Tetrode, F.W. Rec. 200-250 volt, choke output, 13-170 metres. Complete kit of parts with drilled panel and chassis, £4/10/0. Factory built and air tested, £5/10/0.

"LEARNING MORSE?"—Premier Morse Practice Key on Bakelite Base, and Brass Movement, 3/3. General Purpose Morse Key, 5/10. Heavy Duty TX Key on Cast Base, 10/-. Bakelite Buzzers, 1/9. Complete Kit of Parts for Valve Oscillator, as described in W.W. "Learning Morse," 25/-.

Special Offer of Record Auto-Changer Units for A.C. Mains by famous manufacturer. Play 8 records. Latest type Magnetic Pick-up, Auto-stop, Start and Rejector. Limited number only at £4/19/6. Carriage Paid.

SPECIAL OFFER. ROTHERMEL PIEZO BRUSH CRYSTAL PICK-UPS. New Junior P.U. with arm, 19/6. Standard S.8 Model with arm, 29/6. P.U. head only, De Luxe Model, 19/6.

ROLA MOVING COIL SPEAKERS, complete with Transformers, 6½in. P.M., 12/6. 8-in. P.M., 16/6 10in. P.M., 22/6. G12 P.M., 66/-.

MAINS TRANSFORMERS. Manufacturers' surplus. All brand new and Guaranteed.
Input 110 v. and 220 v. A.C. Output 325-325 v., 120 m.a. 6.3 v., 2-3 amps., 5 v. 2 amps, C.T., 7/6 each. Input 230 v. A.C. Output 325-325 v., 75 m.a., 5 v. 2 amps., 6.3 v. 2-3 amps. C.T. 6/6 each. Input 100-250 v., 300-300 v. 60 m.a. 4 v. 5 a. C.T., 4 v. 1 a., 6/11. Output 325-325 v. 180 m.a., 5 v. 2-3 amps., 6.3 v. 2-4 amps., 12/6.

PREMIER BATTERY CHARGERS for A.C. Mains. Westinghouse Rectification complete and ready for use. To charge 2 volts at ½ amp., 11/9; 6 volts at ½ amp., 19/-; 6 volts at 1 amp., 22/6; 12 volts at 1 amp., 24/6; 6 volts at 2 amps., 36/6.

REPLACEMENT VALVES FOR ALL SETS EUROPA MAINS VALVES. 4 v., A.C. Types, A.C./H.L., A.C./L., A.C./S.G., A.C./V.-M.S.G., A.C./H.P., A.C./V.H.P. (5-pin), all 5/3 each. A.C./H.P., A.C./V.H.P. (7-pin), 7/6. A.C./Pens-I.H., 7/6; A.C./P.X.4, 7/3.; Oct. Freq. Changers, 8/6; Double Diode Triodes, 7/6; 350 v. F.W. Rect., 5/6; 500 v. F.W. Rect., 6/6; 13 v. .2 amps. Gen. Purpose Triodes, 5/6; H.F. Pens and Var.-Mu H.F. Pen., Double Diode Triodes, Oct. Freq. Changers, 8/6 each. Full and Half-Wave Rectifiers, 6/6 each.

TRIAD HIGH GRADE U.S.A. VALVES, all types in stock. Standard tubes 5/6 each, Octal Base tubes, 6/6 each. 80's 4/6.

PREMIER Short-Wave Condensers, all-brass construction, with **Trolitul** insulation. 15 mmf., 1/9; 25 mmf., 1/10; 40 mmf., 2/-; 100 mmf., 2/3; 160 mmf., 2/7; 250 mmf., 2/11.

PREMIER SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-49, 78-170 metres, 2/- each, with circuit. Special set of S.W. Coils, 14-150 metres, 4/9 set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 39-86 metres. Suitable any circuit, 2/11. 4- or 6-pin formers, 1/2.

CARDBOARD ELECTROLYTICS, 500v. working, 4 mf. or 8 mf., 1/9; 8+8 mf., 3/6; 50 mf., 12 v., 1/2; 25 mf. 25 v., 1/2; 50 mf. 50 v., 2/-.

UTILITY Micro Cursor Dials. Direct and 100 : 1 Ratios, 4/2. 3-wave Full Vision Dial, 6/9.

LISSEN Dual Range Screened Coils, medium and long waves, 2/9 each.
Orders 5/- and over sent Post Free. Under 5/- please add 6d. postage. All enquiries must be accompanied by 2½d. stamp.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723
CALLERS TO: Jubilee Works or our NEW PREMISES, 169, FLEET STREET, E.C.4. *Central* 2833
or 50, High Street, Clapham, S.W.4. *Macaulay* 2381

SHORT-WAVE EQUIPMENT

"H.A.C." one-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Road, S.W.8.

TUITION

YOUNG MEN (15-20 years) urgently needed to train as Radio Officers for the Merchant Navy; short training period; low fees; boarders accepted. Write or call for full particulars—Wireless College, Colmore, Southampton, or Wireless College, Colwyn Bay.

PRACTICAL Postal Courses, radio television, test equipment design, trade-test coaching for R.A.F. posts, I.P.R.E. and A.W.T. exams.; booklet free.—Secretary, I.P.R.E., 3, Shirley Road, London, W.4.

WANTED

WANTED B.T.S. all-wave coil unit type 4 B.T.U. Also issues of PRACTICAL WIRELESS dated 9-2-35 and 5-12-36; state condition and price.—50, Somersby Av., Sprotborough Rd., Doncaster.

BOOKS

YOU need this war atlas when you read the newspapers or listen to the wireless bulletins. "Newnes Comprehensive War Atlas" will make the progress of the conflict understandable in all its aspects. 8 pages of war maps, including the Scandinavian countries, Western Front, Balkans, and all countries whose frontiers adjoin or are near those of the belligerents. With war strengths of the Armies, Navies, and Air Forces of the Nations.—Of all newsagents and booksellers, 1/6 net, or by post 1/9 from the Book Publisher, George Newnes, Ltd., Tower House Southampton Street, Strand, London, W.C.2.

KNOW what to do before the doctor comes.—Learn from the new book, "First Aid For The Householder," and your knowledge may be the means of saving a life. Deals in simple language with all kinds of injuries and their treatment, war-gases, shock, and the minor ailments of everyday life. Clearly illustrated.—Of all booksellers, 1/6 net, or by post 1/9 from the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

A RADIO Consultant for All—"Everyman's Wireless Book," by F. J. Camm, explains the operation, upkeep, and overhaul of all types of wireless receivers. Illustrated.—Of all booksellers, 5/-, or by post 5/6 from George Newnes, Ltd. (Book Dept.), Tower House, Southampton Street, Strand, London, W.C.2.

THE whole amazing science of wireless is contained in "The Outline of Wireless," by Ralph Stranger. The entire theory of reception is clearly explained. Over 800 pages. Illustrated.—Of all booksellers, 10/6, or by post 11/- from George Newnes, Ltd. (Book Dept.), Tower House, Southampton Street, Strand, London, W.C.2.

FREE ADVICE BUREAU

COUPON

This coupon is available until July 27th, 1940, and must accompany all Queries and Hints.

PRACTICAL WIRELESS, 20/7/40.

"ENGINEERING OPPORTUNITIES"

This unique Handbook shows the easy way to secure A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.M.I.A.E., A.M.I.W.T., A.M.I.R.E. and similar qualifications. WE GUARANTEE—"NO PASS—NO FEE." Details are given of over 150 Diploma Courses in all branches of Civil, Mech., Elec., Motor, Aero, Radio, Television and Production Engineering, Draughtsmanship, Tracing, Inspection, Building, Government Employment, etc. Write for this enlightening Handbook to-day. FREE and post free. *Men with radio knowledge can obtain attractive posts in the Services.*

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, 409, Shakespeare House, 17, 18, 19, Stratford Place, London, W.1

RADIO TRAINING MANUAL 15 P.W.

Published every Wednesday by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand : GORDON & GOTCH, LTD. South Africa : CENTRAL NEWS AGENCY, LTD. Subscription rates including postage : Inland 23s. 10d. per annum, 11s. 11d. for six months ; Abroad 21s. 8d. per annum, 10s. 10d. for six months. Registered at the General Post Office for the Canadian Magazine Post.

BATTERY AUTO-BIAS—See page 391

A NEWNES PUBLICATION

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

Edited by F. J. CAMM

Vol. 16. No. 410. July 27th, 1940.

Contents

Practical Wireless
BLUEPRINT SERVICE

These Blueprints are drawn full size.
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint*. A dash before the Blueprint Number indicates that the issue is out of print.
(Practical Wireless (issues dated prior to June 1st, 1940). 4d. Post Paid
(Issues dated June 1st, 1940, and after) 5d. Post Paid
Amateur Wireless .. 4d. " "
Wireless Magazine .. 1/4 " "
The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.
Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

PRACTICAL WIRELESS

CRYSTAL SETS

	Date of Issue	No. of Blueprint
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94

STRAIGHT SETS. Battery Operated.

One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen),	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans)	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90

Mains Operated

Two-valve: Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve: Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve: Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets: Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets: Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
Four-valve: Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve: Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve: Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve: Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68

PORTABLES.

Three-valve: Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve: Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated.

One-valve: Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve: Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve: Blueprints, 1s. 6d. each		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve: Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.

Two-valve: Blueprints, 1s. each.		
Consolectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve: Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve: Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386

SUPERHETS.

Battery Sets: Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
"Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets: Blueprints, 1s. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366

PORTABLES.

Four-valve: Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve: Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve: Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve: Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve: Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet: Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397

Mains Operated.

Two-valve: Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve: Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve: Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391

MISCELLANEOUS

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM308
Harris Electrogram battery amplifier (1/-)	—	WM309
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* 36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)		WM408

Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
Vol. XVI. No. 410. July 27th, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Trickle Charging

ONE of the bugbears of the battery-user's existence is the accumulator. Many have overcome difficulties in the replacement of H.T. batteries by adopting small mains units, but for reasons of economy have not converted their receiver to mains operation, although mains facilities may be available. Consequently, repeated visits to a charging station are called for, and unless two batteries are kept, there is a period during which the receiver is out of commission. Two batteries may, of course, be used, and thus there will not be any gap in the times available for listening, but there is still the inconvenience of carrying the battery to the charging station and bringing it home. Furthermore, in some localities there may not be any facilities for taking the battery and the listener may have to wait until a service depot collects it, which is done in some country districts at regular intervals. However, with quite simple apparatus the battery receiver may be made, in effect, "mains maintained," if not mains operated. In this system, the H.T. is provided by a mains unit or battery eliminator, as it is generally called, and the accumulator may be kept always in a usable condition by recharging it when the set is switched off. This is possible on either D.C. or A.C. mains and some details of the arrangements available are given on page 395.

"Spring Meeting"

ALTHOUGH racing has now ceased, an amusing Irish play with a racing atmosphere will be heard on July 27th in the Home Service. This is "Spring Meeting," by M. J. Farrell and J. Perry. It is the story of an impecunious Irish baronet, his two daughters, a rather eccentric maiden aunt whose secret vice is gambling, a family butler who runs the entire household, and a couple of lovers for the two girls.

"Monte Carlo"

JACK BUCHANAN will be heard in his original part in the radio adaptation of "Monte Carlo" in the Film Festival series, No. 8, on July 29th. "Monte Carlo" was probably one of his greatest artistic successes, although at that time he was better known for a brilliant succession of musical comedies. In the play Jack Buchanan will be working with Douglas Moodie.

Du Mont Television

A PERMIT has been granted to the A. B. Du Mont Labs of New Jersey for the construction of a television transmitter on the top floor of the 42-storey office building at 515, Madison Avenue. It will operate on the 78-84 mc/s band as a Class 2 television broadcaster for programme research, using a system whereby changes may be made in the number of lines, number of frames and interlacing schemes at the transmitter and the receivers will automatically follow any transmitted signal.

"P.W." to be Published Once a Month

Owing to the acute shortage of paper, this journal will temporarily appear as a monthly magazine, and this issue is the last of the weekly series. The first monthly issue, dated September, price sixpence, will appear on August 7th, a fortnight hence.

It will contain more pages and the regular features will be augmented by new ones.

Readers will understand that these steps are of a temporary character to enable us to conserve paper supplies during the shortage, and that we shall reappear as a weekly publication as soon as circumstances permit.

It is essential that every reader, including those who have already placed a standing order for the weekly issues, should complete the new order form on page 406 of this issue. This is the only way to ensure receiving your copy as your newsagent is not able to return unsold copies and will thus only secure the exact number ordered.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Band of the Week

FOR the second time in just over two months, Joe Loss will provide the band of the week next week. Recently leaving a residential job to take up stage work, this is probably the only touring stage band playing solely dance music, indulging in no spectacular stunts and relying purely upon musical appeal. Vocalists with the band are Monte Rey, Paula Green and Chick Henderson.

News Flash

MOST listeners are familiar with the American term "News Flash," and at the moment a joke in the U.S.A. refers to the announcer who said "We interrupt these news bulletins to bring you a programme." Recently, however, a WLW announcer went one better. The station was relaying an NBC news bulletin from Europe when an important press bulletin came into the newsroom at WLW. The announcer cut into the relay and thus became one of the few announcers who have interrupted a news programme to present a news flash.

"Station BBLBBO"

CINCINNATI post-office officials are likely to go berserk soon if they get much more mail addressed to Station BBLBBO. The correspondents in reality are writing to Station WLWO, short-wave international outlet operated by The Crosley Corporation, which also runs WLW. It happens that on the air WLWO's call letters, read in Spanish, sound something like "doobluh-vey ellay doobluh-veh-oh." This is because the Spanish W is spoken as a double-V. The Spanish V also sounds like a B. Listeners who fail to pay close enough attention think they're hearing "double B." But "double B" is two letters in any language. So WLWO is getting mail as BBLBBO — probably the longest set of call letters in any language.

Roy Speer

THE last job to be undertaken by Roy Speer before he joins up will be a programme on the life of Stephen Foster. The show will be produced by Douglas Moodie, and will be heard in the Home Service programme on August 1st.

Tracing Transformer Connections

Simple Methods of Identifying the Different Windings and the Various Tappings

By FRANK PRESTON

IT sometimes happens that it is wished to make use of a transformer which has previously been relegated to the junk box. Provided that it is in good condition, the transformer may be just as good as a new one, but in many cases the terminals or leads may not be identifiable. In that case, the first step must be to trace the connections and find to which part of each winding they are attached.

L.F. Transformers

When it is a simple low-frequency transformer there will be only four connections, and therefore little difficulty will be experienced in dividing them into two pairs. It is necessary only to connect a pair of 'phones in series with a small dry battery, connect one battery terminal to one transformer connection and then to touch the second 'phone lead against the other terminals or leads in turn. When there is a "double plop" in the 'phones as the contact is made and broken in this way it will be known that the other end of the winding has been found. The point is illustrated in Fig. 1. It should be remembered that a rather faint "click" will probably be heard when other connections are touched, but the sound will not be repeated as the contact is broken.

Winding Resistances

Having thus separated the four connections into two pairs it will remain to find which is for the primary and which for the secondary. This can most easily be determined by simple resistance measurement, since the primary will have a lower resistance than the secondary. In most instances, however, the constructor will not have a resistance bridge or multi-purpose meter with which readings can be taken in ohms. It is just feasible to use a pair of 'phones and a battery cell, as shown in Fig. 1, but it might be necessary also to connect a fairly high resistance in series between the battery and the transformer. By this means it may be possible to limit the current to such an extent that the sound heard when connection is made to the higher-resistance (secondary) winding is very faint.

Using a Meter

Alternatively, the 'phones can be replaced by a milliammeter reading up to about 5 mA. When using a 1½-volt battery cell or a 2-volt accumulator it will generally be found that the meter reading is about 3 mA. on the primary and considerably less on the secondary. If the primary had a D.C. resistance of only 500 ohms, however, the current would be 4 mA. at 2 volts. With a lower resistance than this it would be necessary to insert a resistance of about 500 ohms in series to prevent overloading the meter. On the other hand, if it were found that the resistance was so high that only a minute current passed, it would be necessary to increase the test voltage. In any case, accurate readings are not necessary since it is required only to find which winding has the higher resistance; and that winding is the secondary.

With class B transformers, output transformers and other types, the secondary may have a lower resistance than the primary. There would probably be some indication on the component to show that it was not an ordinary L.F. transformer, and by combining a little common sense with the resistance testing it would not be difficult to decide which were the proper connections.

Multi-winding Transformers

There is more difficulty when dealing with a mains transformer, since in that case there will generally be at least three windings. Even then, the leads or terminals attached to the different windings will probably be grouped in some way, so that the sets of connections can be recognised. A check can be made by using a small battery and 'phones or meter, as described above. To safeguard the meter, however, initial tests should be made with a 500-ohm resistor in series with it. This is because the resistance of the low-tension secondary is almost negligible by comparison with that of the other windings.

Another point to bear in mind is that there will generally be more than two leads from each winding, due to the provision of tappings. It is therefore necessary to make preliminary tests to isolate all

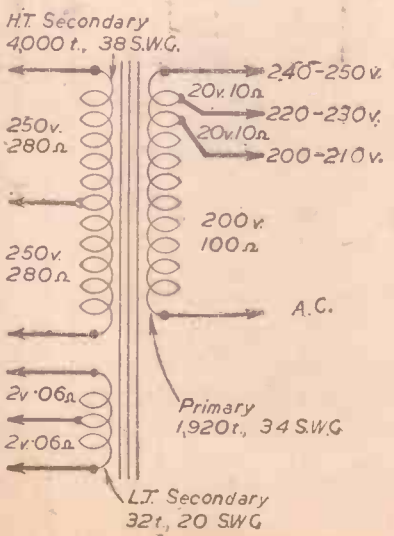


Fig. 2.—Approximate figures relating to a typical transformer of good design.

those connections to any one winding. Having done this, the terminals of leads can be marked with a spot of paint or by sticking on marked strips of adhesive paper.

Comparing Resistance

The next step is to find which of the windings has the highest resistance, or at least, to find the two connections between which the highest resistance exists. These will probably be for the high-tension secondary, but they may be for the primary. If, however, it appears that the winding is centre-tapped, it will be fairly certain that this winding is the H.T. secondary.

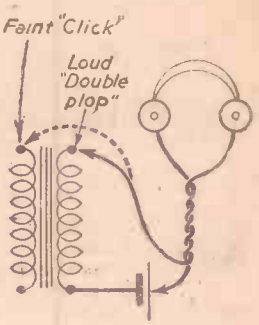


Fig. 1.—Method of making preliminary tests with an L.F. transformer.

Similarly, if it is noticed that there are a number of connections to one winding, there need be little doubt that that is the primary, since there will be two or three tappings for different mains voltages between, generally, 200 and 250.

Of these, find the two between which there is the highest resistance and mark them. Then check the approximate resistance between each of these and the remainder. The highest reading obtained this time will show which is the A.C. or zero connection and which is the low-voltage (probably 200-210-volt) tapping. Mark these leads and repeat the tests between each of these and the remaining primary tappings. It will then be possible to mark the tappings in order of their voltage; tappings are usually provided for 200-210, 220-230 and 240-250 volts, but this is not standardised.

What to Expect

The general procedure will be simplified by examining Fig. 2, which shows the circuit for a typical well-made transformer, and shows the voltage points and the approximate resistances between them. The figures given are arbitrary, but apply to a good transformer wound on a core with a 1 sq. in. cross-section core and having eight turns per volt. It should be stressed that the resistance figures indicated are very approximate, and that they vary considerably according to the particular transformer. It will, nevertheless, be reasonable to assume that the relationship existing between the figures is about right for a transformer of the type indicated.

It might be found impossible to determine with any degree of accuracy the resistance of the low-tension secondary, and therefore it might be impossible to find which is the centre tap, and which are the two ends, by using any of the methods described above. A fairly simple test can easily be made, however, by connecting a flash-lamp bulb and 3-volt or 4½-volt (according to the rating of the bulb) battery in series with different pairs of terminals. It will be found that the light of the bulb is dimmed to a rather greater extent when connection is made between the ends of the windings than when the bulb and battery are in series with either half of it. If an ammeter is available the test can be made more easily, by using a 2-volt accumulator or dry battery with a 3-volt, .3 amp. bulb. The current passed will then be slightly over and slightly under an average current of about .2 amp. If an ammeter reading up to .5 amp. is not available a milliammeter can be used with a shunt so that the full-scale reading is between .25 and .5 amp.

The general arrangement described can be applied to any kind of transformer. Before starting to take current readings, however, find how many windings there are and draw the circuit; this will help in checking the working as the tests proceed.

Battery Auto-bias

Obtaining Automatic Bias for Variable-mu H.F. Stages, as well as for Output Stages in Battery-operated Receivers

By W. J. DELANEY

MANY users of battery-operated receivers are fascinated by the fact that the H.T. battery may be dispensed with by using an H.T. battery eliminator or mains unit. Generally, however, a grid-bias battery is retained, either for the L.F. stages, the H.F. stages, or both. In the A.C. mains receiver automatic grid bias is employed, and this has a

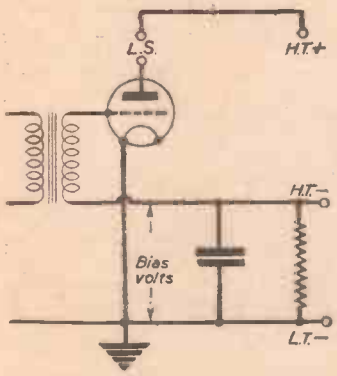


Fig. 1.—The normal method of providing auto-bias for an output stage.

number of advantages which the battery user is generally unable to obtain. In previous articles in this paper we have described how a simple circuit arrangement may be incorporated in a battery receiver to permit the G.B. battery to be dispensed with for the biasing of L.F. valves, and then, when a mains unit is employed, the question of battery replacements is automatically answered. The problem of the L.T. supply is, of course, overcome by using a trickle-charger, in which case the features of "all-mains" operation are brought to the battery set with a minimum of expense and with no material change in the receiver. The latter consideration is one which often has a great effect on the amateur. He has used a certain receiver for a considerable time and is attached to it, with the result that he hesitates to scrap it or modify it. When mains facilities are available, however, he can make the set 'all-mains.'

the H.T. negative and connecting a by-pass condenser across the latter two points. This is shown in Fig. 1. From this it will be seen that the total anode current of the receiver will flow through the resistance, and this will result in there being a difference of potential across the resistance, the actual voltage being easily calculated from standard Ohms Law. The total anode current is divided into the bias voltage required and this gives the answer in thousands of ohms. The wattage of the resistance may then be calculated in either of two ways. You can multiply the current by the voltage, or multiply the current by itself and then multiply the answer by the value of the resistance. In all cases of Ohms Law working, of course, the current is expressed in amps., remembering that 1 milliamp is .001 amps. An example will make the arrange-

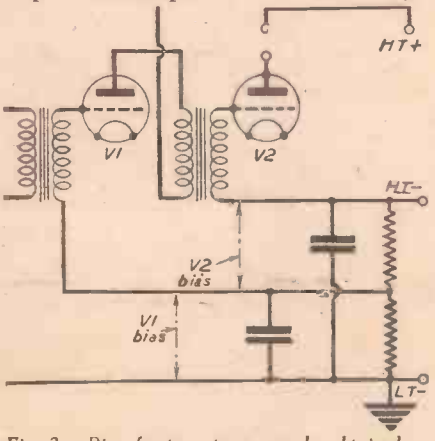


Fig. 2.—Bias for two stages may be obtained as shown above. Two resistors or a tapped component may be used.

ment quite clear. Supposing we wish to provide an output valve with 10 volts bias, and the total anode current of the receiver is 5 milliamps. The value of the resistance will be 10 divided by 5, giving 2,000 ohms by the first method; or 10 divided by .005, which also gives 2,000 ohms. The wattage will be 10 by .005, or .05 watts by the first method, and .005 x .005 x 2,000 by the second method. This is also .05 watts.

there are two L.F. stages in the receiver we will need a further bias voltage for the intermediate valve. This will, obviously, need a lower voltage than the output valve and this means that a lower value of resistance will be needed. However, by adopting the same method of calculation as has just been described, and then sub-

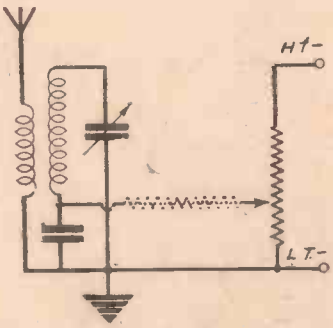


Fig. 3.—Using a variable resistance for variable bias for an H.F. stage.

tracting the answer from the resistance value found for the output valve, it will be seen that our requirements may be met by using two resistances in series, taking the biasing lead for the first valve from the junction of the two resistances. Thus, keeping to the example just given, suppose that our first L.F. stage needs 5 volts bias. The total current is still flowing through the biasing circuit and therefore the bias resistance will have to have a value of 5 divided by .005, or 1,000 ohms. Our total bias resistance will thus be made up from two 1,000-ohm resistances in series, and the biasing leads will be taken from the junction and from the "top" as shown in Fig. 2. Each lead should, of course, be by-passed to preserve stability and assist in the full reproduction of the lower notes. It will also be found that a small by-pass condenser or the omission of the condenser may also lead to loss of volume.

We now come to the difficult point so far as the majority of battery users are concerned. That is, the biasing of H.F. valves. Normally, it is not desirable to

(Continued on page 405)

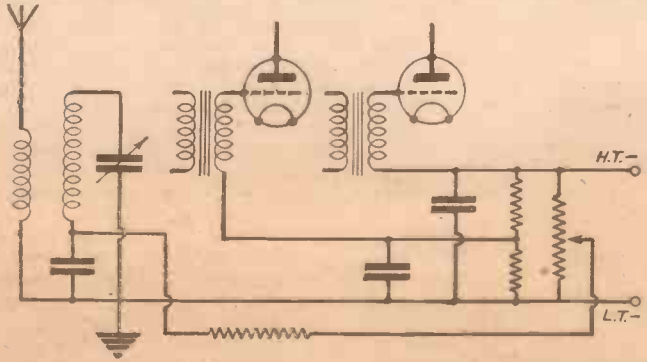


Fig. 4.—Complete biasing scheme, one variable H.F. bias circuit, and 2 L.F. circuits.

L.F. Bias

The bias for an output valve of the battery-fed type may easily be obtained by arranging for the grid to be returned to a point which is negative in respect to the filament of the valve. This requirement is answered by inserting a resistance between the H.T. negative lead and the normal earth line, returning the grid connection to

Additional Bias

The arrangement just described, however, only provides a single biasing point, and if

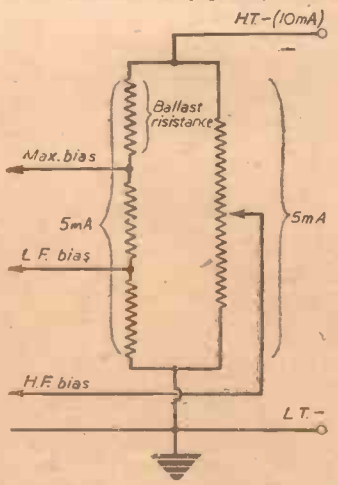


Fig. 5.—Using a ballast resistance to simplify calculations in the bias circuit.

Beginners' Blunders

This Article Explains How to Avoid Many of the Pitfalls Which Are Met With in Constructional Work

TWO qualifications essential for satisfactory participation in the great hobby of radio are a sound theoretical knowledge and a flair for practical constructional work. Unfortunately, however, the latter is often sacrificed to the former, in an endeavour to acquire a store of technical information, and this conception of starting the hobby might, in itself, be classified as one of the first blunders the average beginner makes.

Taken as a whole, the majority of the troubles usually experienced by the would-be radio enthusiast are not, as one would expect, due to the lack of knowledge of the fundamentals. For instance, it is highly probable that a beginner selects for his first constructional effort a well tried and reliable published design, thus eliminating the need for any technical knowledge. Any such design, however, cannot guarantee that the constructional work will be carried out with the same skill and experience as that possessed and used by the designer; therefore it is with this part of the work that the beginner encounters items which provide innumerable little traps for the man who is without any practical electrical or constructional experience.

Blueprints

Published blueprints of tested and guaranteed designs are one of the *greatest aids* to the beginner; all the problems associated with the selection and layout of the essential components are completely eliminated, and as such blueprints as those which are listed in each issue of PRACTICAL WIRELESS are full-size replicas of the actual set, it is practically impossible for the veriest novice to go wrong with the items mentioned above. There are, however, many other items, all connected with the ultimate completion of the constructional work, which are capable of ruining all the skill and care expended on the original design.

Fixing Components

When a blueprint is used, the correct positions of the fixing holes for the various components can be marked off on the chassis or baseboard by overlaying the print and pricking through the necessary spots. This method will ensure accurate location of all parts, an item of great necessity with many circuits. If a published print is not employed, *i.e.*, if the receiver is being assembled from a theoretical diagram, then it is strongly advisable to take a piece of cardboard or stiff brown paper the size of the proposed chassis, and on it lay out the components and, eventually, mark off the fixing points. When doing this, careful consideration must be given to all the wiring which will be associated with the components, as this will lead to greater efficiency, a cleaner wiring scheme, shorter connecting wires and, finally, the planning of the wiring to avoid possible interaction between various parts of the circuits.

When fixing components, always take the trouble to see that they *are fixed securely* and that the correct size of screws or bolts is used for each particular component. Nothing makes an assembly job look so unsightly and unprofessional as loose components and large hideous screws, many with their heads badly marked, and more often than not, not screwed right home. With a metal chassis, when suitable bolts have to be used, it is always advisable to slip a shake-proof washer under the nut, as it is surprising how soon a bolt can shake loose, often with very *disastrous* results.

All drilling should be carried out, whenever possible, before any components are mounted in position. This applies in particular to variable condensers and exposed H.F. chokes or coils, as any metal cuttings or filings from the drilling and finishing are likely to get into such components and seriously affect their efficiency.

Terminals

All terminal shanks *should be inspected* to see whether they are *perfectly secure* in their component before bolting it down, otherwise, when tightening up the terminal head there will be the possibility of the shank rotating with the result that an *imperfect* connection will be formed and, when a metal chassis is used, the shank being unscrewed sufficiently to cause it to touch the chassis and produce a *short-circuit* to earth.

Remember that all terminals used for radio work have a *right-hand* thread so see that the wire loop forming the connection is placed under the head in the manner which will cause the head, on being screwed down, to *close* the loop and not open it and tend to force the wire off the terminal collar.

Get into the habit of making a neat loop, with small round-nose pliers, when using single tinned copper wire, whilst with flexible wires it is essential to twist together all the strands as neatly and firmly as possible, and then form a loop having the correct diameter for the terminal shank concerned, the loop being completed by making two or three twists of the end round the flexible wire.

Insufficient attention is often given to these items. They might seem very unimportant, but in actual practice, a considerable loss of efficiency, short-circuits and intermittent results can be produced by carelessly made connections. Always cut the connecting wires to the exact length, see that their insulation is perfect right up to the terminal or soldering tag, and make quite sure that the wire or strands are not fractured, or partially severed whilst removing the insulating covering.

Soldering

The soldering of all radio connections is to be recommended in preference to other methods, but it must be realised that such connections must be well and truly soldered otherwise they can be greater trouble-makers than, say, a terminal. Many beginners blunder along, making what they think to be soldered connections, but which in actual fact are nothing more than an unsightly mess of solder and flux. Much has already been written in these pages describing the art of soldering, therefore, in this article essential reminders must suffice. See that the soldering bit is properly tinned, is at the correct working temperature, i.e., just sufficient to cause the solder to run, that the parts to be soldered are perfectly clean and free from the slightest trace of grease, and that only a very thin film of flux is applied.

The chief causes of unsatisfactory soldered joints are: iron too cold or too hot, dirty parts, the failure to keep the soldering-iron on the parts long enough to allow them to reach the correct temperature for the solder to take, and the too liberal use of flux. The beginner would do well to practise with odd lengths of wire until he can make a really satisfactory joint before he attempts to use the iron during his radio assembly work.

Live Spindles

Certain components, such as variable condensers, switches and potentiometers, often have their operating spindle in contact with other parts of the component. This is of no disadvantage in many instances, but there are circuit arrangements where a short-circuit could be produced if the component is mounted on, say, a metal panel or a metal bracket fixed to a metallised wood baseboard, without taking the precaution of fitting insulating washers. This applies in particular to reaction condensers if the anode is connected to the moving vanes, and potentiometers or switches in any way connected with the positive H.T. supply. If the beginner is not sure about any component, then a simple continuity test should be applied, using a small dry battery and low reading voltmeter or headphones which will soon indicate if the spindle is alive. Failing this test, then it would be wisest to play for safety, and insulate the component from any metal mounting.

Long Leads

On no account should the wiring of a receiver be carried out in such a manner that long lengths of wire are used when short, direct connections could be made. This applies in particular to all wiring associated with anode, grid, reaction and heater circuits.

ON YOUR WAVELENGTH

By Thermion

Once a Month!

THE paper problem has not improved during the past months, and the shortage is having its inevitable effect on all publications. Costs are rising, and the supply has to be conserved and equitably rationed. Some readers may not perhaps understand what the ration means. Publications are limited to 30 per cent. of their normal requirements. That would mean, in effect, that we should only be permitted to publish an eight-page journal, which would not be satisfactory, firstly, from the readers' point of view, and secondly, from an economic point of view.

The inevitable solution is that this journal must appear once a month instead of once a week until the time arrives for the paper supplies to flow freely and *ad lib.* once more. Every reader joins with me in expressing the hope that this time is not too far distant. Monthly publication is the only solution under present circumstances. This issue, therefore, is the last of the weekly series for a time. The character of the journal will be maintained as a monthly magazine, and it will continue to include all of the features which have found their places in our pages week by week. In order that too great a period will not elapse between the last week's issue and the first monthly issue, our next issue—the first of the monthly series—will appear on August 7th, a fortnight's time.

Readers will understand that this measure has been adopted under force of present circumstances, but whether published *per mensem*, or even per annum, we shall continue to keep the flag of wireless experimentation and the interests of constructors and listeners flying until the piping days of peace, plenteous programmes, amateur transmission, experiment, and blueprints, and freedom from the curse of Hitler, return.

When those times arrive, this journal will revert to weekly publication. In the meantime will readers please note that the first monthly issue containing more pages, dated September and price sixpence, will be on sale on August 7th.

Appeal

ONE of my readers, R. W. L., who is stationed at a lonely spot, appeals to a fellow reader to provide his Company with a small battery portable. Anyone who has such a set and is willing to supply it should communicate with me marking envelopes "R. W. L."

The Wrinkles Page

I HAVE had a large number of letters from readers expressing opinions concerning this feature. The Ayes and the Noes are in about equal proportion. As the journal is now to be published once a month there will be a little more time to select items and to check them. One or two readers point out that the feature provides those not too well blessed with this world's goods with an opportunity for purchasing components which they would not otherwise be able to possess. That, of course, was the idea in introducing the feature, and since it was introduced in the first issue we have distributed over £1,000 to readers in this way. The whole basis of such a feature, however, must be originality. Even in the best organised communities there are the few black sheep. I have before me as I write a hint submitted by one who claims to be a reader, the illustration and text of which is copied word for word from an American magazine, and this, in spite of the warning which has been issued on the Hints Page, and in my columns, during past weeks. When such hints slip through, as occasionally they are bound to do, other readers who have seen the hint in its original setting may presume that we have resorted to the practice of lifting from other journals. I am particularly anxious, therefore, to lend my aid to putting a stop to this despicable practice on the part of a dishonest few. Suitable action will be taken in any further attempts on the part of these few to obtain money under false pretences.

ORDER IT NOW!

This illustration indicates the handy size of "The Radio Engineer's Pocket Book", which costs 3/6, or 3/9 by post. It contains 160 pages of facts, figures and formulæ, and easily slips into the waistcoat or uniform pocket. Send postal orders to The Publisher, Book Department, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Our Roll of Merit

Our Readers on Active Service—Fifth List.

E. G. Hope
(L.A.C., R.A.F.),
London, W.4.

S. V. Dormer
(A.B.-L.T.O.),
Dover, Kent.

J. F. Watinfall
(The Queen's Royal Regiment),
Falmouth.

R. C. L. Baker
(Signals, Black Watch),
Tooting Junction, London, S.W.

W. C. Livens
(Signm., R.C.S.),
North Shields.

R. W. Lay
(Private, Royal Norfolk Regt.),
Norfolk.

C. W. T. Green
(Gunner, R.A.),
Bognor Regis.

L. J. Harris
(Gunner),
Cheshunt, Herts.

E. M. Varley
(M.S./Sgt., R.E.),
Selby, Yorks.

The Short-wave Log

MANY readers have asked for this feature to be reintroduced, but there are difficulties in the way. Some of the short-wave stations have been broadcasting anti-British propaganda and it is illegal now for editors to publish the times and the wavelengths of certain foreign transmissions. Rest assured when the moment is propitious this feature will be reintroduced.

Many readers who wrote to me about the Hints Page have also made valuable suggestions for future articles. Some of these suggestions will be put in hand.

The Radio Engineer's Pocket Book

THERE has been a big run on the first print of The Radio Engineer's Pocket Book recently published at 3s. 6d., or by post 3s. 9d. from the offices of this journal. Readers on active service find this handy size book of great value because it does not occupy a lot of space, easily slips into the uniform pocket and contains practically every radio fact, formula and table required. Additionally, it contains a great amount of other useful information applicable to other industries, and the mensuration and trigonometrical formulæ are two examples of this.

"The Superhet Manual" and "Diesel Handbook."

SIMILARLY, the Superhet Manual at 5s., by post 5s. 6d., has had a good reception. A large chunk of the first print has gone. These two latest additions to our library of standard technical works have elicited many letters of appreciation from purchasers. Readers who require copies should, however, order them at once. Whilst I am dealing with books I should like also to draw their attention to another technical volume published from the offices of this journal. It does not deal with radio, but, as so many readers are now driving diesel vehicles, they will certainly be interested in "Diesel Vehicles: Operation and Maintenance," which costs 5s., or 5s. 6d. by post.

Analysing Circuit Networks

How to Examine and Follow Modern Radio Circuits by a Simple Process of Sub-division

By H. J. BARTON CHAPPLE, B.Sc.

WHEN being initiated into the principles of circuits the first thing encountered is the simple one of a direct current source connected up to one or more pieces of apparatus in series which possess pure resistance only. Voltage, current and resistance are then interrelated by the well-known Ohms Law which says that current is equal to voltage divided by resistance. In a radio receiver, however, especially one of modern design, this simple rule can seldom be applied straight away, because in nearly every case there is an inter-connection between circuits which means that one component or lead is usually performing a double or triple function. To quote a simple case as an example the low-tension circuit of a battery-fed receiver also carries on one side the high-tension circuit along which flows the full anode current of the set. Furthermore, it is very seldom that we can isolate one integral circuit which is functioning as a result of a steady direct current flow. Alternating or fluctuating circuits at both high and low frequencies are circulating in the various circuit branches, and it is common knowledge that the behaviour of the various components in the set varies according to the rapidity of the alternations, and again is quite different from what would occur if only D.C. were present. The inductance of coils and wires, together with the capacity of condensers and wires have special effects on current flow and usually assume much greater importance in the receiver circuits than the resistance alone.

Points to Remember

The old hand will remember, and the beginner should know, that capacity and inductance offer a degree of opposition to the flow of alternating currents, which varies according to frequency and in a way which differs very materially. It simplifies matters considerably, therefore, if circuits and components are treated as separate networks in which are included inductance, capacity and resistance in either series or parallel combinations. This will enable the behaviour of the network to be predicted with accuracy when the values of the quantities are known or calculated in relation to the frequency of the alternating currents flowing in the circuit. There is no need to delve into mathematical intricacies in order to understand better the problems of networks, but one or two facts should be memorised. Although at very high frequencies a pure resistance increases slightly in value due to what is known as the skin effect, to all intents and purposes the resistance can be regarded as unchanged whether the current flow is alternating or direct. If resistances are placed in parallel so as to split the current path, the overall circuit resistance is decreased, but when in series the total resistance is increased.

When it comes to coils, transformers, chokes, etc., these possess what is known as inductance and present a definite impedance to the flow of alternating current, which impedance is measured in ohms. The higher the frequency the higher becomes the impedance, and in consequence it is frequently found that the drop in voltage across an inductance when direct current is flowing, is much less than the A.C. voltage drop when an alternating current is passed through the componen

A Cancelling Effect

In the case of condensers the property they possess is that of offering impedance to the passage of an alternating current, this impedance decreasing in ohmic value as the frequency increases. That is to say, its opposition to current flow works in the opposite way to that of an inductance, and if an inductance and condenser are placed in series, then the effects tend to cancel one another out. Of course, it is known that no one component or part of a circuit possesses inductance, capacity or resistance in a pure

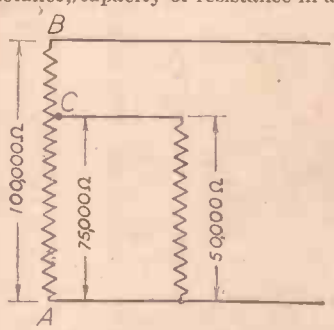


Fig. 1.—A potentiometer application for a simple network.

form, but they can be treated in network form as having these items correctly interlinked for the purpose of any calculations.

For example, a special coil may offer a high impedance to the flow of an alternating current, but the capacity effect of the windings themselves is equivalent to placing a condenser across the extremities of the component, and this may seriously affect its working, while the D.C. resistance of the coil is another factor which has to be taken into consideration.

A Practical Example

Armed with the knowledge of these elementary facts, however, it is now possible to see how simple network analysis

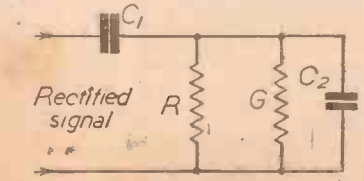


Fig. 2.—The elements of R.C. coupling shown as a network.

can be undertaken. Hardly a single receiving set is made now, whether mains driven or battery fed, without some form of potentiometer being incorporated in the circuit so as to break down the full voltage to one or more intermediary values to enable valve electrodes to be furnished with their rated potentials. This is really a simple network, but its simplicity provides a pitfall into which many people fall. For example, if a 100,000 ohm potentiometer is joined across a D.C. source of 200 volts there will be a uniform reduction of voltage along the resistance winding in direct proportion to the amount of resistance in circuit. It is very seldom, however, that voltage alone is required but rather that current has to be drawn from the network, while at the same time maintaining the voltage which should be applied, to, say, one of the screens of a valve. Furthermore, the addition of a resistance in parallel with the potentiometer tap point reduces the total resistance across the main voltage supply.

A suitable example will make this clear, and as an illustration it will be assumed that there is a 100,000 ohm potentiometer across a 200 volt supply, this giving a current flow through the resistance of 2 mA. If, as shown in Fig. 1, a 50,000 ohm impedance is tapped on to a point distant 75,000 ohms from the bottom end, then at first sight this would seem to give a voltage of 150 between A and C. The 50,000 ohm resistance in parallel between points A and C has altered matters, however, and the combined resistance between A and C is now 30,000 ohms, making the resistance AB equivalent to 55,000 ohms. Current flow from B to C will now be just under 4 mA, and the drop of voltage between B and C will be approximately 90 volts, making the potential available between A and C equal to 110 volts, instead of the 150 volts without the 50,000 ohms in parallel.

A Popular Coupling

Yet another application of network analysis is seen in the familiar form of resistance-capacity coupling, which was so popular in the early home constructor days. The rectified or low-frequency signals are fed via a coupling condenser to the grid of the first L.F. valve whose grid is taken to bias via a grid leak. If this circuit is turned into a network it will be as shown in Fig. 2 where R is the grid leak, G the filament to grid resistance of the L.F. valve, C1 the coupling condenser, and C2 the capacity existing between grid and filament. To apply the necessary rectified signal to the grid of the L.F. valve, that is across R, there must be only a small drop of voltage across C1, in other words the capacity of C1 must be reasonably high. After this there are three paths in parallel, which reduces the overall impedance, and it is essential to keep the impedance across the grid of the valve high. This condition is usually met by the normal value of G, but if C2 happens to be of too large a value, then the reactive impedance offered by that section of the network will be too low at the highest frequencies the circuit is called upon to handle. This simple network, therefore, explains why a limitation to successful operation of such a simple circuit is so often set by valve inter-electrode capacities.

Yet another simple network is provided by the familiar smoothing circuit placed after the valve or dry rectifier used for converting A.C. into D.C. This circuit smooths out the rectified supply, and if the main smoothing choke and second condenser are regarded as being in series across the rectified supply, then it is easy to see that there is only a very small D.C. drop of voltage across the choke, which leaves the remainder for feeding to the appropriate voltage feed.

Simple Trickle Chargers

Details of A.C. and D.C. Charging Systems for the Beginner

IN conjunction with an H.T. battery eliminator, a trickle charger provides the simplest means of operating a battery set from the mains supply. In addition, the conversion is less costly than that involving the use of special A.C. valves, because it makes possible the use of exactly the same components as before. Yet another advantage is present when the mains supply is D.C. because the modification of a battery set to run from this supply is not always easy.

The trickle charger can be made up either as a unit entirely on its own, or as a part of the H.T. supply unit. In this article, however, we will consider the L.T. portion as being separate from the rest of the power supply, although readers will readily understand how it can be incorporated.

For D.C. Mains

The very simplest form of trickle charger is that for use on a D.C. supply, since this does not necessarily involve the use of any wireless components at all, but only of an electric lamp, lamp-holder, and a length of flex. The arrangement is shown in Fig. 1, where it will be seen that the electric lamp is wired in series with one lead to the accumulator from the supply socket. The purpose of the lamp is to limit the current passing through the accumulator to the correct figure for charging purposes. Thus, by changing the lamp for others of different wattage rating the charging current can be varied as desired. This a a point which is frequently misunderstood, and readers often write to ask how the lamp can possibly be suitable since a voltage approximately equal to that of the mains supply must be applied to its terminals, and thus the same voltage must be applied to the accumulator. This reasoning is not sound, for the voltage actually applied to the lamp or to the accumulator is dependent upon the resistance of the component concerned. (If you cannot appreciate this, apply Ohm's Law, which has been given often enough in these pages.)

The Charging Current

We have said that the charging current depends upon the wattage of the lamp, so we must now explain further. The wattage is the product of the applied voltage and the current in amps, so that if the voltage is, say, 240, a 60-watt lamp will pass .25 amp. (60 divided by 240). In the same way, a 40-watt lamp will pass .16 amp., or a 100-watt lamp about .4 amp.

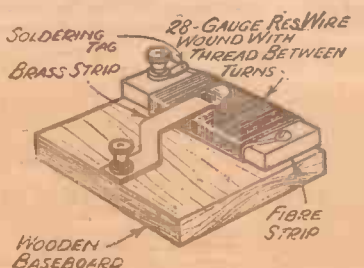


Fig. 3.—This illustration shows the constructional details of the 10 ohm variable resistance described.

The same method of working can be applied to other supply voltages and other lamp ratings.

Generally speaking, a charging rate of between .25 and .5 amp. will be suitable, and a 60- or 100-watt lamp can thus be used. There is only one point to watch in

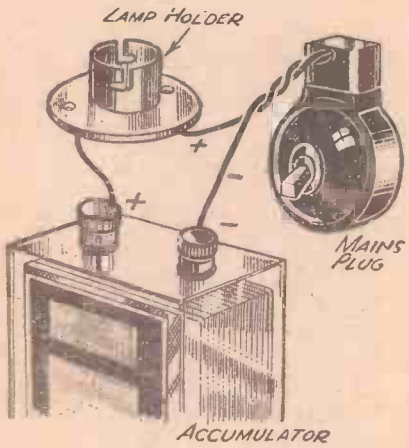


Fig. 1.—Showing the simple arrangement of a trickle charger for use on D.C. mains.

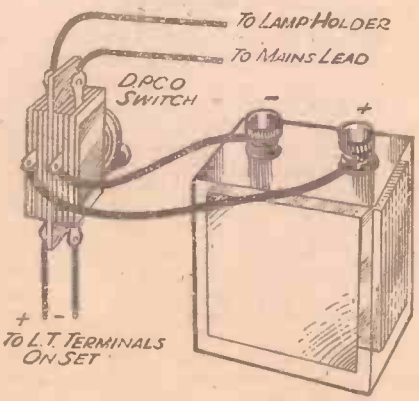


Fig. 2.—The switching system for transferring the accumulator leads from the set to the charger when the former is out of use.

connection with this simple form of charging from D.C., which is that the polarity of the supply to the accumulator must be correct and as shown in Fig. 1. There are different methods of finding the polarity, but the simplest of all is to dip the two leads to be connected to the accumulator terminals into a glass of salty water. A lamp must be included in series with one lead. Keep the leads well apart, grip the insulated flex with a strip of rubber or other good insulating material and observe the bubbles given off from the ends of the wires; the wire from which the greater number of bubbles is liberated is the negative. After finding this, clearly mark the leads by binding coloured string round them, or by fitting coloured spades. Also mark the mains plug connector so as to ensure that it is always replaced in the socket with the pins the same way round.

Switching Arrangements

It will be convenient to provide a simple switching arrangement so that when the L.T. supply to the set is cut off the accumulator is automatically put on charge. This can most easily be done by connecting a double-pole-double-throw Q.M.B. switch, as shown in Fig. 2. The time of charging should be such that slightly more power is put into the accumulator by the mains than is taken out by the set. Thus if the L.T. consumption of the set is .4 amp and the charging rate .25 amp., the accumulator should be charged for about two hours for every hour the set is in use. By careful choice of the lamp wattage, however, it will be possible to leave the accumulator on charge for the whole of the time that the set is out of use.

An A.C. Trickle Charger

Charging from A.C. mains is an entirely different proposition, because it is necessary to reduce the supply voltage to a suitable figure, and also to rectify the current, so that D.C. is applied to the accumulator. In practical terms, this means that a transformer and a rectifier must be interposed between the mains and the accumulator. The transformer may be made by using three dozen No. 4 Stalloy stampings for the core, and allowing 16 turns per volt for both primary and secondary windings. The primary may be wound with 38-gauge enamelled wire, and the L.T. secondary with 24-gauge d.c.c., assuming charging current up to .5 amp to be suitable.

The actual charging voltage required is 2.7 volts per 2-volt cell, but allowance must be made for the voltage drop across the rectifier. The latter, incidentally, can be done by using two of the cells as described for the H.T. section wired in parallel, as indicated in Fig. 4. The secondary should then be wound to supply 7 volts (112 turns) when a 2-volt accumulator is to be charged, 9 volts for a 4-volt accumulator, and 11 volts for a 6-volt accumulator. In nearly every case the lowest voltage will be used, but it is a good plan to wind the transformer for the highest, and to take tappings for the other two outputs. We are not going to give any further constructional details for the transformer, because these have all appeared in previous issues.

Making the Variable Resistance

A variable resistance is shown in Fig. 3, and although this is not strictly essential, it is very desirable, since it prevents fluctuation of the charging voltage and

(Continued on next page.)

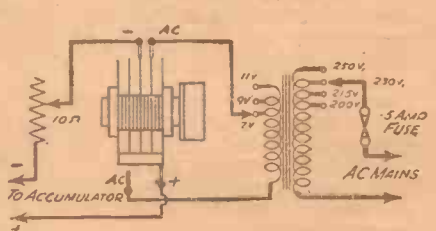


Fig. 4.—The circuit required when using the Westinghouse L.T. 2 rectifier.

SIMPLE TRICKLE CHARGERS

(*Continued from previous page.*)

allows the current to be varied over fairly wide limits. The resistance is shown as being of 10 ohms, and it can be made by winding 2½yds. of bare 28-gauge Eureka wire on a strip of fibre, and making a springy brass strip to slide over it, as shown. It will not normally be necessary to vary the resistance, and the slider can be set to its midway position, but it is well to check the current in the first place by inserting an ammeter between the resistance slider and the accumulator positive terminal. The resistance can then be varied until the charging current, determined as described above, is provided.

Switching With the A.C. Unit

The method of switching the accumulator from "charge" to "discharge" is somewhat different from that suggested in connection with the D.C. unit, but a reliable (and it must be of good make) Q.M.B. switch can be used by following the connections indicated in Fig. 5.

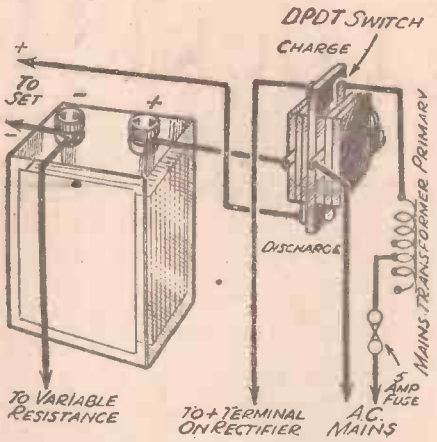


Fig. 5.—The switching system required when using an A.C. trickle charger.

It is possible to modify the mains transformer used for H.T. supply so that it includes an L.T. winding to feed the rectifier, but this is not quite so satisfactory from the constructor's point of view. Should any readers care to adopt the idea, however, it will only be necessary to wind the L.T. secondary winding over the other windings on the spool—placing a layer of oiled silk or insulating tape between the windings—and to connect this to the rectifier. The number of turns will be according to the voltage required and the turns per volt allowed on the original transformer. When this system is followed the method of switching the accumulator will be the same as that shown in Fig. 2, except that the two upper terminals on the switch will go to the variable resistance and rectifier, instead of to the negative mains lead and the lamp. It will also be necessary to include an additional on-off switch in the H.T. circuit.

Problems of the Potentiometer

How to Calculate Voltage Drop and Current Distribution

MOST experimenters can apply the simple rule known as Ohm's Law to the calculation of the value for a voltage-dropping resistance in a radio receiver. Whether the resistance be required for adjusting the value of the anode voltage, or the provision of automatic grid bias, or as a line resistance to ensure the correct heater current in a universal set, the method of calculating its value is the same, namely, to multiply the required

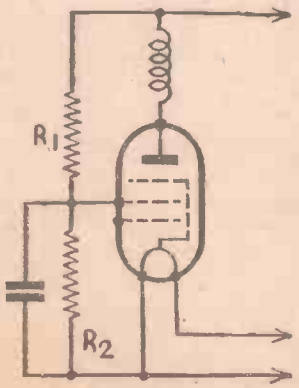


Fig. 1.—A fixed potentiometer for obtaining the screening-grid voltage.

voltage drop by 1,000 and to divide the result by the current to be passed expressed in mA. The answer will give the required resistance in ohms.

In certain positions, however, a mere series resistance is not entirely satisfactory, and in such cases—as, for instance, for obtaining the screen voltage of a screen-grid or screened pentode valve, it is necessary to make use of a potentiometer arrangement with a fixed tapping point as indicated in Fig. 1.

Although the calculation of the values of the two fixed arms of the potentiometer is really quite a simple matter, being nothing more nor less than a slight extension of the Ohm's Law principle, many constructors find it something of a bother. The following brief explanation, however, should relieve the problem of all its difficulties.

Referring again to Fig. 1, it will be seen that the circuit consists of three parts: the upper portion of the potentiometer resistance, R1; the lower arm of the potentiometer, R2, in series with R1 across the high tension supply: and the screen-cathode path of the valve, which is in parallel with R2. If we consider the screen-cathode path as a simple resistance, the "equivalent circuit" of the arrangement will be shown in Fig. 2, where R3 represents the screen-cathode path.

Current Distribution

We can now examine the current distribution in this network. First of all, it will be clear that if the valve were removed from its socket there would be a steady flow of current through the potentiometer of a value equal to the H.T. voltage divided by the sum of R1 and R2. This is what is called the "standing current" of the potentiometer. Now, if the valve is again plugged into its holder, the screen current will flow through R1 and R3, in addition to the standing current through R1 and R2. Thus, the current in R1 will be equal to the potentiometer standing current plus the screen current of the valve, the current in R2 will be equal to the standing current only, and the current in R3 will be the screen current only.

In order to ensure "good regulation"—that is to say, a reasonably constant screen voltage under varying circuit conditions—it is usual to arrange the network so that the potentiometer standing current is at least four times the screen current. Let us assume that in a certain battery receiver an anode feed voltage of 100 v. is available, that the correct screen voltage for the high-frequency pentode employed is approximately 40 volts, and that under these conditions the screen current will be 0.4 mA.

The first step is to decide upon a suitable value for the potentiometer standing current, which, for the sake of argument, we will make 1.5 mA., or a little less than four times the screen current. It will be clear, therefore, that the resistance R1 will have to carry 1.5 plus 0.4 mA., or 1.9 mA. in all, and in doing so drop 60 volts, leaving 40 volts, the required screen voltage. The

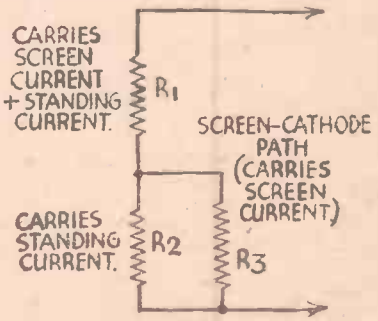


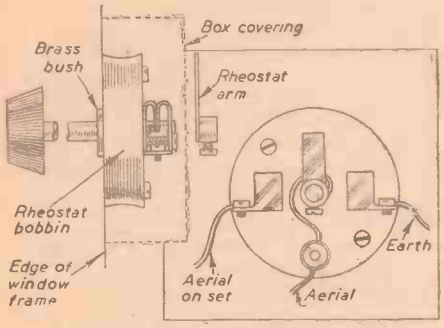
Fig. 2.—The equivalent electric circuit of Fig. 1.

value of R1 should be 60 multiplied by 1,000 and divided by 1.9, or, approximately 31,500 ohms. R2, which has to pass only the standing current of 1.5 mA., and drop only 40 volts, should have a resistance of approximately 26,500 ohms. As these values are not standard resistance sizes, R1 would probably be made 30,000 ohms and R2 25,000 ohms.

Practical Hints

Semi-rotary Aerial-earthing Switch

HERE are particulars of a very useful aerial-earthing switch I have constructed and used with great satisfaction. It is made so that the hole in the window frame for the existing aerial can be utilised.



An improvised semi-rotary aerial-earthing switch.

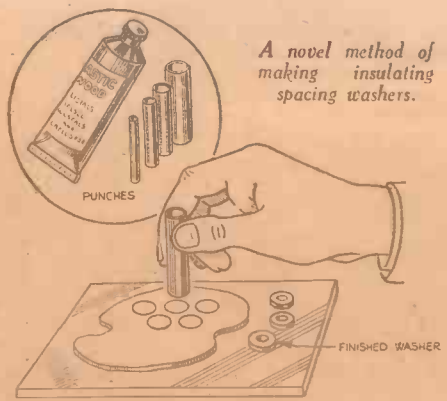
The ebonite bobbin and arm (cut short) were taken from an old rheostat, and the two clip contacts from an old knife switch. The clips need drilling and are fixed by means of a nut and bolt to the base, thus providing terminals. A brass bush is fitted in the centre hole, and in this revolves the rod with the arm attached. A pigtail connects the aerial terminal to the arm, and the switch is enclosed in a small wooden box on the outside of the window frame, as indicated in the sketch.—JOHN BRIDGES (Gateshead).

Making Insulating Spacer Washers

THE constructor frequently finds the necessity to space and insulate certain components away from panels, baseboards, brackets, etc., and for this some form of insulating washer or collar is required.

Where such extras are not supplied with the component, the amateur will generally cut them from a sheet of ebonite or paxolin, filing each down to the required thickness, which is often a rather laborious process.

A simple method, worth a trial, is that of cutting these washers out of plastic wood. As will be seen from the sketch, the plastic wood is rolled out to the required thickness on a sheet of glass or metal (not wood), small home-made punches being then used to cut out the required circles. These are then left flat to thoroughly harden, and can afterwards be dipped in thin shellac to make them damp-proof. The punches can be quickly made from a sheet of copper foil, cutting strips, and rolling round pencils, etc., and giving each a touch of solder at the top and bottom of the seam. In making the washers, it will generally be found best to cut out the outside diameters first, and then the small inside ones, as the centres can be more easily judged in this way.—R. L. GRAPER (Chelmsford).



A novel method of making insulating spacing washers.

THAT DODGE OF YOURS!

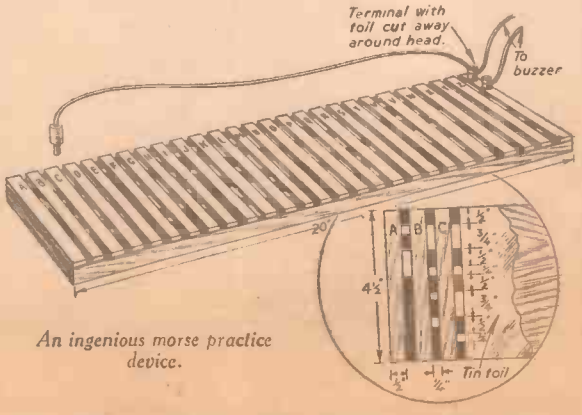
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

A Morse Practice Device

THE accompanying illustration shows a device I use for morse practice. Readers learning the morse code will find this simple apparatus a help for getting the "tune" of the letters.



An ingenious morse practice device.

A wooden base, 20in. by 4½in., a sheet of tin-foil the same size, and 27 strips of wood 4½in. x ⅛in. about ⅛in. thick are first required. Lay the foil on the wood and screw down the strips, as shown, leaving a space between each strip ⅛in. wide. Before screwing down the last strip two bolts are needed; one is bolted through the tin-foil and strip, the other through the strip only, the tin-foil being cut away so that it does not touch the head. One end of a wire about 2ft. long is connected to the latter bolt, and to the other end of the wire a plug is connected.

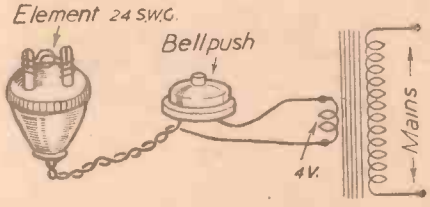
Now, beginning in the first space on the left-hand side, measure down ½in. from the top and paint over the space with a small brush. Now miss a ⅛in. space, paint a space ⅛in. long, miss ⅛in. and paint the remaining space down to the bottom. Mark this strip A. It will be seen that a space ⅛in. is left for the dots and ⅜in. for the dashes, with ⅛in. painted between the dots and dashes. The illustrations make this clear, the shaded parts being the ones that are painted.

It may be found necessary to paint the parts over with two or three coats to make good insulation.

In use, the terminals are connected in place of the morse key, then on drawing the plug down the slots the appropriate letters are sounded in the buzzer or oscillator. It will be noted that the timing will be correct at any speed.—A. SOUTHWOOD (Saltford).

A Cigarette Lighter

JUDGING from the burnt matches which found their way into the ash-tray, my den is a popular resort for the short-wave fans of the district. Since they are notorious for using my matches, I constructed a lighter which has proved its worth, especially now that the match shortage has become evident.



An electric cigarette lighter for the radio den.

I found an old two-pin plug top in my junk, and this, together with a piece of flex, a couple of inches or so of 24 S.W.G. resistance wire, and a small bell-push, completed the job. The flex is wired into the plug in the normal way and the resistance wire in the form of a double loop is connected in the slots of the plug pins. The supply is taken from the 4v. winding of the old mains transformer in my test panel. The length of the heating element I found by experiment. The object of the bell-push is obvious.

I estimate the loading of the element at less than 10 watts, and the time for lighting a cigarette at five seconds. This means that I can light over 2,000 cigarettes for the price of one match with current at 1d. per unit. For the drawing-room I have proved that a bell transformer will stand up to the job without harm.—E. JACKS (Leigh, Lancs).

Comment, Chat and Criticism

Outline of Musical History—10

Further Sketches of the Lives of Some of the Leading Figures in the Romantic Movement. By Our Music Critic, MAURICE REEVE

CONTINUING our sketches of the lives and work of the great figures of the nineteenth-century romantic movement, we must not omit that of Hector Berlioz who was born in Côte-Saint-Ande, France, in 1803. Sent to Paris to study medicine, he forsook his search for the Hippocratic oath and entered the Conservatoire, gaining the coveted "Prix de Rome," with his cantata "Sardanapalus" in 1830.

All his life he was also a literateur, and most of the inspirations for his major works came from his study and admiration of such kindred spirits as Byron, Scott, Hugo, Dumas, etc. His own memoirs are one of the most remarkable and outspoken autobiographical works. He made concert tours and visited London in 1851. After visiting Liszt in Weimar, he settled in Paris, where he died in 1869.

Berlioz was a remarkable genius and, not unnaturally, possessed all the defects of his qualities. Throwing all conventions to the four winds and, in spite of a worship of Beethoven, abandoning all classical forms, he wrote programme music *par excellence*. His orchestra was his palette and he used it solely to illustrate the story he set out to tell. It was an enormous orchestra, which, in his "Requiem," contained sixteen kettledrums, sixteen trombones, sixteen trumpets, four ophicleides, two tubas, ten cymbals, twelve horns, etc.

His so-called symphonies and overtures are all expressions of some story or scene from life founded on the poetry or prose of the similar movement which governed literature then, as it did music. "Les Francs Guges," "Waverley," "Rob Roy," "King Lear," "Harold of Italy," "Symphonie Fantastique" (episode in an artist's life), are some of the titles. His choral works include "La Damnation de Faust," "Romeo et Juliette," and "l'Enfance du Christ." His operas, "Benvenuto Cellini," "Béatrice et Bénédict" and "Les Troyens," are no longer on the repertory as such, but much of the music is standard fare in the concert hall.

All Berlioz's work is on a colossal scale, and stamped with a most original genius, though many a page is tedious padding and many an effect a vulgar display. But movements such as the "Royal Hunt" and the "Storm," in "Les Troyens," are imperishable masterpieces.

I purposely brought forward the notice of Rossini and his work for reasons stated at the time. Otherwise, and chronologically, he would occupy this and the following paragraphs.

Chopin

Chopin, 1810-1849 is altogether a unique figure in music, and to his work, perhaps more than to that of any of the others, would we refer to if we wanted to cite the quintessence of the romantic movement.

Born near Warsaw, of a French father and a Polish mother, he made his home in Paris from 1831 onwards, and lived amongst the highest society and all the leading spirits of the movement. A brilliant pianist and teacher, he founded a dynasty of great "Chopin" players, the first generation of whom were his own pupils. The supreme poet of his instrument, he founded both an entirely new school of piano writing and of piano technique.

His work, with a few minor and second-class exceptions, was given wholly to the piano. Consequently one cannot mention his name along with the great symphonic or operatic masters—more especially one like Beethoven who was supremely great in almost every department and branch of music. But although Chopin must be considered a miniaturist by the side of such men, his work for the piano was so perfect, and as a musician he was so astonishingly original, that, coupled with the enormous influence he has exercised right down to our own time, he must be ranked amongst the first flight of creative masters, even if we impose the qualification already alluded to.

His output was very small—judged by any standard—and limited to one instrument. But he furnished that instrument with a series of master works which still holds its place of supremacy in pianoforte literature. In his four Ballades, four Scherzos, twenty-four Studies, Polonaises, Nocturnes, two Sonatas (the first one is negligible), Barcarolle, Fantasie, Polonaise Fantasie, Berceuse, etc, he gave us an entirely new type of work based on an entirely new conception of the piano as a medium of musical self-expression.

Although austere in so far as they are "absolute" music and devoid of semblance of a programme, they glow with romantic passion and an intoxicating "something" that renders them unique in piano literature. Daringly original in form and exploiting the chromatic scale to lengths undreamed of before, they have held the platform with an ever-increasing devotion on the part of pianists, musicians other than pianists, and audiences alike.

As a Melodist

But it is above all as a melodist that he is revered by so many, though the thoughtful musician finds him the subtlest of harmonists as well. A Chopin melody, together with its incomparable ornamentation, has no counterpart anywhere else in music. Only Schubert or Mozart might stand alongside with him. But their styles and media were so different that comparisons are scarcely legitimate.

A spirit of romance pervades every page of his work. But it is not a namby-pamby romance, but a virile and masculine emotion which is charged with all the pulsating throb of life itself. Works like the scherzos and polonaises are demonaic in their furious energy, and they rush and sweep the listener onward with their cataclysmic fury.

Even in the gentlest and sweetest numbers such as the G major Nocturne, the Berceuse or some of the preludes, Chopin is always the tenderest and most solicitous of lovers; never the mere sentimentalist. But when he is aroused, as in the works mentioned above, the two sonatas, some of the other preludes, etudes, etc., no piano music outside Beethoven's can compare with his for their thrill and emotional appeal. They range over the whole gamut of human feeling and they exploit the instrument, in every direction, to the fullest limits of its capacity. The very soul of the piano is enshrined in his pages to a greater degree than in any other writer for the instrument. Beethoven and a few of Liszt's choicest works excepted.

Chopin was a master craftsman, if on a small scale. His "Ballade" and "Scherzo" forms—if I may coin such a phrase—are entirely original and have never been even successfully imitated. All his work is finished and polished to the *n*th degree, and not a ragged thread can be found in his entire output.

A Brilliant Pianist

He was an extremely brilliant pianist and numbered most of the leading lights of Parisian society and fashion as his pupils. As with Beethoven, the dedications at the head of his works offer an illuminating key to the world he moved in. It is said that on the days before his public appearances as pianist he practised nothing but Bach's preludes and fugues.

The "Chopin technique," the "Chopin rubato;" in fact, the whole "bag of tricks" for playing Chopin's music and imparting to it that enchanting "something" which always stirs us so when we hear it, are traditions which have been passed down through five generations of pianists and pianist teachers from the master himself, who confided with such of his own disciples as Scharwenka, Mikuli, Klendworth, etc. To-day, the Pole, Vladimir Horowitz, is unquestionably the most inspiring exponent of this most delectable music in the world. He has just turned thirty and, ultra-modern in his method and style, he is an incomparable pianist in many other masters than Chopin, but in Chopin's music particularly.

The playing of Chopin's music is perhaps the most "personal" thing there is in the concert world to-day. Unquestionably the most widely performed of all the piano masters, it is, for this reason, the least frequently well played. It demands qualities of temperament and of a personal approval to the music which makes it readily understable why we so seldom hear it played to our complete satisfaction.

Circumstantial evidence strongly shows that the chief of these requirements is a few drops of Polish blood in the player's veins. For it is undeniable that, with one or two honourable exceptions, all the master Chopin players are Poles. They alone succeed in imparting to it that "something" without which it falls so flat. Or perhaps I might put it the reverse way, and say that they alone distil from it the incomparable perfume, or otto, which makes of it the most unique, striking and seductive work that the most fortunate of instruments can claim for its own.

Intervalve H.F. Coupling

In This Article We Discuss the Choice of Couplings to be Used Between an H.F. and a Detector Stage

LAST week we dealt with the question of amplifiers employing two H.F. stages, but there are also several interesting details worthy of explanation in simple H.F. stages. We have seen in past issues that questions of selectivity and sensitivity are answered by H.F. amplifier design, but many constructors find difficulty in deciding upon the circuit to be used in a simple single H.F. stage. We refer in this connection to the intervalve coupling, and not the aerial circuit. There are at least three forms of coupling available, and each of these has its own particular merits, and all are suitable for incorporation in a modern receiver. Perhaps the most usual form of coupling is that known as the tuned-grid, and shown in diagrammatic form in Fig. 1. In this arrangement an H.F. choke is included in the anode circuit of the H.F. valve and a lead is taken from the lower end of this to one side of a fixed condenser, the other side of which is joined to the tuning coil in the grid circuit of the detector.

This circuit arrangement is very suitable when building an amplifier for adding to a normal detector-L.F. receiver, since the fixed condenser is then merely connected to the aerial terminal of the original receiver. It is evident that the high-frequency amplifier simply takes the place of the aerial, supplying the input to the detector—but after amplification. The tuned-grid coil calls for very little consideration, for it is simply a standard tuner of any type, although if a ganged condenser is to be employed it should have characteristics exactly similar to those of the tuning coil used in the grid circuit of the preceding valve. If the coil is of different type it is probable that it will be impossible properly to trim the sections of the gang condenser, with a result that there must be a tremendous loss in signal strength, especially at certain parts of the tuning scale.

Ganged Tuning

To prevent this trouble, the best course is to employ separate condensers for the two circuits or to use a two-gang condenser of the type having an external trimming adjustment capable of producing a fairly

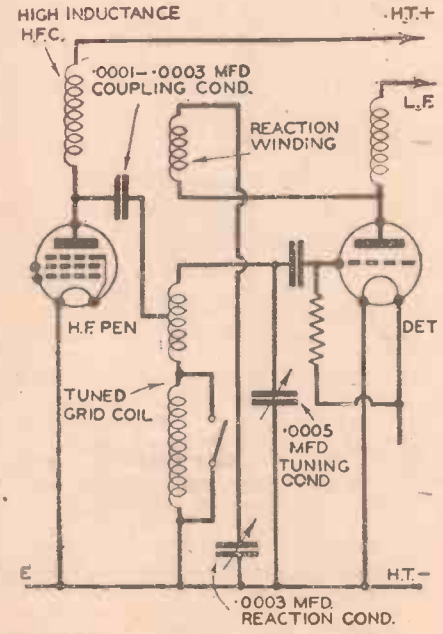


Fig. 1.—A tuned-grid intervalve circuit (with reaction). Battery valves are shown, but the connections are similar for mains valves.

wide variation in capacity—.0001 mfd., for example.

The H.F. choke is a very important link in the circuit, and has a considerable influence upon the efficiency of the finished set. First and foremost the choke should have an inductance of not less than 200,000 microhenries, whilst a value of twice this figure is to be preferred when using a high-frequency pentode, the A.C. resistance of which might easily be as high as 1,000,000 ohms. The choke should also have as low a self-capacity as possible consistent with the appropriate inductance, a value of 3 to 5 mmfd. being sufficiently good for the purpose. It is also desirable that the choke should be of the screened type, since the screening assists very considerably in obtaining stable operation of the receiver when it is adjusted to give really high amplification. It is sometimes considered that if the coils are screened it is unnecessary to screen the chokes as well, but it must be remembered that the latter can create an extensive magnetic field which might easily "link" with nearby connecting leads and other necessarily unscreened components such as fixed condensers.

The fixed coupling condenser is not generally a critical component, and it is almost invariable to choose a value of .0002 mfd. for it. This is, in fact, a good average, but a certain increase in selectivity can be obtained by reducing this value to .0001 mfd., and a little extra signal strength may be gained by using a capacity of .0003 mfd. This point will best be appreciated when it is remembered that the condenser acts in a very similar manner to that component frequently included between the aerial lead-in and the aerial terminal on the set; this being the case, many constructors may prefer to use a preset condenser, which can be modified until the most suitable capacity is found.

Tuned-anode Coupling

A simpler circuit than the tuned grid is the tuned-anode arrangement shown in Fig. 2. In this case the choke is not required, the tuned winding of the coil being wired directly in the anode circuit of the H.F. valve. Correctly used, this method of connection—in theory, at any rate—gives rather greater input to the detector than the tuned-grid circuit, although in practice this is not always realised. The reason for the greater efficiency is that the impedance in the anode circuit of the H.F. valve is infinite when the set is tuned to a signal, whereas the impedance of the choke must be appreciably lower. The chief practical advantage of tuned anode, however, is that it saves a choke and a fixed condenser. On the other hand, the circuit as shown has the definite disadvantage that the moving vanes of the tuning condenser are not connected to earth, but to H.T.+, which means that a gang condenser of normal type could not be used. This little difficulty can easily be overcome by using the connections shown in Fig. 3, where a 1 mfd. fixed condenser is connected

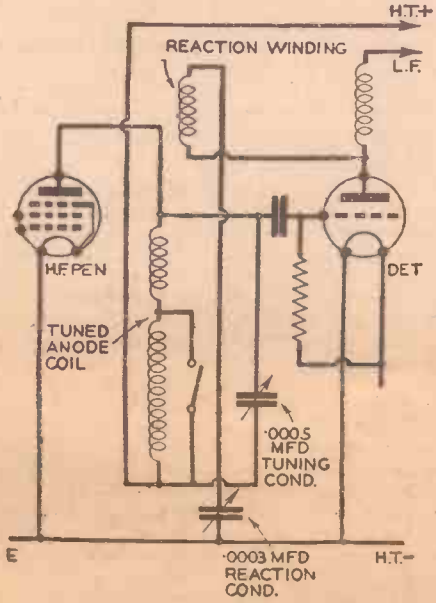


Fig. 2.—The simplest form of tuned-anode circuit in which the tuning condenser is connected in parallel with the anode coil (the same type may be used as in a tuned-grid circuit).

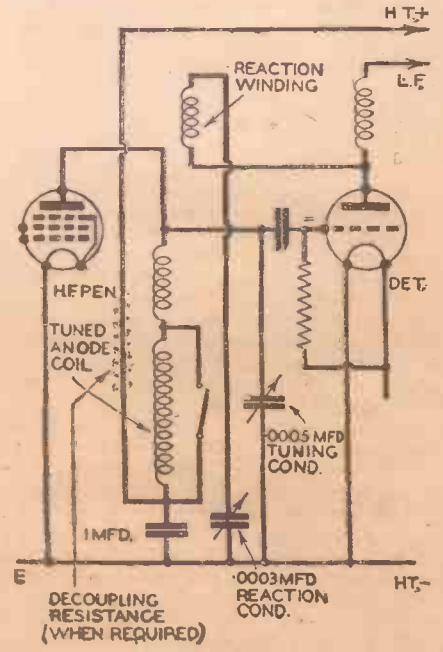


Fig. 3.—An improved tuned-anode arrangement in which an ordinary gang tuning condenser can be employed.

INTERVALVE H.F. COUPLING

(Continued from previous page)

between that terminal of the coil which is joined to H.T.+ and earth, the variable tuning condenser being connected between the anode of the H.F. valve and earth. It will be seen that in this case the tuning condenser is in series with the high-capacity condenser across the coil; this, however, produces the same effect as when the tuning condenser alone is in parallel with the windings. When it is necessary to

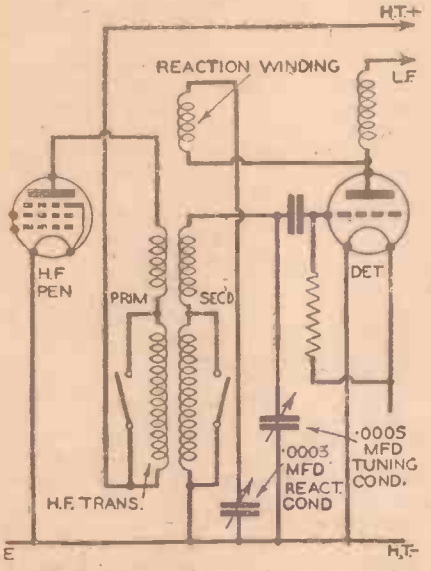


Fig. 4.—An intervalve coupling circuit which combines the advantage of tuned-grid and tuned-anode—the tuned H.F. transformer arrangement.

decouple the anode circuit of the H.F. valve, or when the H.T. voltage to it has to be "dropped," the 1 mfd. condenser is required in any case, and so its cost need not be considered. A decoupling resistance is indicated in Fig. 3 by broken lines. There is one other slight disadvantage of the tuned-anode circuit, even when it is arranged as shown in Fig. 3, which is that the full voltage of the H.T. supply is applied between its terminals, so that if the vanes were to touch, a short-circuit would result. Provided that a good-class condenser be used, however, this can be ignored.

H.F. Transformer Coupling

The third form of intervalve coupling is that shown in Fig. 4, and this is in reality a combination of the other two arrangements. The coupling provided is by means of an H.F. transformer, the secondary winding of which is tuned, the primary being aperiodic. In the present instance it is not possible to use a three-point wave-change switch, and two separate on-off switches, or a four-point switch, must be used instead, unless a by-pass condenser is used in the same manner as in the tuned-anode circuit described above. The tuned-transformer method of coupling combines the advantages of both of the systems previously considered, besides which, theoretically, it provides a certain amount of voltage step-up, due to the secondary winding having a greater number of turns than the primary. This additional amplification is not always realised in practice, but the method of coupling is extremely good when a well-designed coil is employed. But if a poor coil is employed it is usual to find that the receiver is very inefficient at various wavelength settings, or that reaction control is very "unsteady."

As far as the single-valve high-frequency amplifier which we are considering is concerned, it does not matter very much which of the three types of coupling is used, provided that the disadvantages and special points dealt with are borne in mind. On the other hand, when we come to consider a receiver having two H.F. stages the position is rather different, and it is best for the amateur to avoid using a pair of tuned-anode circuits, because it is then usually rather difficult entirely to avoid self-oscillation, due to the fact that the circuits are *too* efficient, as mentioned in last week's article.

Component Layout

It will probably be best now to turn away from the purely circuit design for a time and deal with the question of component layout. This is, unfortunately, a matter which is rather difficult of adequate explanation. The principal reason for this is that the actual disposition of the components must depend, essentially, to a very great extent upon the size of chassis or baseboard, and the type of cabinet into which the finished receiver is to be fitted. Because of these difficulties we must first explain the matter in rather general terms in an attempt to supply the information required by the constructor-designer in planning his own particular receiver.

One explanation of the matter of arranging the parts is to the effect that they should be placed as nearly as convenient in the same relative positions as they occupy in a conventional circuit diagram. This is not a bad way of viewing the question, since a circuit is drawn in the most compact form possible, so that the leads between the various components are as short as possible, that the H.F., detector, and L.F. sections of the circuit are spaced out, and that there is a logical sequence of valve stages. This general idea can be followed whether chassis or baseboard construction is adopted, but in the former case the parts can be rather closer together and may "overlap" to a certain extent, due to the fact that some are mounted on the upper and some on the lower surface of the chassis. An example of a suitable general arrangement of the components in a three-valve (variable-mu H.F., detector, and pentode) circuit is shown in Fig. 5, which indicates the approximate lengths of wiring.

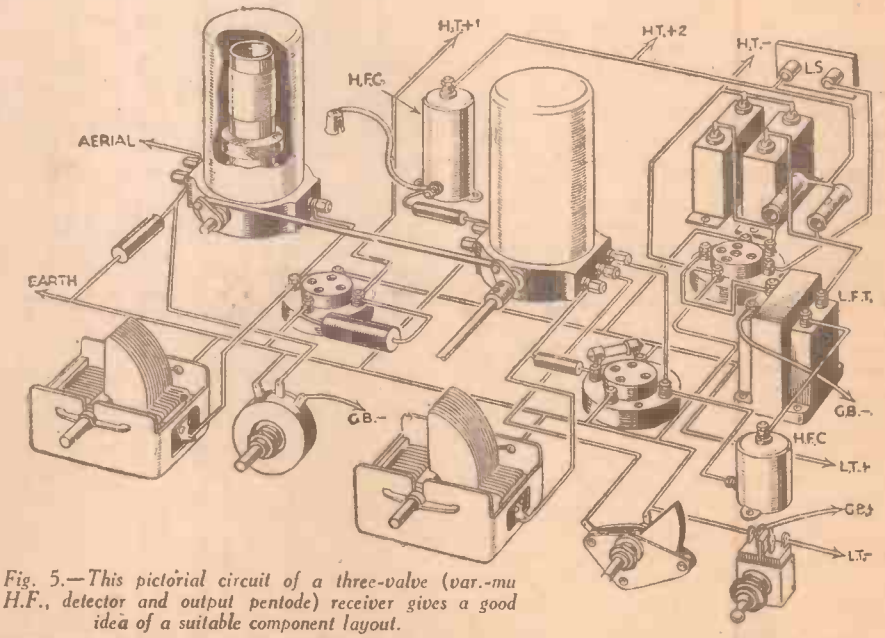


Fig. 5.—This pictorial circuit of a three-valve (var.-mu H.F., detector and output pentode) receiver gives a good idea of a suitable component layout.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., price 1s. weekly (annual subscription, £2 10s.)

Latest Patent Applications.

11028.—Philips Lamps, Ltd.—Remote-control wireless receivers. June 29th.

10998.—Standard Telephones and Cables, Ltd.—Single side-band diversity radio-receiving system. June 28th.

10999.—Standard Telephones and Cables, Ltd.—Single side-band diversity radio-receiving system. (Cognate with 10998.) June 28th.

Specifications Published.

522889.—Eckersley, P. P., and Carpenter, R. E. H.—Wire broadcasting-receivers.

522737.—Murphy Radio, Ltd., and Davies, K. S.—Synchronisation of television receiving apparatus.

Printed copies of the full Published Specifications only, may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Audible Radio Frequencies

SIR,—I have read with interest the articles of Mr. D'Arcy Ford on the subject of detection, and have, each week, hoped to find a letter from one of your readers disproving the new theory which he refers to. However, as I have not yet read anything of the sort I felt bound to write and comment on it myself, as, were Mr. Ford's principle correct, it might cause great trouble to newcomers to radio who are endeavouring to understand the principles of audio-frequency coupling.

Although the output from a detector might consist of a radio frequency wave with its datum line shifted, I cannot believe that such an output can pass through the A.F. stages of a receiver, or at least through the A.F. stages of a receiver of normal construction. Therefore I do not propose to disprove any of the theory of the workings of the detector itself, but rather to discuss its effect on the A.F. stages and, in particular, on the coupling of those stages.

The effect of shifting the datum line of a wave, whether modulated or not, can be achieved by adding to it a source of constant potential, i.e. D.C. Now to obtain any useful output from an amplifying valve having an input similar to that in Fig. 7 of Mr. Ford's article in the July 13th issue of your paper, it is necessary for that D.C. potential to be faithfully passed on and amplified. With any normal method of coupling this is impossible, and the graph of the output of the valve reverts to that of the input to the detector. A circuit with characteristics similar to that of the V.F. stages of a television receiver is required, using the D.C. restoring diode which has been the subject of so many discussions. An alternative is either to direct-couple the stage or to preset the degree of bias on the stage in accordance with each station tuned in. The first method is inconvenient and the second consists essentially of providing a second anode bend detector instead of an audio stage. As, anyway, none of these methods is used or is necessary in the normal set, we may presume that the theory is erroneous.

Without in any way wishing to reflect on Mr. Ford's undoubted ability, and indeed, I am glad to see that the old experimenting spirit remains in the radio world, I would recommend him also to study the effect of the output of an additive mixer of the old type, and the subsequent effect on I.F. tuning, should such an output consist of a shifted datum line carrier with I.F. superimposed.

I trust that this letter will be interpreted in the spirit in which it is written, namely, that of an honest desire to correct an ingenious but incorrect theory.—GERALD R. W. LEWIS (Cheltenham).

Station HCJB—Quito

SIR,—I have noticed several letters recently in your paper about station HCJB in Quito. Just before restrictions were placed on Q.S.L. cards I wrote to this station in March, and have just received a reply with a very nice card showing a photo of the station with the national colours. In the accompanying letter the times of programmes directed to N. America are given. They are Ecuadorian Echos at 6 p.m. E.D.S.T. and Friendship Hour at 9 p.m. E.D.S.T. Both these programmes are in English. For those (they say) who are technically minded here is a description of the station. It is a 10 kW transmitter, and at present has a four-element close-spaced rotary beam fed by a 500 ohm line delta matched. The antenna is 2 x $\lambda/2$ high, the entire mast being rotatable. The mast weighs approx. 2 tons and is 95ft. high. The general practice of a buried copper wire fixed to the ground is used. The transmitter tube line up is a 42 oven crystal oscillator driving a pair of 807 push-pull doublers, driving a pair of 100THs in parallel, working a push-pull stage 450TLs. The final R.F. stage is a push-pull F129B Federal valve designed for television operation. The modulator is a resistance impedance coupled driver, making it produce 18 db of inverse feedback into the audio final, which is a pair of F891s. The transmitter has the conventional protection for overload, relays, and automatic power switches. I hope this will be of interest to other readers of your fine paper.—E. J. BRIGGS (Wallasey).

Prize Problems

PROBLEM No. 410

STURVIS had a two-valve short-wave battery set which had been in operation for some time. His normal broadcast receiver broke down, and as he wished to listen to some special programmes he decided to convert his short-wave set. He therefore took out the short-wave coil and replaced it by the coil taken from his broadcast set. He short-circuited the long-wave section correctly, but could not get the Home Service programme. He had previously ascertained that the breakdown in his broadcast set was not due to a faulty coil. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 410 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, July 29th, 1940.

Solution to Problem No. 409

The transformer which Barnes purchased had the terminals marked in the old form, OP, IP, OS and IS. He wrongly assumed that the "O" terminals referred to the primary and the "I" terminals to the secondary and thus his connections did not permit of the action of a transformer.

The following three readers successfully solved Problem No. 408 and books have accordingly been forwarded to them:

A. Smith, 100, Laburnum Road, Redcar, Yorks.

R. Smart, Stragglethorpe Grange, Brant Broughton, Lincoln.

A. Faslin, 38, Whitton Avenue, Greenford, Middx.

"Radio Training Manual"

SIR,—At last I find myself in a position to follow the example of some of your other readers now in the Services, and drop you a few lines.

I have been rather out of touch for the past few months, as I was unable to get my copy of PRACTICAL WIRELESS in France.

I have only just read about the "Radio Training Manual." Can you tell me how I can qualify for a copy? I know I have to save the coupons, but I would like to know where to get a form to fill in.

I can tell you that I am really glad to be back in the Old Country, and to PRACTICAL WIRELESS, too. We had some exciting times but were lucky enough to scrape through. I am looking forward to our final victory, and then we can settle down to our hobbies as before.

Wishing PRACTICAL WIRELESS the very best of luck.—RANSOME C. L. BAKER (Ayrshire).

[*You can obtain a copy of the "Radio Training Manual" by forwarding to our Publishing Dept. a P.O. value 2s., and four coupons cut from consecutive issues of* PRACTICAL WIRELESS.—ED.]

Super One-valvers

SIR,—For the benefit of readers in the same position as Mr. Maynard, I should like to describe how I have turned the "Simplest Short-wave One" into a Super One-valver.

Instead of using the usual single tuning condenser, I am now using the bandspread system by having a .00025 and .000005 mfd. condensers in parallel.

All these controls are mounted on an aluminium panel.

I also have a variable condenser with capacity of .0001 mfd. in series with the aerial which is an indoor one about 15ft. long with a right-angled bend in it to the opposite wall of the room, so as to make it more directional for receiving purposes.

Lately, I have picked up besides the more usual stations, TAP and 8BV on the 31 m. band, and also VLQ2 and three Americans.

I usually operate the set with 80v. H.T.—M. POLIMENI (New Malden).

"P.W." in France

SIR,—I wish to assure you of my continued support of your periodical. Even while in France I was receiving my copy of PRACTICAL WIRELESS regularly. Somewhere over there reposes my folder of the weekly data sheets you published, and which I used to collect each week. I am glad that you have decided to re-publish these sheets in the form of a handbook, and assure you that I shall be one of the first to apply for my copy. Those data sheets were undoubtedly the most extensive of their kind that I have seen.

I also have my copy of the "Radio Training Manual," and although I have not yet had an opportunity to read it right through, I see that there is much information in it that I shall find useful.

I am afraid that at present my radio activities are confined to planning for the future, and hoping that I shall be able to make a start sooner than I expect. I had the good fortune to come through Dunkirk safely, and am now back in England. I have quite a number of back copies of PRACTICAL WIRELESS to catch up with, which have been to France and returned without reaching me. With many thanks, and congratulations on carrying on under present difficulties.—JOHN B. DORE (Bishop Auckland).

More About Distortion

Decoupling and Other Circuit Details are Discussed Here

As has already been explained on many occasions, a falling-off in the response to some frequencies may be due to a variety of causes. When it is the high notes which are lacking, the most obvious cause is that the tuning is too selective. It is well known that to sharpen the tuning beyond a certain degree means a loss of the higher notes. The popular band-pass tuning arrangement was introduced for the express purpose of overcoming this defect.

The transmission from a broadcasting station, although stated as being radiated at one definite frequency, say 1,000 kilocycles (300 metres), actually occupies a band of frequencies extending over about nine or ten kilocycles, so that to get proper reception the receiver must not tune too sharply or some of the side bands will not be received. On the other hand, if the tuning is too flat, there will be interference from other stations. A band-pass tuner

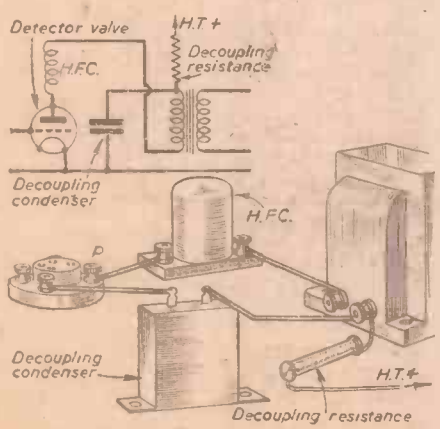


Fig. 2.—Adequate decoupling helps to eliminate distortion due to feed-back.

gives a more or less even response over a band of frequencies of about nine kilocycles, while on either side the response drops off sharply. In this way the demands of both quality and selectivity are satisfied.

If your set is not provided with band-pass tuning, and the tuning is very selective, then some means should be provided to compensate for the cutting off of the higher notes which will naturally result. One method is to use an L.F. transformer which has a rising characteristic, that is to say, one which provides greater amplification of the high notes than the medium and low ones.

Tone Control

An even better arrangement is to use a tone-control circuit such as we have recently described. Most careful designers will specify something of this sort in a set with ordinary tuning, but if your receiver is not so provided, or if it is lacking in high-note response for some other reason, then a simple tone control, consisting of a fixed condenser with a variable resistance across it, should be connected in series with one of the speaker leads. The effect of this will be to reduce the response to the low notes and so level matters somewhat.

A point worth mentioning in connection with high-note cut-off is that reaction can introduce noticeable distortion. As the reaction control is advanced, so the tuning becomes more selective. Reaction should never be used to any great extent with band-pass tuning, as it immediately alters the shape of the response curve from a flat topped one to a pointed one, and so defeats the whole object of the system.

If a receiver suffering from poor upper frequency response is fitted with a triode as the output valve, then its substitution by a pentode will, in a large measure, restore the brilliance of the original transmission. Matching of the impedance of the speaker and the new valve is, however, necessary. If a multi-radio speaker is used, then the adjustment can easily be carried out. Failing this an output choke with suitable tappings for a pentode should be used.

"Attack"

We now come to what is known as lack of "attack." This is a slurring of reception caused by the inability of the moving elements of the speaker to follow the rapid fluctuations of the speech current. It is due, of course, to the inertia of the reed or the moving coil (as the case may be) together with that of the cone. This may sound rather technical, but it simply means that the moving parts are too heavy and do not "jump to it" as they should do.

Unfortunately, if a speaker suffers from this defect to any marked degree, the only course open is to substitute another one. Naturally, nothing can be done to the receiver itself, since the cause of the trouble lies entirely with the speaker. Obviously, it is unwise to try to lighten the reed (moving iron) or the moving coil, as this will probably do more harm than good. The use of a lighter cone may help matters, but here again care must be taken that rigidity is not sacrificed for the sake of lightness. Incidentally, with good-class moving-coil speakers the weight of the moving coil is kept very low by the use of the lightest materials, so that if the reproduction from your present speaker lacks sparkle, try the effect of substituting another of modern design.

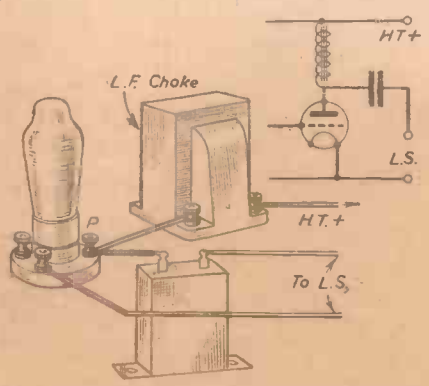


Fig. 3.—Showing how a simple choke-filter system provides decoupling for the output stage.

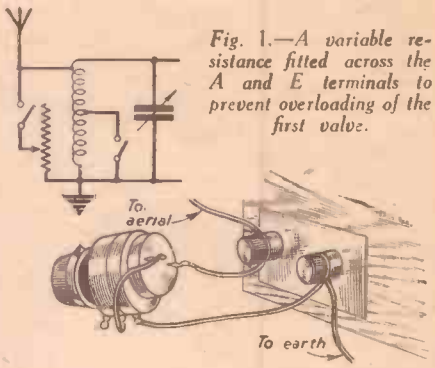


Fig. 1.—A variable resistance fitted across the A and E terminals to prevent overloading of the first valve.

In the case of distortion resulting from deformation of the wave-form, there are so many different causes giving much the same effect that it is almost impossible to say, by listening to a receiver suffering from this form of distortion, to what particular cause it is due. We know the results are characterised by blurred, muffled, or rough reproduction, but it must be left to the reader to find out, by the process of elimination, the actual cause or causes. Distortion of this type is most frequently associated with the incorrect use of valves, such as under and over-biasing, overloading, etc.

Let us take an elementary case of incorrect bias causing distortion in a battery set. Suppose the H.T. battery has been in use for some time and its voltage has dropped considerably. Distortion sets in. This may be partly due to the increased internal resistance of the battery resulting in a certain amount of back coupling, but it may also be very largely attributable to too much bias. Naturally, when the battery was new the bias would be set to the maximum figure for undistorted reproduction, but it must not be forgotten that as the H.T. voltage drops so the grid bias needs lowering, since the amount of bias necessary depends on the anode voltage—the higher the grid bias required, and vice versa.

Therefore, if the setting of the grid bias was left unaltered it would be too high after the H.T. battery had been in use for some time. In such a case reducing the setting of the bias tappings will usually improve matters considerably and so give the H.T. battery a new lease of life.

Overloading the Detector

Overloading a valve is quite a common cause of distortion. With modern receivers employing high-magnification valves in the H.F. stages it is very often the detector which causes the trouble. Detector overload is not always easy to diagnose, as the resulting distortion is not of a very blatant nature. However, if it is present it will spoil the reproduction, although in a somewhat intangible manner. The symptoms to look for are over-emphasis of the high notes and a marked double-hump effect in the tuning of loud transmissions, the maximum signal strength being obtained just slightly on either side of the true wavelength. Another feature is that the reaction control or any pre-detector volume control will appear insensitive on powerful transmissions, quite a large movement of the control making but little difference to the volume. A screen-grid valve used as a detector is particularly liable to overloading.

To increase the power-handling properties of the detector it is always worth while trying an increase in anode voltage, at

the same time using a grid leak and condenser of suitable values. The leak should be about ½ megohm to 1 megohm and the condenser .0001 mfd. For short-wave the leak may be increased to 3 megohms. If overloading still occurs, then some form of predetector volume control must be fitted and brought into operation on the strong transmissions. The ideal form of control is provided by the use of variable-mu valves in the H.F. stages. Another good scheme for reducing the input to the detector, in the case of a straight tuned circuit, is the connection of a variable resistance between the aerial and earth terminals of the set. The resistance should either have a definite "off" position or else be fitted with a switch to cut it out of circuit when maximum sensitivity is required. A suitable value for the resistance is 50,000 ohms. One of the combined volume controls and switches now on the market can be recommended for this purpose. (See Fig. 1.)

Distortion Due To Back Coupling

It was mentioned just now that distortion may be caused by the internal resistance of the H.T. battery. The reason for distortion in this case is two-fold. Firstly, there is the obvious reason that the anode current of the various valves is lowered between the optimum figure, and, secondly, there is the question of back coupling. Obviously, since the anode circuit of all the valves is completed through the high-tension battery, the internal resistance of this is common to each anode circuit, and thus forms a coupling between one valve and another. In this way fluctuations in the current passing through the later valves will cause corresponding fluctuations in that passing through the earlier ones. These fluctuations, owing to the time taken for the currents to travel through the succeeding stages, will be out of step, or out of phase as it is called, with the fluctuations of the original current. This will produce a howl. Sometimes, instead of a howl, the noise produced is of so low a pitch that each separate beat can be distinguished. It is then called "motor-boating."

The way to cure L.F. howls and motor-boating is to get rid of the undesirable coupling by decoupling. First of all, a resistance and condenser connected in the plate circuit of the detector valves, as shown in Fig. 2, should be provided. If this fails, then further decoupling of a similar nature should be employed in the intermediate L.F. stages (if any) and the last valve should be decoupled by using choke output, if it is not already fitted, as in Fig. 3. A very old dodge for curing motor-boating consists of changing over one pair of leads to the L.F. transformer. Either the wires to the terminals marked "H.T.—" and "P" are changed round or else those to terminals "G" and "G.B."

Of course, L.F. howling and motor-boating are of so blatant a nature as to hardly come under the heading of distortion at all. On the other hand, there may be just sufficient back coupling in the L.F. stages of a receiver to introduce distortion without actually causing a definite howl. The reproduction will be characterised by a certain roughness. Where it is due to a run-down H.T. battery there is also loss of volume. The use of a pocket voltmeter will soon determine if the battery is getting low. If so, the remedy is obvious. Of course, the use of adequate decoupling, and the readjustment of grid bias, as already explained, will help to increase the useful life of the high-tension battery.

Adding Extra Decoupling

It is quite possible to get distortion, due to L.F. back coupling, in a receiver in which the H.T. battery is quite O.K., or in a mains receiver even although decoupling should be supplemented. The best way to do this is to either fit larger decoupling condensers (say 2 mfd. in place of existing 1 mfd. components) or else to

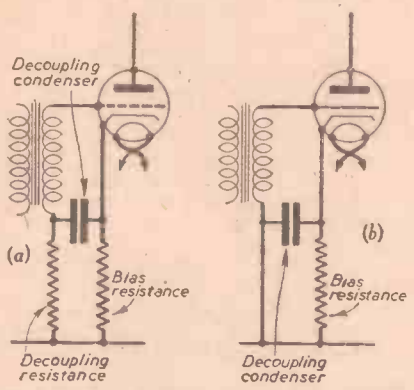


Fig. 4.—The effectiveness of a decoupling arrangement can be increased by adding another condenser in parallel.

connect extra ones in parallel with the present ones.

In an all-mains set, where grid bias is obtained by utilising the drop in voltage across a resistance, decoupling of the associated grid circuits is necessary, and this is actually carried out by using a resistance and condenser as in Fig. 4 (a). In some receivers, however, the resistance is omitted, the condenser being used as in Fig. 4 (b). In the latter case, a resistance may often be included with advantage.

Microphonic Tendencies

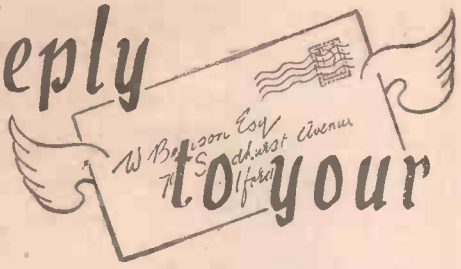
A frequent cause of distortion which is sometimes overlooked is that produced by microphonic feed-back. The sound waves from the speaker travelling through the air and also, in the case of a combined receiver and speaker, through the cabinet and chassis, set up vibrations in the valves and vanes of the variable condensers, etc. In extreme cases a loud, sonorous howl will build up, which drowns everything. However, this condition is not often met with, but a receiver will frequently be found to be working in a state where a microphonic howl must almost manifest itself on loud passages, the result being a rough, jarring kind of reproduction.

The most usual cause of the trouble lies with the detector valve, this valve being particularly susceptible to any vibrations transmitted to it through the holder or through the air. Modern valves are not generally subject to this trouble.

Condenser Vane Vibration

The vanes of variable condensers, especially if they are thin and unsupported at the tips, are liable to start vibrating when sound waves from the speaker impinge on them, or are transmitted to them through the chassis. The remedy here consists of mounting the condensers on rubber buffers. This is easily done with ganged condensers as a soft rubber washer can be placed under each foot of the condenser. With panel-mounted condensers of the one-hole fixing variety it is rather more difficult, but the mounting of the panel, or even the whole chassis, on pieces of sponge rubber will prevent the direct transmission of the vibrations through the cabinet and panel to the condensers.

In reply to your letter



Accumulator Charging

"I wonder if it is possible to modify and perhaps alter the full-wave rectifier circuit on page 35 of your "Wireless Transmission for Amateurs" in order to use it as a charging plant. I have made up this unit with a type 80 American valve and the transformer gives 4 volts at 1, 2, 3 amps. and 250 volts D.C. The condenser used is a single one, electrolytic, of 4+4 mfd."—K. T. (Chigwell).

FOR charging purposes you need a low voltage, generally not greater than 6 volts, and at a current of up to 2 amps. Trickle charging may, of course, be carried out with a current of only .5 amps. Now the latter current is equivalent to 500 milliamps, and you will see, if you examine the curves of your type 80 valve, that it is designed to deliver a current of only 135 mA max., and that is with 550 volts per plate. At 250 volts per plate you will only be able to get about 100 mA and thus accumulators would take weeks to charge. It is a general rule that mains units designed for H.T. supply purposes cannot be broken down for charging purposes in view of the small current which is supplied. It is a simple matter to break down the voltage to the required 2, 4 or 6 volts, but the current will not increase to permit charging to be carried out. The article in this issue on trickle charging should be of interest to you.

Twelve-range Test Meter

"As a regular reader I wish to build up your test meter described on June 29th. You state the switch can be obtained from A.B. Metal Products. Will you kindly give me the name and address of these people so I can get into touch with them?"—T. T. (Horbury).

THE switch in question may be obtained direct from Messrs. Peto Scott, of 77, City Road, E.C.1, and the reference number is PW.5. We regret we are, at the moment, unable to quote a price for this particular switch unit. The full description is a 2 bank, 1 pole, 12 way combination.

Conductance

"I have noted in some valve references recently a term 'conductance.' I cannot find this in my dictionary and wonder if it is possible to state exactly what it is. I presume that as it is absent from my dictionary that it is a new or coined word used only in valves and I should be glad of an explanation."—L. R. (Edinburgh).

THE term is an abbreviation of mutual conductance, or, in American literature, transconductance. This latter term is also an abbreviation for control-grid-plate transconductance and this term explains itself. Conductance is sometimes referred to as "slope", and it is the ratio of a change in anode current to the change in control-grid voltage producing it, under the condition that all other voltages remain unchanged. Thus, if a grid-voltage change of .5 volts causes an anode-current change of 1 mA, the slope is 2 mA per volt. It may also be expressed as .001 (amps.) divided by .5, or .002 mho. The mho, it will be remembered, is the unit of conductance and is the spelling of the word ohm backwards. For convenience a millionth of a mho of a micromho is used to express the transconductance, and therefore .002 mhos would be expressed as 2,000 micromhos.

Best Detector

"I am building a quality set and am keen to incorporate the best detector. I cannot decide between anode bend and a standard diode, and should be glad if you could advise me which, in your opinion, would be the better."—S. T. E. R. (Canterbury).

THERE would probably be not much to choose between the two if both were arranged properly. The diode would probably give weaker signals but from a quality point of view, with normal speaker and other circuit arrangements, you would no doubt find it hard to distinguish between the two. For general use, however, we think you would find it preferable to incorporate a grid leak rectifier, using low values of leak and condenser and high H.T.—the arrangement generally referred to as power-grid detection. With normal components, speaker and room acoustics this would no doubt prove the most useful and economical detector scheme.

Cabinet Resonance

"I have built a good radio-gram cabinet, using ¾in. timber, and with good area for speaker. There is just one point and that is undue boominess on speech. This does not seem so troublesome on music, but speech is too deep for comfort and I should like to overcome it."—S. S. A. (Bispham).

THE trouble may be due to the circuit or speaker, but it is possible to have cabinet resonance which can give rise to the trouble you are experiencing. This may be overcome by lining the cabinet, or by adopting some anti-resonance scheme. A good plan is to line the cabinet, say, by using felt or other "deadening" material. Among the various materials we have tried we recommend felt carpet underlay; several thicknesses of newspaper, or corrugated cardboard. It is sometimes also possible to close in the back of the cabinet, with holes cut in it to break up the air column.

Voltage Tapping

"I need a lower voltage from my H.T. unit but do not know whether to use variable or fixed tapping for this. The volts are for detector and perhaps you would tell me which is the proper thing to do."—G. de T. (Paisley).

THERE is no rule regarding the provision of a voltage tapping point on an H.T. unit. If you can be certain regarding the voltage you require, and the current which is flowing, you could fit a fixed resistance. For a detector stage, however, it may be worth while to provide a variable voltage so that smooth reaction could be obtained under all circumstances. A low value potentiometer in series with a fixed resistance could be connected across the H.T. output, the values being chosen according to the output of the unit and the range of voltage required.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

K. D. R. (Cumberland). The details were given again in our issue dated May 11th. They are included in most of our books, including the latest "Radio Engineer's Pocket Book."

H. E. (Plymouth). Do not try to remove the screening. We suggest you look elsewhere for the trouble, but doubt that the valve is at the root of it.

L. R. (Manchester.) The wavelength is approximately 49.3 metres, but there is no data available at the moment concerning the transmission.

T. T. (Winchester). The coils are not now available. Use the Bulgin multi-range units or separate coils made up to form an all-wave unit.

A. G. S. (Kingsknowe). We do not advise fitting the arrangement as the radiogram was designed for high-quality without the feed-back. In this particular circuit there would be no advantage in fitting it.

G. E. (Blackburn). The pick-up is quite sensitive and should work satisfactorily. Use a good speaker for maximum quality.

L. R. (Penzance). We have no details of the set and cannot recommend any modification.

B. A. F. (Colchester). Use straight push-pull arrangement, that is, with normal grid bias.

O. O. (Lewisham). The carrying case could be lined but it will affect signal strength. We would suggest that you try some alternative circuit rather than to try screening.

E. G. C. (Primrose Hill). Stranded wire is definitely superior, although more expensive. All enamelled would be preferable.

L. D. A. (Winchester). The battery is now a standard line and should be obtainable from any good radio dealer.

L. W. (Rickmansworth). The volume should be controlled by the volume control, not by detuning. This is bound to introduce distortion in a modern superhet.

P. F. (Newark). Double the current is flowing and therefore the resistance value must be halved.

T. K. (Goldthorpe). The 6 mA range has a resistance of 40 ohms; the 30 mA range is 12 ohms, and the 120 mA range is 3 ohms. The normal resistance on the voltage range is 330 ohms per volt.

B. M. (Faversham). Two I.F. stages are often employed in communication type receivers, but for normal broadcast reception you will find a single stage will prove adequate.

L. T. R. (Hereford). Ten watts is more than ample. The quality will undoubtedly be high when the volume control is kept down to normal domestic level, but there will be a considerable waste of power. Five watts should prove quite satisfactory under the conditions mentioned.

The coupon on page iii of cover must be attached to every query

NEW COSSOR RECEIVER

MESSRS. A. C. COSSOR announce two new receivers, Models 34 and 47, with which is coupled Model 77. Of the latter pair one is for A.C. and the other A.C./D.C. operation, whilst Model 34 is a battery model. This has been introduced for the benefit of country dwellers who need a receiver giving "mains performance" but who have no mains facilities. It is a four-valve superhet fitted with Q.P.P. output stage. The circuit incorporates full A.V.C., and among the various features may be mentioned tone control and volume control; extension speaker and pick-up sockets; full station-name dial, and a 10-in. moving-coil speaker. The price of this model, with double capacity 120-volt H.T. battery and 60 A.H. accumulator, is 11 guineas.

The circuits of Models 47 and 77 are identical except for the slight differences called for in the Universal mains model, and again a superhet circuit is utilised. Permeability-tuned iron-cored I.F. transformers are fitted, as well as iron-cored aerial transformers on the medium and long wavebands. In addition to these there is also a short-wave section covering from approximately 16 to 52 metres. A single slow-motion control is provided and has a concentric three-position wavechange switch. Volume and tone controls are provided, together with output or extension speaker sockets. In both models there is a triode-hexode frequency-changer, variable-mu I.F. stage and double-diode triode detector/amplifier. In the A.C. model a power triode output stage is fitted, whilst the A.C./D.C. model has a tetrode in the output stage. An 8in. speaker is fitted to both sets and the prices are 11½ guineas for the Universal model and £11 7s. 6d. for the A.C. model. Descriptive leaflets and other data may be obtained from Messrs. Cossor on application.

One of the new Cossor receivers—Model 77.

BATTERY AUTO-BIAS

(*Continued from page 391*)

use a common circuit for H.F. and L.F. biasing in view of the risk of instability. That is the first problem. Secondly, the H.F. valves generally need variable bias and this introduces the difficulty of keeping other voltages constant. However, by splitting our circuits it is not a difficult matter to arrange for the supply of the bias which may be adjustable and which will not affect L.F or other voltages. The same rules apply as in the case of the L.F. stages, taking the maximum bias needed by the H.F. valves: that is generally referred to as the "cut-off voltage." This will give the total value of the potentiometer needed for the H.F. stage, and then the arm of the potentiometer is joined to the tuned circuit. A series resistance may be included here, with a condenser by-pass for H.F stopping in the usual way. The arrangement is shown in Fig. 3, and it will at once be apparent that the difficulty which will now arise is that we need two resistors across the H.T. negative circuit, as the values needed for H.F. and L.F. will undoubtedly clash. That is to say, the value of the variable component will be such that the bias tappings for the L.F. stages will have to be at such a point that the potentiometer would have to be tapped. This may be possible in some cases, especially where a home-made potentiometer is used. Alternatively, tappings may be possible on some commercial types of potentiometer, where the winding is exposed, but it is desirable to use a separate component. This brings us to a little difficulty, as the use of two separate biasing circuits such as are now indicated will result in the provision of two alternative paths for the anode current and thus the original calculations will be upset. For instance, if we needed a 2,000 ohm circuit for the L.F. stages, and our calculation shows that a 2,000 ohm component is also needed for the H.F. circuit, the inclusion of these two components in parallel will result in an equivalent resistance of only 1,000 ohms in circuit, or looked at in another way, the total anode current will divide equally into two sections. Thus there will only be half of the current which we normally calculated in each bias circuit. Remember in this connection that the current is fixed in this type of calculation, and that the current will thus divide proportionately through the two biasing circuits. It may take a few minutes to arrive at suitable values, although it is possible to calculate the values exactly by one or two various formulae. These are, however, rather complicated, and trial and error methods will undoubtedly prove most satisfactory for the majority of readers, especially as a high standard of accuracy is not necessary on the H.F. side in view of the fact that the control is adjustable. As a simple way out of the difficulty it is best to adopt the following arrangement. The H.F. bias will, in the majority of cases, be in excess of that needed for the output valve. Therefore, make the L.F. and H.F. bias circuit values identical, which will result in the current dividing into two equal portions. For the calculations already given, therefore, take half of the normal anode current when working out the values of resistance, and then on the L.F. side you will have to use an extra resistance to make up the total value, this resistance being included between the H.T. — point and the grid return circuit of the output valve. Fig. 5 illustrates the point clearly.

YOU MUST ORDER "PRACTICAL WIRELESS"

(6d. Monthly) from your newsagent to-day!

As you have read elsewhere, this is the *last weekly issue* of "PRACTICAL WIRELESS." It now becomes a monthly, and the first monthly number will be on sale on Wednesday, August 7th (dated September).

It is IMPORTANT, however, that your newsagent has your order for a regular supply, so in your own interests please fill up the form below and hand it to him. Unless you do this you may be unable to obtain your copy. GO TO IT—NOW!

ORDER FOR "PRACTICAL WIRELESS"
6d. Monthly

To .....
(Name of Newsagent)

Please reserve for me each month a copy of "PRACTICAL WIRELESS," commencing with the first monthly issue (dated September) published on Wednesday, August 7th, 1940.

NAME .....

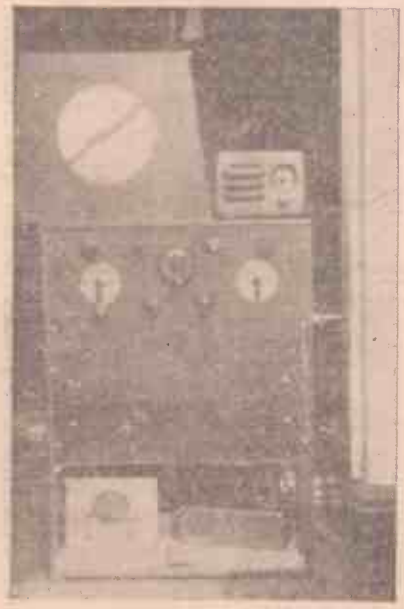
ADDRESS .....

.....

The British Long-Distance Listeners' Club

JUDGING by the correspondence which we are still receiving, it would appear that the real enthusiasts are still able to find time for the continuation of their hobby, in spite of the summer months and, in a great number of cases, longer hours of working. We have taken a few letters at random from the rather extensive B.L.D.L.C. mail, and these, we think, bear out the contention mentioned above.

Member 6711 enclosed a photograph of his equipment, which is reproduced below. He says: "The R.X. at the top of the rack is a four-stage S.W. receiver, consisting of an H.F. Pen (Hivac HP215), in a T.R.F. stage, which incorporates the usual tuned-grid system. The detector is a triode, D210, and this feeds an R.C.C.-coupled stage, L210, which, in turn, is transformer-coupled to



A corner of the wireless den of Member 6711, showing the neat arrangement of his equipment.

the Y220 output pentode. The power supply is obtained from a D.C. eliminator, in conjunction with an accumulator for the L.T. feed. This part of the equipment occupies the lower part of the rack, where a frequency meter can also be seen. The small receiver next to the loudspeaker is a four-valve midget commercial set, tuning on medium and long waves. In the middle portion of the rack, which was originally intended for a transmitter, spare parts and log-books, etc., are kept."

National Appeal for Aluminium

Although this appeal is meeting with such magnificent response, it offers a particularly fine opportunity for all B.L.D.L.C. members to make a most useful contribution to the country's needs, and Member 2713 of Gravesend puts forward the following suggestion, which we think is very praiseworthy: "I think the appeal for aluminium will give members of the B.L.D.L.C. an opportunity to do something towards the National Effort, and I suggest that if one or two members in each town or village would be willing to act as receiving depots, all other members in their localities could take all their old condensers, those of the variable type having aluminium frames or vanes, together with all other scrap aluminium, to them, and the collectors could then take the material to the nearest authorised depot. I am sure if members will look through their junkboxes, they will find many odds and ends of aluminium which they do not require."

The above suggestion is certainly very sound, but in view of instructions already given in the National Press and to avoid complications, we think it would be more satisfactory if each member took his own contribution to the nearest official collecting centre. We hope every member will take an active part in this scheme, as no aluminium part is too small, and it is amazing how much material can be collected if a thorough search is made amongst the old components which have no immediate use.

An Appeal

Member 6409, now in the R.A.F., sends us a very interesting letter, in which he makes an appeal on behalf of the other members of his Hut. He states: "There is one form of entertainment which is lacking at the moment, and which we all miss very much, namely, radio. If any of your readers have a battery portable which has seen better days, and of which they are willing to dispose, we would indeed be very grateful to receive it. We would, of course, pay all carriage costs. While making this appeal I would like to say how very much I appreciate PRACTICAL WIRELESS every week, and how much I regret that I cannot join in any active contests at the present, owing to very obvious reasons."

If any members or readers can do anything towards the above request, we think they had better communicate with us first, so that we can put them in touch with the member mentioned above. We would add that Member 6409 comes from the East Barnet district.

Contact Wanted

Member 6575, of 22, Drummond Drive, Stanmore, Middlesex, when sending details of a very fine log he has compiled on a 1-v-1 home-constructed receiver, asks us to put him in touch with other members, so will those in his area get in communication with him.

Member 6727, of 24, Charles Street, Heaton, Newcastle-on-Tyne, is most anxious to hear from any fellow members, especially those who have built the World Ranger Three, or the Fleet S.W. Two. He is particularly anxious to know of the results obtained with the two receivers mentioned above.

Member 5932, of 27, Unity Street, Sheerness, Kent, who appears from his very interesting letter—for which many thanks—to be a very active member, would like to make contacts with other S.W. enthusiasts in his district. We would add that he has been carrying out some interesting work with a beam aerial, which is very simple to construct, so perhaps we shall be hearing from him again giving us more details.

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2d. per word (minimum charge 2/- each paragraph). Series discounts of 5 per cent. for 13, 10 per cent. for 26 and 15 per cent. for 52 insertions are allowed. All advertisements must be prepaid.

EACH paragraph will commence with the first word printed in bold face capitals. Additional words in bold face capitals are charged at 4d. per word.

ALL communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel.: Pad. 5891.

LITERATURE

NEW Edition. American Amateur Relay League Handbook. 500 pages of up-to-the-minute technical information, 8/-, post 6d.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

BRAND New Edition "Amateur Radio Handbook," 330 pages, 4/- post free.—R. S. G. B., 16, Ashridge Gardens, London, N.13.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make. 24-hour service, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

REPAIRS to moving coil speakers. Coues/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service.
L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

MORSE EQUIPMENT

FULL range of Transmitting Keys, Practice Sets, Oscillators, Recorders and other Radio Telegraph Apparatus, designed and manufactured by T. R. McElroy, World's Champion Telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

MORSE TRAINING

WIRELESS Code Courses. "Book of Facts" Free.—Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised 4in. to 14in. including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

NEW RECEIVERS AND AMPLIFIERS

"CHALLENGER Radio Corporation," the best firm for reliable and fully guaranteed ultra-short-wave radio, have on view in London some of the finest receivers ever made; for instance, a five-valve TRF Midget (2 bands) at 75/-; a mains-battery transportable (operating without alteration on A.C., D.C., or batteries), at £8; an 8-valve radiogram chassis with valves and speaker, 4 wave-bands, at £8/8; a 6-valve tuning unit with five wave-bands, including 4½–10 metres, at £8/18/6; tuning unit with output stage and speaker at £11; a 13-valve receiver with five wave-bands, including 5-10 metres, variable selectivity inter-station noise silencer, chassis, valves, and auditorium speaker complete, £16/16; an 18-valve twin chassis including such refinements as variable selectivity, contrast expansion, C.W. beat oscillator, variable sensitivity, inter-station noise silencer, with valves and auditorium speaker, £28/17/6; any American valve for 1925–1940 receivers for 6/- each (only firsts such as Raytheon, National Union, &c., supplied). Why not call and handle these receivers at your leisure? Also in stock a few American P.A. speakers and cabinets. There is no obligation to purchase. Alternatively, fully illustrated catalogues will be forwarded on receipt of 2½d. stamp.
Challenger Radio Corporation, 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point Marble Arch, down Bayswater Rd., turn 5th right.

RADIO CHASSIS

ARMSTRONG COMPANY have a limited number of chassis not included in the current catalogue, but carrying the makers' guarantee. Chassis are offered at especially economical prices. Several examples are given below.

ARMSTRONG RF96 All-wave Radiogram chassis with R.F. pre-amplifier, supplied complete with matched moving-coil speaker. £6 10s. 0d.

ARMSTRONG RFPP7 All-wave Radiogram chassis with R.F. pre-amplifier and Push-pull output using PX4 valves capable of handling 6 watts. £7 7s. 0d.

ARMSTRONG 7 stage Radiogram chassis complete with matched speaker, £4 10s. 0d.

ARMSTRONG have several other models. Please write for particulars.

ARMSTRONG COMPANY, WARLTERS ROAD, HOLLOWAY, LONDON, N.7.

RADIO MAP AND GLOBE

WEBB'S Radio Map of the World enables you to locate any station heard. Size 40" by 30" 2 colour heavy Art Paper, 4/6, post 6d. Limited supply on Linen, 10/6, post 6d. WEBB'S Radio Globe—superb 12" full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post Paid. 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

RECEIVERS AND COMPONENTS

BANKRUPT Bargains. Brand new 1939-40 models, well-known best makes, makers' sealed cartons, with guarantees, at less 30%-40% below listed prices; also Midgets, portables. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163A, Strand, W.C.2.

DENCO.—Ultra low loss S.W. components, receivers, polystyrene insulation. Send 2d. for Catalogue.—Warwick Road, Clacton, Essex.

COULPHONE Radio. Change of address to Station Road, New Longton, Preston. Goods previously advertised still available. Crystal Pickups, 18/6. Rola G12's with transformer: Energised 52/6, P.M. 65/-. 40 per cent. discount on valves. Stamp for lists.

RADIO CLEARANCE, LTD. See previous issues for full list of bargains.

RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. Holborn 4361.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.

5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.

15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7". 15/- the Kit.

5/- 100 Wire-end Resistances, assorted capacities. ½ and 1 watt, 5/- per 100.

ORMOND Loud-speaker Units, 2/6. Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.

2/- Tool or Instrument Carrying Cases, ex Government Stock. Wood 9" x 7" x 7", 2/-.

SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

PREMIER RADIO

SHORT-WAVE KITS IDEAL FOR OVERSEAS NEWS AND MORSE RECEPTION.

Incorporating the Premier 3-Band S.W. Coil. 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2-volt valves. **3-Band S.W. 1-Valve Kit, 14/9. 3-Band S.W. 2-Valve Kit, 22/6.**

DE LUXE S.W. KITS

Complete to the last detail, including all Valves and Coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in Coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adaptor Kit	20/-
1 Valve Short-Wave Superhet Converter Kit	23/-
1 Valve Short-Wave A.C. Superhet Converter Kit	26/3
2 Valve Short-Wave Receiver Kit	29/-
3 Valve Short-Wave Screen Grid and Pentode Kit	68/-

NEW S.W. A.C.4 KIT. H.F. Pentode, Pentode Det., 4-watt Output Tetrode, F.W. Rec. 200-250 volt, choke output, 13-170 metres. Complete kit of parts with drilled panel and chassis, £4/10/0. Factory built and air tested, £5/10/0.

"LEARNING MORSE?"—Premier Morse Practice Key on Bakelite Base, and Brass Movement, 3/3. General Purpose Morse Key, 5/10. Heavy Duty TX Key on Cast Base, 10/-. Bakelite Buzzers, 1/9. Complete Kit of Parts for Valve Oscillator, as described in W.W. "Learning Morse," 25/-.

MOVING COIL SPEAKERS, complete with universal Transformers. Celestion Soundex 7" P.M. 12/6. Magnavox 8" 2,000 ohm field, 14/6. B.T.H. 10" 1,650 ohm field 17/3, less transformer, 11/9.

SPECIAL OFFER. ROTHERMEL PIEZO BRUSH CRYSTAL PICK-UPS. New Junior P.U. with arm, 19/6. Standard S.8 Model with arm, 29/6. P.U. head only, De Luxe Model, 19/6.

ROLA MOVING COIL SPEAKERS, complete with Transformers. 6½in. P.M., 12/6. 8in. P.M., 16/6. 10in. P.M., 22/6. G12 P.M., 66/-. Energised Models 1,250 and 2,500 ohm field, 59/6.

MAINS TRANSFORMERS. Manufacturers' surplus. All brand new and Guaranteed.

Input 110 v. and 220 v. A.C. Output 325-325 v., 120 m.a., 6.3 v., 2-3 amps., 5 v. 2 amps, C.T., 7/6 each. Input 230 v. A.C. Output 325-325 v., 75 m.a., 5 v. 2 amps, 6.3 v. 2-3 amps. C.T., 6/6. each. Input 100-250 v., 300-300 v. 60 m.a. 4 v. 5 a. C.T., 4 v. 1 a., 6/11. Output 325-325 v. 180 m.a., 5 v. 2-3 amps., 6.3 v. 2-4 amps., 12/6.

PREMIER BATTERY CHARGERS, for A.C. Mains. Westinghouse Rectification complete and ready for use. To charge 2 volts at ½ amp., 11/9; 6 volts at ½ amp., 19/-; 6 volts at 1 amp., 22/6; 12 volts at 1 amp., 24/6; 6 volts at 2 amps., 38/6.

REPLACEMENT VALVES FOR ALL SETS EUROPA MAINS VALVES. 4 v., A.C. Types, **A.C./H.L., A.C./L., A.C./S.G., A.C./V.-M.S.G., A.C./H.P., A.C./V.H.P. (5-pin), all 5/3 each. A.C./H.P., A.C./V.H.P. (7-pin), 7/6. A.C./Pens-H., 7/6; A.C./P.X.4, 7/3; Oct. Freq. Changers, 8/6; Double Diode Triodes, 7/6; 350 v. F.W. Rect., 5/6; 500 v. F.W. Rect., 6/6; 4 v. 2 amps. Gen. Purpose Triodes, 5/6; H.F. Pens and Var.-Mu H.F. Pen., Double Diode Triodes, Oct. Freq. Changers, 8/6 each. Full and Half-Wave Rectifiers, 6/6 each.**

TRIAD HIGH GRADE U.S.A. VALVES, all types in stock. Standard tubes 5/6 each. Octal Base tubes, 6/6 each. 80's 4/6.

PREMIER Short-Wave Condensers, all-brass construction, with **Trolitul** insulation. 15 mmf., 1/9; 25 mmf., 1/10; 40 mmf., 2/-; 100 mmf., 2/3; 160 mmf., 2/7; 250 mmf., 2/11.

PREMIER SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-49, 78-170 metres, 2/- each, with circuit. Special set of S.W. Coils, 14-150 metres, 4/9 set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 39-86 metres. Suitable any circuit, 2/11. 4- or 6-pin formers, 1/2.

CARDBOARD ELECTROLYTICS, 500v. working 4 mf. or 8 mf., 1/9; 8+8 mf., 3/6; 50 mf. 12 v., 1/2; 25 mf. 25 v., 1/2; 50 mf. 50 v., 2/-.

UTILITY Micro Cursor Dials. Direct and 100:1 Ratios, 4/3. 3-wave Full Vision Dial, 6/9.

LISSEN Dual Range Screened Coils, medium and long waves, 2/9 each.

Orders 5/- and over sent Post Free. Under 5/- please add 6d. postage. All enquiries must be accompanied by 2½d. stamp.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723

CALLERS TO: Jubilee Works or our NEW PREMISES, 169, FLEET STREET, E.C.4. *Central* 2833

or 50, High Street, Clapham, S.W.4. *Macaulay* 2381

RECEIVERS AND COMPONENTS

20 ONLY NOW LEFT.—K.B. 6-valve chassis, 8 press button A.C. mains superhet, 3 wave bands (S.M.L.) magic-eye tuning indicator, manual tuning, less valves, in perfect condition, price 35/- carriage paid. See also previous issues for other bargains. Valves required: TH4, TV4, VP13C, DDT13, N31, UU8. Aluminium Screening Box, 3-section, 8½in. x 3½in. x 4in., 1/3 each. Superior Rubber Covered Aerial Wire for S.W. reception, 50ft., 2/9 post free.—London Central Radio, 23, Lisle Street, London, W.C.2. Gerrard 2969.

SHORT-WAVE EQUIPMENT

"H.A.C." one-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Road, S.W.8.

TUITION

YOUNG MEN (15-20 years) urgently needed to train as Radio Officers for the Merchant Navy; short training period; low fees; boarders accepted. Write or call for full particulars—Wireless College, Calmore, Southampton, or Wireless College, Colwyn Bay.

WANTED

WANTED, Used and Unused Aluminium Recording Discs, cheap for cash.—Landauer, Burchetts Farm, Ockley, Surrey.

COMMUNICATION receiver, RME-69, with D.B.20. Preselector preferred, or similar particulars.—20, Oakwood Road, Sutton Coldfield.

WANTED.—Pair Triogen coils with spindle and position register. Good condition, moderate, price on p.c. to Poole, 50, Oxford Road, Southsea.

BOOKS

YOU need this war atlas when you read the newspapers or listen to the wireless bulletins. "Newnes Comprehensive War Atlas" will make the progress of the conflict understandable in all its aspects. 8 pages of war maps, including the Scandinavian countries, Western Front, Balkans, and all countries whose frontiers adjoin or are near those of the belligerents. With war strengths of the Armies, Navies, and Air Forces of the Nations.—Of all newsagents and booksellers, 1/6 net, or by post 1/9 from the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

KNOW what to do before the doctor comes.—Learn from the new book, "First Aid For The Householder," and your knowledge may be the means of saving a life. Deals in simple language with all kinds of injuries and their treatment, war-gases, shock, and the minor ailments of everyday life. Clearly illustrated.—Of all booksellers, 1/6 net, or by post 1/9 from the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

FREE ADVICE BUREAU

COUPON

This coupon is available until August 7th, 1940, and must accompany all Queries and Hints.

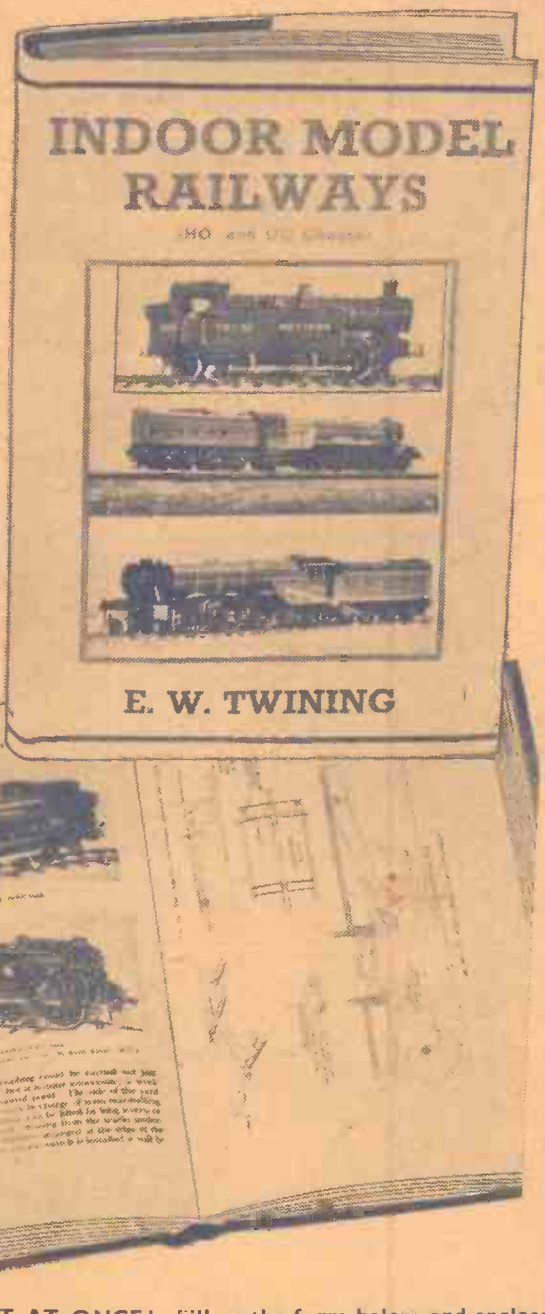
PRACTICAL WIRELESS, 27/7/40.

MODEL RAILWAYS ARE GREAT FUN

and here is

"INDOOR MODEL RAILWAYS"

Presented at Half Price



IT'S extraordinary, isn't it, how everyone loves to operate a miniature railway, even if it's only a clockwork set. We can amuse ourselves for hours with engines, points and signals ; and there's endless fun in working out all sorts of intricate track layouts.

To-day every reader of "Practical Wireless" can become a model railway enthusiast by obtaining this splendid book on the subject, written by one of the best-known model railway experts in the world. It is sold normally for 5/-, but by special arrangement there is a copy reserved for you for only 2/6 plus 6d. for the postage and packing.

SCALE DRAWINGS & PHOTOGRAPHS

The small reproduction of the book on right shows engine types, and designs for coupling. Throughout the book there are special photographs of engines, wagons, coaches, station layouts and railway buildings, and designs and plans for tunnels, track, crossovers, signals, point levers and all the other exciting things that go to make up a big railway system.

ELECTRIC WORKING —HOW IT IS DONE

Do you know the principle by which electrically-controlled model railways work ? INDOOR MODEL RAILWAYS deals with this most fascinating subject in a special chapter, and it is written simply so that you are able to understand with ease the secret of the mechanism hidden beneath the "boiler."

"INDOOR MODEL RAILWAYS"

is the standard work on the subject, with fullest information on :

Early Small Gauge Railways : Origin of HO and OO Gauges.
Gauges, Scales and Dimensions.
Electric Traction Motors, Rotation and Reversing.
Prototype Locomotives and Modelling Same.
Motor Mechanisms and Their Adaptation to Prototype Engines.
The Twin Railway, Its Locomotives and Electrical Working.
Electric Motor Coaches, Carriages, Wagons and Auto-Couplers.
Track, Layout and Engineering Works.
Third-Rail and Two-Rail Systems, Control and Signalling.
Architectural Features, Etc., Etc.

Profusely Illustrated and Handsomely Bound

POST AT ONCE! Fill up the form below and enclose with a postal order for 3/- (2/6 for the book at half-price, plus 6d. for postage and packing). **INDOOR MODEL RAILWAYS** will then be posted to you and you can start work on a hobby that has enthusiasts in every part of the world.

2/6

To the Book Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

Please send me INDOOR MODEL RAILWAYS at the special price of 2/6 plus 6d. for postage and packing.

I enclose P.O. value 3s. No.....

NAME.....

ADDRESS .....

..... P.W. 27.7.40

George Newnes, Ltd.

RADIO TRAINING MANUAL 16 P.W.

Published every Wednesday by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand : GORDON & GOTCH, LTD. South Africa : CENTRAL NEWS AGENCY, LTD. Subscription rates including postage : Inland 23s. 10d. per annum, 11s. 11d. for six months ; Abroad 21s. 8d. per annum, 10s. 10d. for six months. Registered at the General Post Office for the Canadian Magazine Post.