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A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 409.

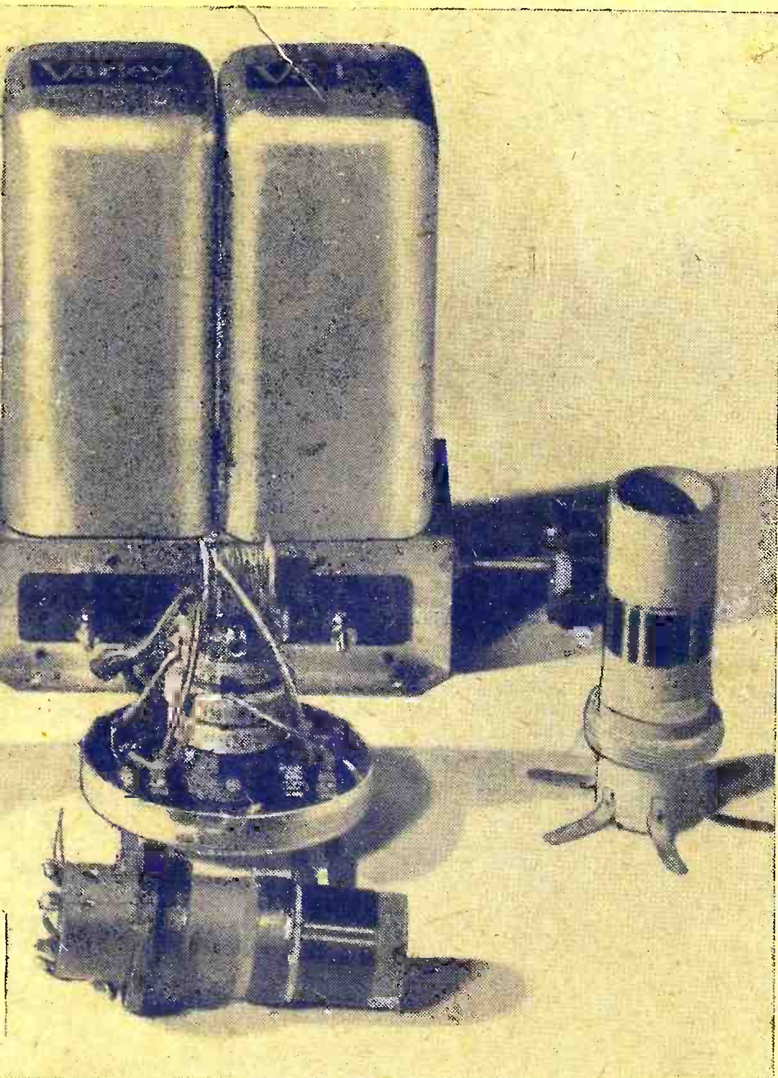
Practical Wireless and PRACTICAL TELEVISION

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

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.

	Date of Issue	*No. of Blueprint*
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

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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

	Date of Issue	*No. of Blueprint*
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

	Date of Issue	*No. of Blueprint*
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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.

	Date of Issue	*No. of Blueprint*
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

	Date of Issue	*No. of Blueprint*
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 Wireless and 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

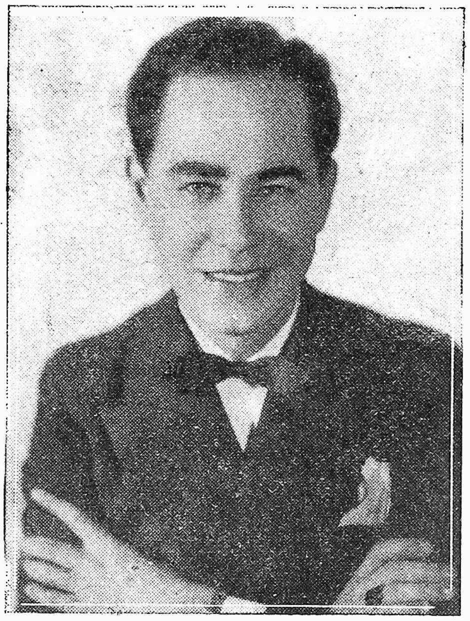
AN increasingly popular sideline among radio dealers in America is the air conditioning unit. This is a self-contained device made to fit on a window-sill or table and provides de-humidified, fresh filtered air in summer and fresh filtered air (warm) and ventilation in winter. This device is taking its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

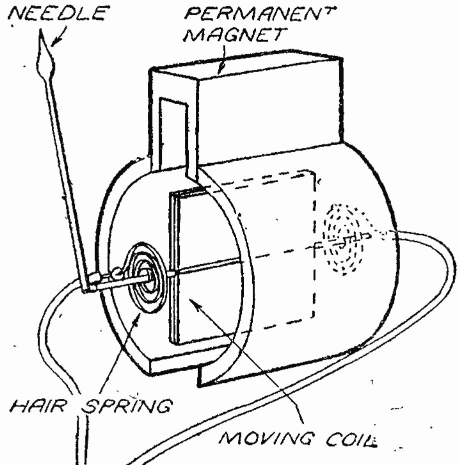
With radio work, the measurements involved will cover the following rather wide range: D.C. voltages from low values up to, say, 500 volts D.C.; current from 0-1 mA up to 150 mA's; mains voltages, both A.C. and D.C., the former at normal supply frequencies; A.C. voltages and currents, at frequencies 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 values, thus making it very difficult to read accurately the bottom part of the scale.



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

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

by The Experimenters

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 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 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.

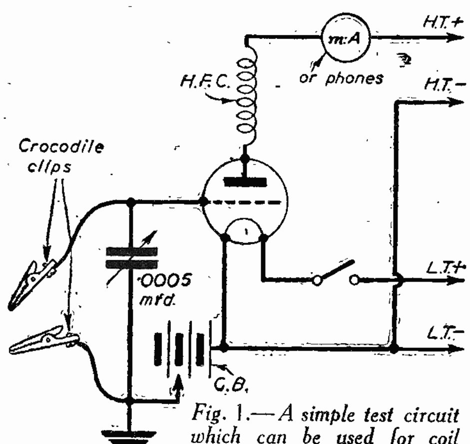


Fig. 1.—A simple test circuit which can be used for coil testing and matching.

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.

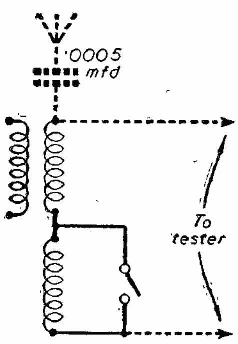


Fig. 2.—Method of connecting the coils to the test circuit.

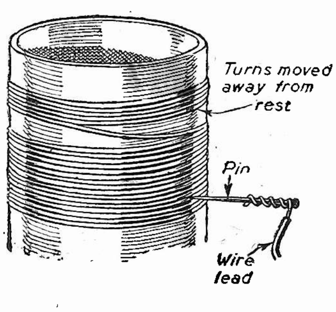


Fig. 3.—A simple method of varying the inductance by moving a few turns and of making contact to intermediate turns on the coil by means of a pin.

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 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.

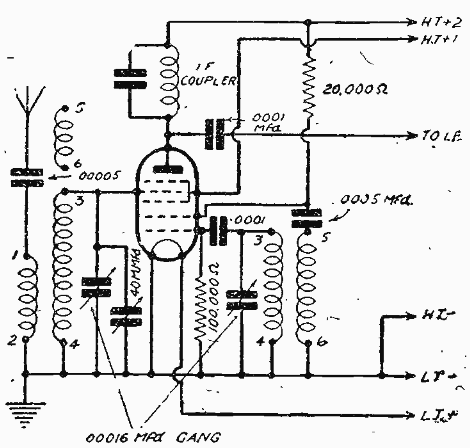


Fig. 1—Frequency-changing stage utilising a pentagrid valve for battery use.

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 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.

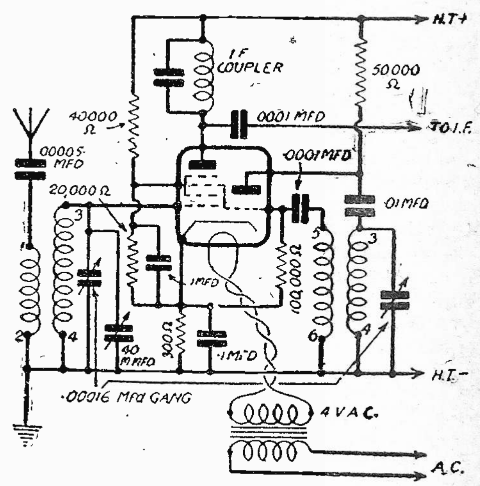
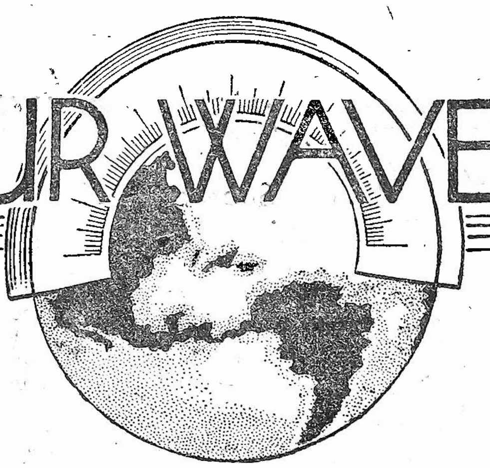


Fig. 2.—A triode-hexode frequency-changing stage for A.C. mains use.

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.

"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.

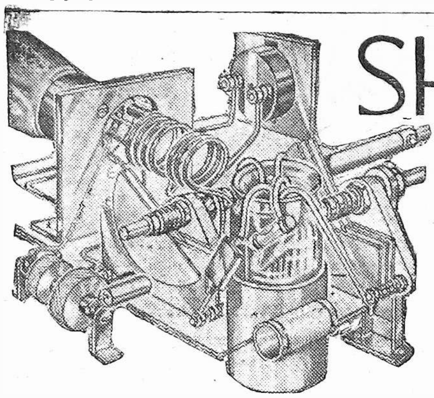
Our Roll of Merit

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.



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.

'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.

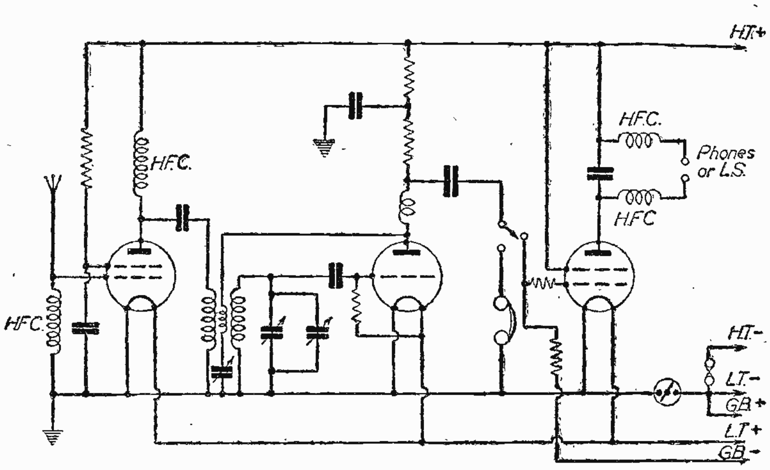


Fig. 1.—Suggested circuit of a short-wave 3-valve battery set. Components not marked will be of standard values.

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.

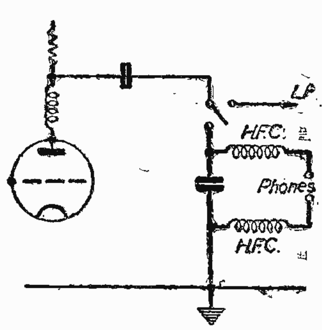


Fig. 2.—The phone circuit of Fig. 1, following the detector, may be arranged as shown here to improve stability.

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 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.

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 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.

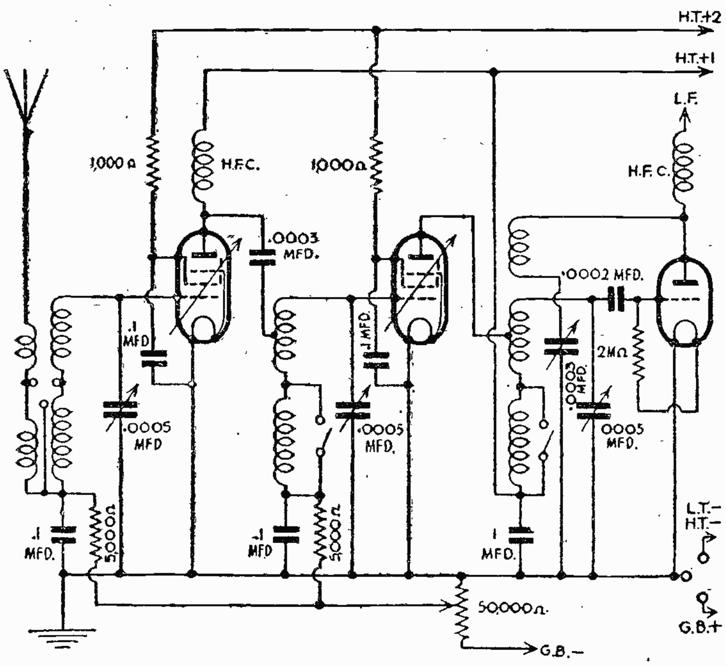


Fig. 1.—Skeleton circuit of a 2 H.F. amplifier with asymmetrical tuning circuits.

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 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.

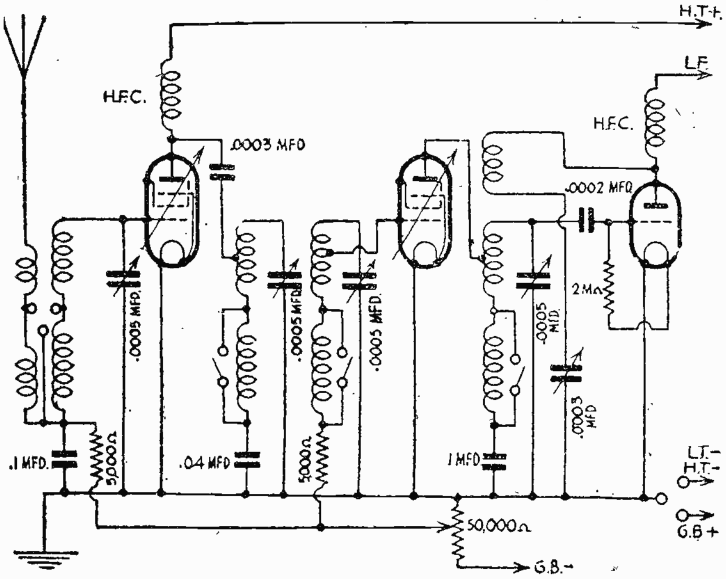


Fig. 2.—Band-pass tuning is here incorporated between the H.F. stages.

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, 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 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.

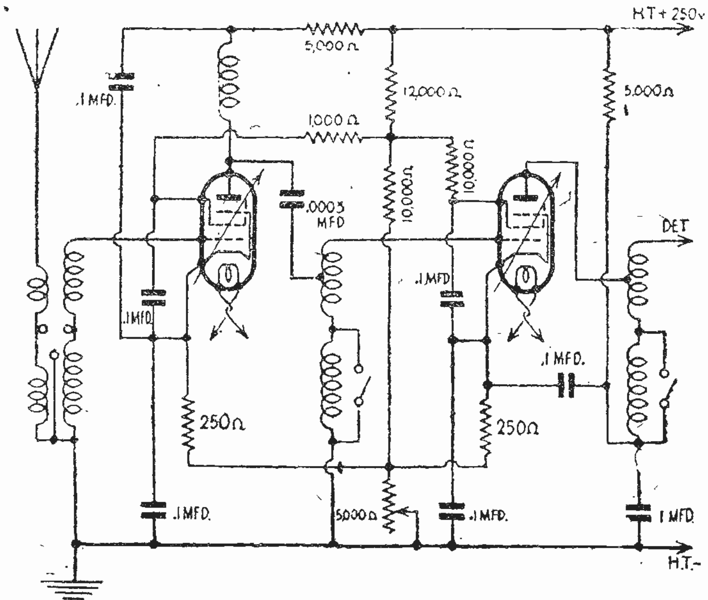


Fig. 3.—S. G. and Variable-bias controls. Values shown are average.

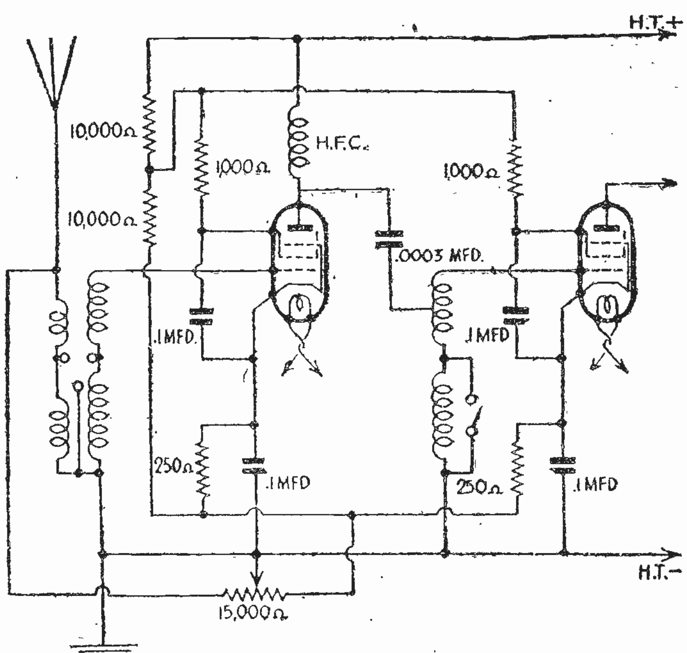


Fig. 5.—A dual form of volume control, reducing signal input and increasing bias voltage.

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.

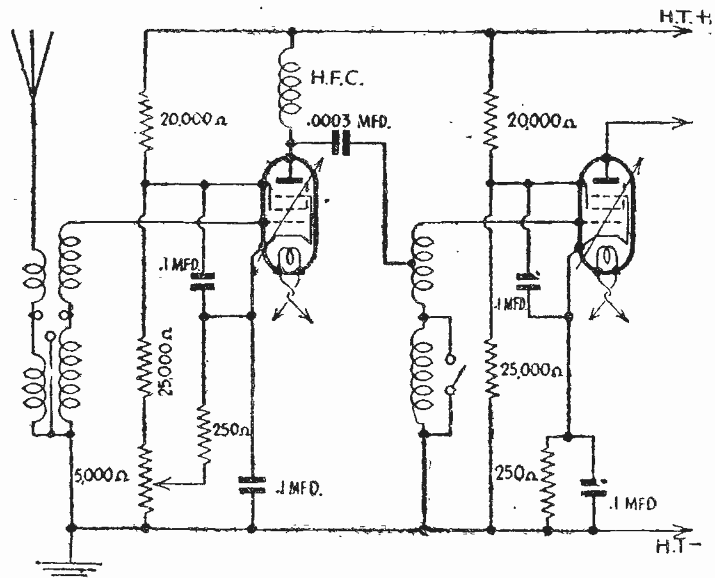


Fig. 4.—An alternative scheme with control of the first valve only.

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

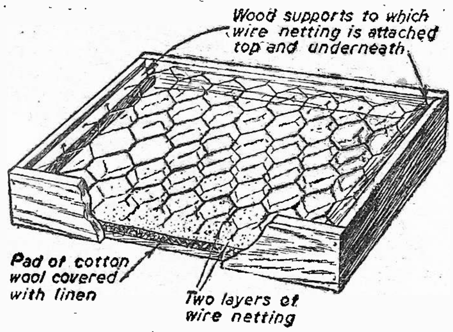
A new type of rectifier is announced by the Westinghouse Brake and Signal Co., Ltd. This rectifier, the result of six years' research, is of the selenium compound type, and is intended primarily for power rectification. It is not intended to replace the copper-copper oxide rectifiers, but for a number 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 ¼in. down. On to the underside of

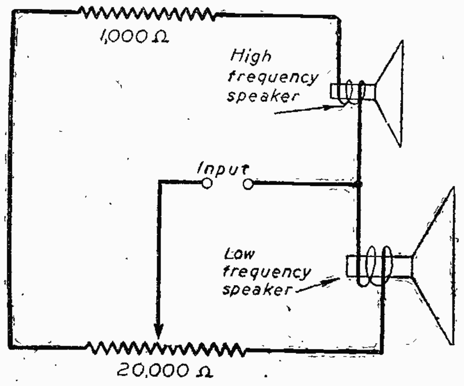


A valve-rack made with pieces of wire netting.

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.

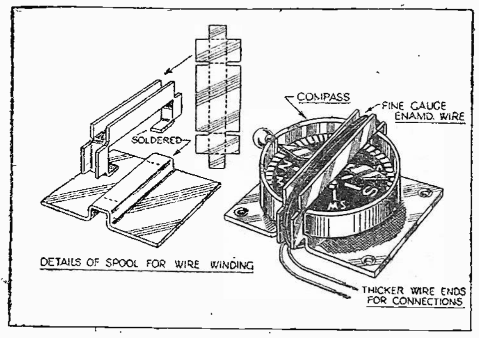


A tone control circuit for two loudspeakers.

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).

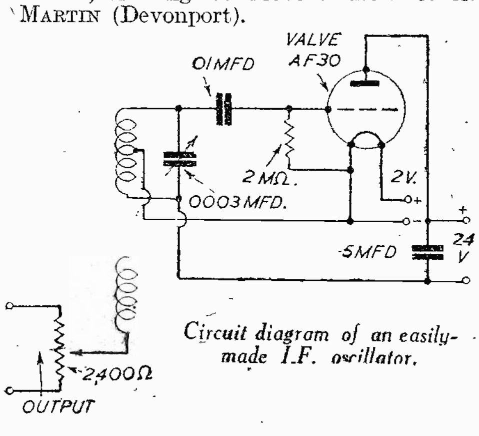
An I.F. Oscillator

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

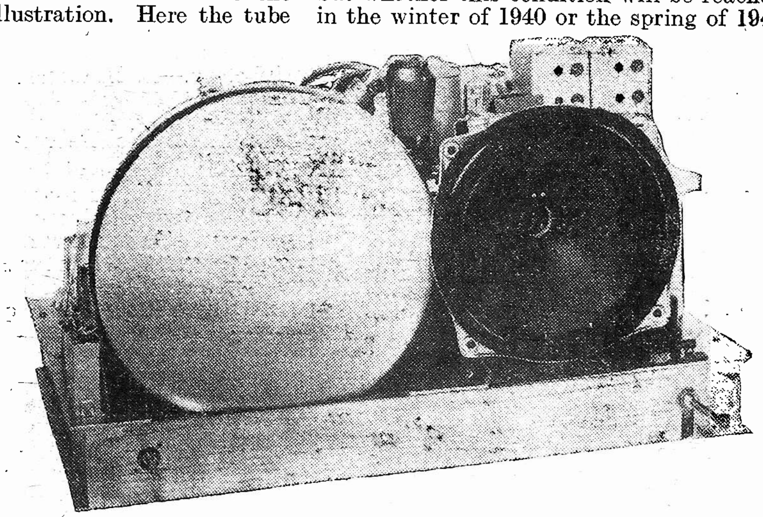
IT is well known that when an electron multiplier is built with electrodes of caesium on silver there is a high ratio of secondary emission for every primary electron bombardment. On the other hand, experience has shown that these same surfaces have the disadvantage of relatively high vapour pressures 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 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.



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

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.

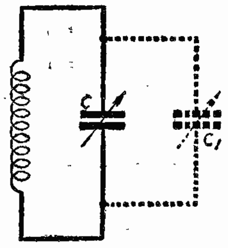


Fig. 1.—The standard signal-frequency tuned circuit.

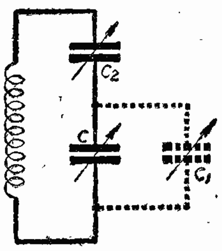


Fig. 2.—This is the equivalent oscillator tuned circuit.

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.

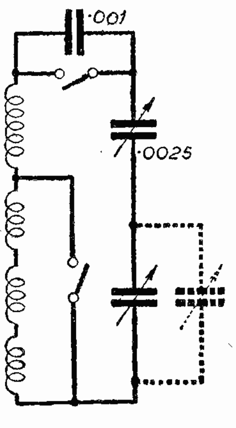


Fig. 3.—This is an oscillator circuit employing a standard tuning condenser.

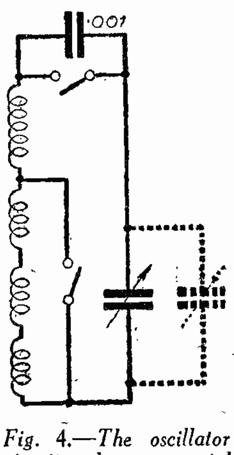


Fig. 4.—The oscillator circuit when a special shaped-plate tuning condenser is used.

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.

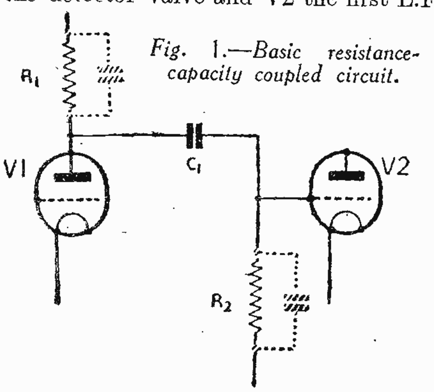


Fig. 1.—Basic resistance-capacity coupled circuit.

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

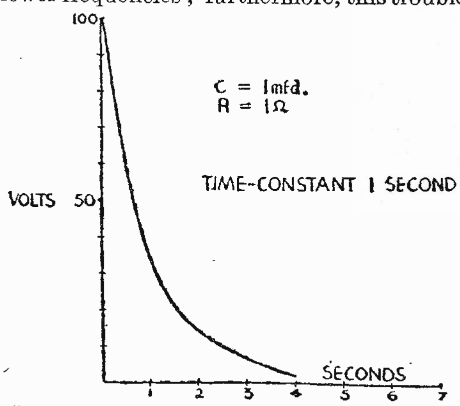


Fig. 2.—Discharge curve of the grid circuit.

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.

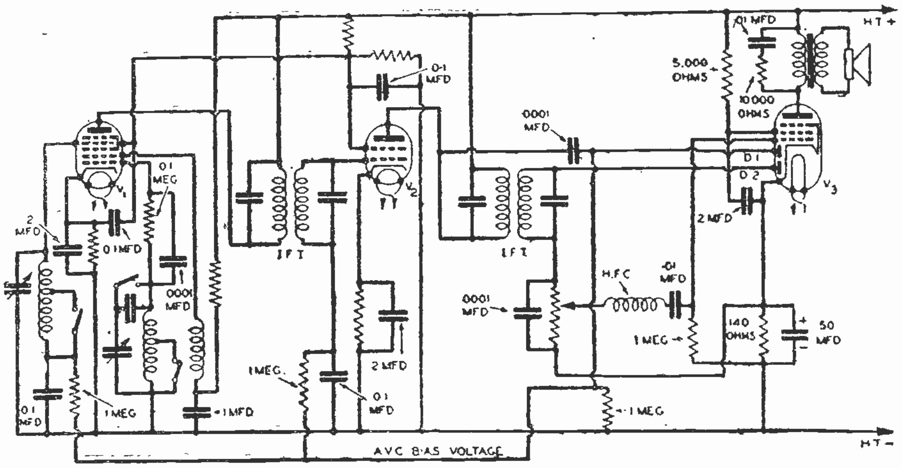


Fig. 1.—An A.C. three-valve superhet circuit with A.V.C.

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 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.

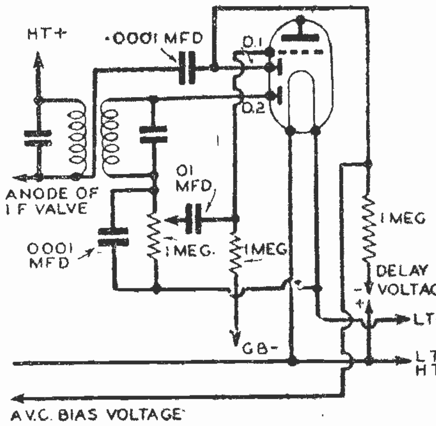


Fig. 2.—This is a delayed A.V.C. circuit.

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

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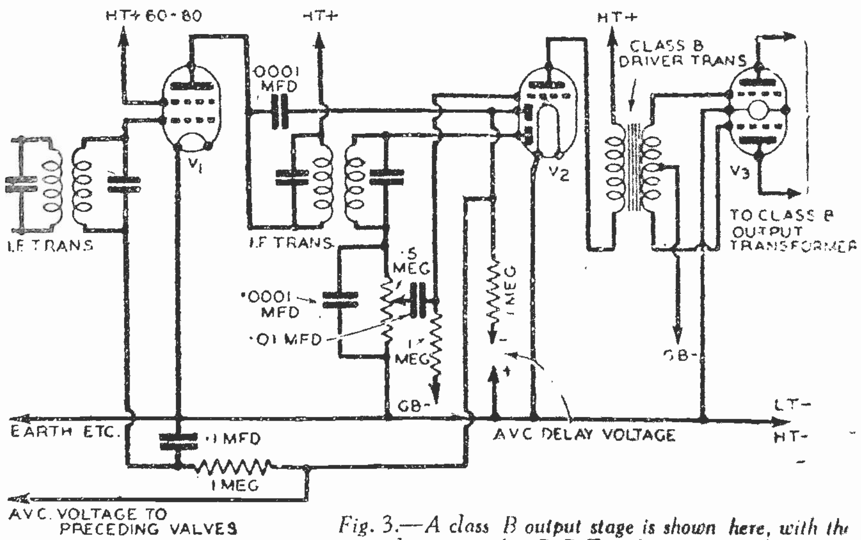


Fig. 3.—A class B output stage is shown here, with the triode section of a D.D.T. valve acting as driver

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.

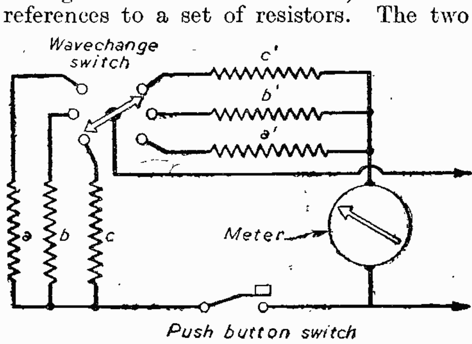
The triode section of the double-diode triode is used as the Class B driver in this circuit. It is usual to use a small power valve as driver for a Class B stage, but provided the smaller type of Class B valve is used with the circuit shown it should give 1 to 1½ watts output.

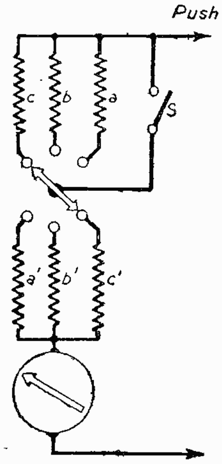
To obtain higher sensitivity than a four-valve superhet of this type would give, a signal-frequency H.F. stage could be employed with advantage. This stage could be controlled by the A.V.C., and this would improve the A.V.C. characteristic, although two controlled valves in a superhet give a sufficient 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 $\pm$ 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 t_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.

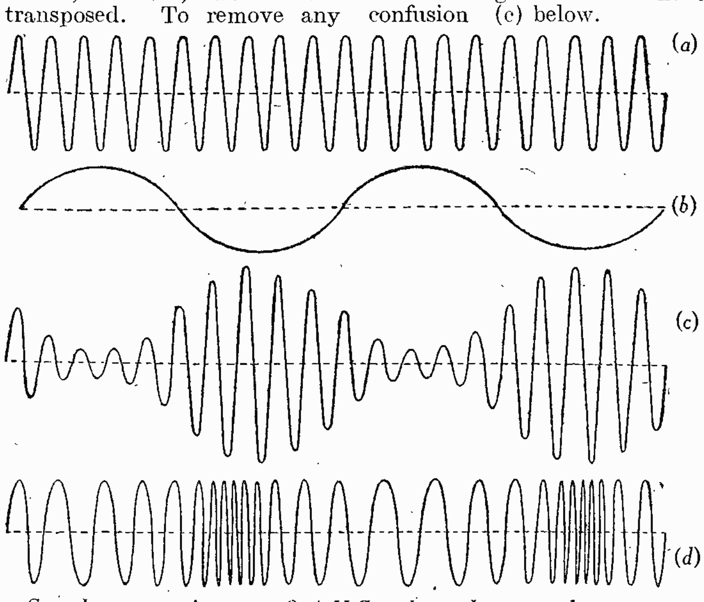
Faulty Fixed Condensers

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.

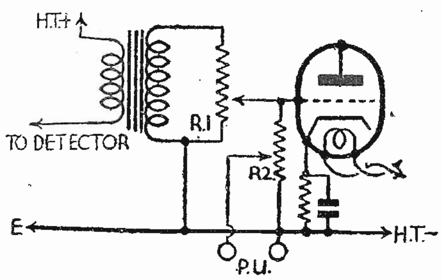


Fig. 1.—A simple fading circuit for radio and gramophone.

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.

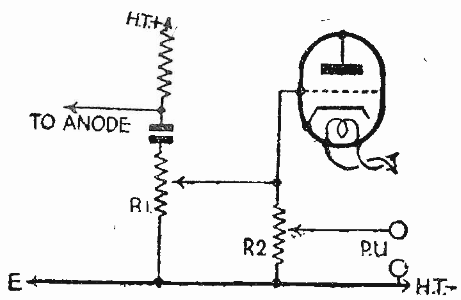


Fig. 3.—In this arrangement signals may be superimposed on those present at the grid.

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.

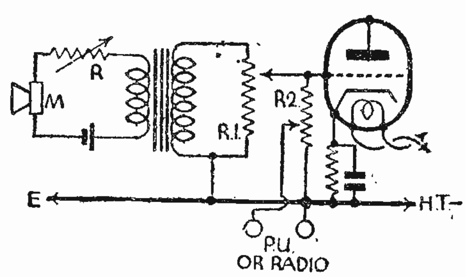


Fig. 2.—This mixer arrangement enables music and speech to be mixed.

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.

In reply to your letter

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.

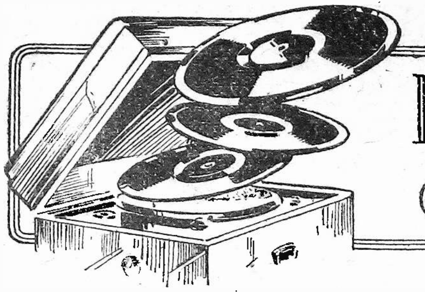
BARNES had a small resistance-capacity coupled two-valve battery set which he wished to improve. He found a market stall selling old components, all guaranteed, and amongst them was an old L.F. transformer. He purchased this and added it to his receiver in place of one of the R.C.C. units, but could 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 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.

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 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, UU3. Aluminium Screening Box, 3-section, 8¼in. 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.'

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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.**

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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.**

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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.

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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**; 100 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/-.**

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