HOW MUCH HIGH TENSION?—See Page 219

A NEWNES PUBLICATION

Edited by F. J. CAMM

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Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 25th, 1940.

Contents

NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 113.

FORCE

The absolute unit of force is the Poundal, which is that force, acting for unit time, which would impart unit velocity to unit mass.

1 dyne	=0.00007233 poundal.
1 dyne	=0.00102 gram.
1 dyne	=22.48 × 10^7 pounds.
1 megadyne	=1,000,000 dynes.
1 poundal	=13,825 dynes.
1 poundal	=0.03108 pound.
1 poundal	=14.10 grams.

ENERGY

Energy refers to capacity for performing work, for moving against a resistance.

1 erg	=2.373 × 10^{-6} foot poundals.
1 erg	=7.376 × 10^8 foot pounds.
1 g.cm.	=7.233 × 10^{-5} foot pounds.
1 joule	=10^7 ergs.
1 foot poundal	=421.390 ergs.
1 foot pound	=1.35573 joules.
1 foot pound	=13,825.5 g.cm.

The actual energy, Kinetic energy, or dynamic energy of a moving body ½ mass × velocity ^{2}.

No. 114.

POWER

1 watt	=10^7 ergs per second.
1 watt	=23.731 foot poundals per sec.
1 watt	=0.7376 foot lb. per second.
1 watt	=0.001341 h.p.
1 kilowatt-hour	=2.654,200 foot pounds.
1 kilowatt-hour	=1.3411 h.p. hour.
1 kilowatt-hour	=859.975 calories.
1 foot poundal per second	=421.390 ergs per second
1 foot poundal per second	=1.35573 watts.
1 horse-power	=746 watts.
1 horse-power	=550 foot pounds per second.
1 horse-power	=178.122 calories per second.

ELECTRICAL EQUATIONS

Amperes × volts	=watts.
Joules ÷ seconds	=watts.
Coulombs per second	=amperes.
Watts ÷ 746	=effective h.p.
Coulombs ÷ volts	=farads.
0.7373 foot-lb. per second	=1 joule.
Volts × coulombs	=joules.
Watts × 44.236	=foot-lb. per minute.
Kilowatts × 1.34	=h.p.

No. 115.

HEAT

A therm is the heat equivalent of an erg on the G.G.S. system.

The Centigrade Heat Unit (C.H.U.) is the heat required to raise 1lb. water 1°C.

A calorie as used in engineering calculations represents the heat required to raise 1 kilogramme of pure water 1°C. This is the Great Calorie. The Small Calorie represents the heat required to raise 1 gramme of water 1°C.

1 calorie (g.c.)	=0.0039683 B.T.U.
1 calorie (g.c.)	=4.1862 joules.
1 calorie (g.c.)	=3.088 foot lb.
1 calorie (g.c.)	=0.005614 horse-power second.
1 B.T.U.	=252.00 calories.
1 B.T.U.	=1,005 joules.
1 B.T.U.	=778.1 foot lb.
1 B.T.U.	=1.4147 horse-power second.
1 C.H.U.	=1.8 B.T.U.

TIME

1 sidereal second=0.99727 second (mean solar).

1 second (mean solar)=1.002738 sidereal second.

Length of seconds pendulum latitude 45°= 39.1163 in. 99.3555 cm.

No. 116.

ENGLISH WEIGHTS & MEASURES

LONG MEASURE

12 inches (in.)	=1 foot (ft.)
3 feet	=1 yard (yd.)
5½ yards.	=1 rod, pole or perch
40 poles (220 yards)	=1 furlong (furl.)
8 furlongs (1,760 yards)	=1 mile (m.)
3 miles	=1 league
1 chain	=100 links (22 yards)
10 chains	=1 furlong
6 feet	=1 fathom
6,080 feet per hour	=1 knot
4 inches	=1 hand

AREA (Square Measure)

144 square inches	=1 square foot.
9 square feet	=1 square yard
30¼ square yards	=1 square pole
40 square poles	=1 rood
4 roods	=1 acre (4,840 square yards)
640 acres	=1 square mile

MEASURES OF VOLUME AND CAPACITY (Cubic Measure)

1,728 cubic inches	=1 cubic foot.
27 cubic feet	=1 cubic yard
1 marine ton	=40 cubic feet
1 stack	=108 cubic feet
1 cord	=128 cubic feet

No. 117.

MEASURE OF CAPACITY (Liquid or Dry Measure)

4 gills	=1 pint
2 pints	=1 quart
2 quarts	=1 pottle
2 pottles	=1 gallon
4 quarts	=1 gallon
2 gallons	=1 peck
4 pecks	=1 bushel
8 bushels	=1 quarter
12 bags	=1 chauldron
5 quarters	=1 load
2 loads	=1 last

Wine Measure

2 pints	=1 quart
4 quarts	=1 gallon
10 gallons	=1 anker
18 gallons	=1 runlet or rundlet
42 gallons	=1 tierce
2 tierces	=1 puncheon
1½ puncheons	=1 pipe or butt
2 pipes	=1 tun

Ale and Beer Measure

4 gills	=1 pint
2 pints	=1 quart
4 quarts	=1 gallon
9 gallons	=1 firkin
2 firkins	=1 kilderkin
2 kilderkins	=1 barrel
1½ barrels	=1 hogshead
1⅓ hogshead	=1 puncheon
1½ puncheons	=1 butt or pipe

No. 118.

Avoirdupois Weight

27.34375 grains	=1 dram
16 drams	=1 ounce
16 ounces	=1 pound (lb.)
14 pounds	=1 stone
2 stone (28 lb.)	=1 quarter
4 quarters	=1 hundredweight (cwt.)
20 cwt.	=1 ton
100 lbs.	=1 cental

Apothecaries Weight

20 grains	=1 scruple
3 scruples	=1 drachm
8 drachms	=1 ounce
12 ounces	=1 pound

Apothecaries' Fluid Measure

60 minims	=1 fluid drachm
8 drachms	=1 fluid ounce
20 ounces	=1 pint
8 pints	=1 gallon

Diamond and Pearl Weight

3.17 grains	=1 carat, or
4 pearl grains	=1 carat
151½ carats	=1 ounce (troy)

Paper Measure

24 sheets	=1 quire
20 quires	=1 ream
2 reams	=1 bundle
10 reams	=1 bale

Troy Weight

3.17 grains	=1 carat
24 grains	=1 pennyweight (dwt.)
20 pennyweights	=1 ounce
12 ounces	=1 pound
1 lb.	=5,760 grains
1 lb. avoir.	=7,000 grains

(See also page 223.)

Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
Vol. XVI. No. 401. May 25th, 1940.
EDITED BY
F. J. CAMM
Staff:
W. J. DELANEY, FRANK PRESTON.
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Your Copy of the RADIO TRAINING MANUAL

THE demand for this great new work, offered recently in "Practical Wireless," has been exceptional and orders are being dealt with as quickly as the presses can complete copies. In war-time, however, delays occur which are unavoidable, and if you do not receive your copy within the next few days, please do not make enquiries. Rest assured your order is in hand and that your copy will be posted to you the moment it is ready.

Summer-time Conditions

ALTHOUGH most listening is carried out in the winter months, the most interesting long-distance work may be done in the summer. During the dark nights signals travel much easier, and many listeners are finding that with the approach of the long hours of sunlight signals are not so easily heard. Consequently the receiver must be more accurately handled, or improvements must be effected to ensure that the weak signals are picked up. In this issue we give details of some of the points which should be attended to in order to improve the performance of the receiver for the conditions which will soon be obtaining, and in many other directions the keen listener will take steps to make sure that he can get the best from his set. It is, of course, just as necessary to make a similar type of overhaul at the end of the summer in order that the apparatus will weather the wintry conditions and will not need attention until the following summer.

Midlands v. Wales in Darts

CHARLIE GARNER will be the commentator when the Inter-Regional Darts Match, Midlands *v.* Wales, is broadcast before an audience of troops in one of the Midland Counties on May 27th. The two teams are Cider Mill from Hampton, near Evesham, representing the Midlands, and Rhayader, representing Wales.

Rugby League Commentary

ALTHOUGH war-time sport is not on the usual big scale, listeners to sports commentaries will hear at least one football final. Arrangements are now being made for a commentary on the second half of the match for deciding the Rugby League war-time championship in the North. Lance B. Todd will give the commentary, which will be broadcast in the Home Service programme and for listeners to the Forces programme.

Double Bill Programme

A DOUBLE bill comes from the North on May 25th, when Cecil McGivern will produce "Call for an Author," by Lyn Durham, and "Big Moment" by Norman Holland, in the Home Service programme. The name of Lyn Durham hides the identity of a Gateshead school-master who has written several plays, some of which have been broadcast. "Call for an Author" is the story of a man masquerading as a playwright whose work he has stolen. "Big Moment" a story of the ring, concerns a boxer who banks everything on his last fight for a world championship. He wins the coveted championship but at a terrible price, which is revealed at the end of this exciting little play.

Flanagan and Allen, popular members of the Crazy Gang, who, as mentioned in the third column, will be heard on the air this week. Ben Lyon and Bebe Daniels are in the centre.

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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.

Flanagan and Allen

THE great success of the famous London Palladium Crazy Shows, which have now been running for several years, has been mainly responsible for keeping off the air those master buffoons and mainstays of the Crazy Gang, Flanagan and Allen. Now they are going to make up for lost time by giving four broadcasts between May 25th and May 31st. On May 25th they will be heard from the Hippodrome, Birmingham, in "Youth Takes a Bow"; on May 27th in the Forces Programme series called "Top of the Bill"; on May 30th in a revue to be produced by Tom Ronald; and on May 31st in cabaret from the Grand Hotel, Torquay.

"Melody and Co."

JIMMY O'DEA, the popular Irish comedian, is to star in a new series called "Melody and Co," devised by Vernon Harris and Eric Spear, which is to begin on May 23rd. "Melody and Co." is the name given to a struggling road-show of which Jimmy is the principal comedian, whose ever-changing fortunes listeners will be able to follow from week to week. Others in the cast will be Jack Melford, the well-known light comedian, who has recently been appearing in "The Silver Patrol"; Marion Wilson, from "The Little Dog Laughed"; Patricia Leonard, Jacques Brown and Sam Costa.

Harry O'Donovan and Aubrey Danvers-Walker will be responsible for the dialogue. Twelve years ago, Harry O'Donovan and Jimmy O'Dea, who had met way back in 1919, founded a partnership which was to be a great success. Their road shows, mainly written by O'Donovan, have been favourites with North of England and Scottish audiences for many years past. Eric Spear will be responsible for the music of "Melody and Co." and Vernon Harris will produce.

THE AMATEURS' ACTIVITIES

How to Obtain the Greatest Interest Out of Your Station is Discussed in This Article

By L. O. SPARKS

FROM correspondence received from a vast number of enthusiastic listeners, it is possible to deduce that quite a large percentage of them are not getting the maximum interest and instruction from the hobby which is common to all. A casual observer might get the impression that the failure is due in many instances to financial reasons, and that lack of equipment retards many from making progress. Others put forward the idea that it is not possible to make headway with radio unless one has a fairly sound knowledge of the theory, and that the average person is not prepared to devote hours of studying a subject simply for the sake of a hobby. Whatever truth there is in any of the above suggestions, the writer is of the opinion that they do not touch the root cause of the trouble. Lack of funds can admittedly delay one's activities, but not hold them up altogether, at least, not so far as the real enthusiast is concerned. If he is unable to purchase some particular component or material, he brings his ingenuity into play to enable him to utilise a substitute. Absence of equipment is very irritating, but, again, it is not necessary for it to present an impassable barrier. Testing gear can be constructed, alternative tests can be devised, components can be converted or modified, and the recognised dealers in surplus material and accessories can offer a wide choice of such items at very reasonable prices.

The idea that it is essential for an amateur to commence his activities with a sound knowledge of theoretical matters, is, to put it frankly, quite absurd. I have yet to find the man who decides to take an interest, in a practical sense, in, say, model yachts or railways, holding up his participation in those hobbies until he has acquired a sound knowledge of all the theories relating to them.

Theoretical Knowledge

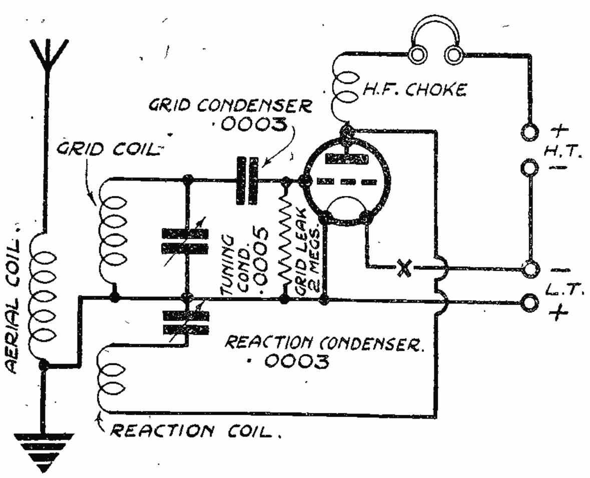
A theoretical knowledge is undoubtedly essential and forms a valuable asset. Without it, the amateur's path will not be too easy, and what is even more important he will not be able to obtain the maximum interest from his hobby. The point to be stressed, however, is that the knowledge of theoretical matters should be acquired by *combining* practical activities with a reasonable amount of reading or studying of the theory. The actual proportions must be left to the individual, his inclination, and the time at his disposal, but every endeavour should be made to try to keep the two branches of the hobby in step as much as possible. It is the failure to do this, plus the misdirection of one's activities, that is responsible for 90 per cent. of the amateurs not getting the very best out of radio and its allied subjects. The more serious of these is the latter; therefore, in this article suggestions are given for suitable lines of experimental work for the amateur to follow.

Aerials

It is naturally assumed that the amateur is employing some kind of receiver. It does not matter whether it is a simple crystal circuit or an elaborate multi-valve outfit, the problems directly connected with aerials form in themselves a vast field for experimental work. A great deal of most interesting investigation can be undertaken with a minimum of outlay, and the subject is such that it brings into play practical skill and ingenuity in the form of construction, location and erection of the aerial, in addition to the various theories which can be formulated according to the observations of the actual results or effects.

Experimental Subjects

Here are a few of the items which lend themselves to interesting experimental work. Location, i.e., effect of surrounding objects; whether any screening is produced by these, or does the proximity of trees, overhead wires or houses have any absorption effect on the signals. The height of the horizontal portion of the aerial; its effect on signal strength and interference. The best proportion between lead-in and horizontal portion; screened and unscreened down-leads; directional effects; where possible, try the aerial in different compass directions and note the effect on stations over all compass points. Various types of aerial; single or twin down-leads; effect of gauge of wire used, and any variation of efficiency with relation to insulation of aerial at points of suspension in all weathers.



The basic circuit of a one-valver which can be used for experimental purposes.

The above list does not include all lines of experiment, but it should open up sufficient work to keep one busy for quite a while, and at the same time combine actual listening periods which will make the experiments all the more interesting.

Inductance

This one word covers a multitude of suitable and very vital experiments, as it embraces coils, transformers (H.F., L.F. and mains), chokes—also in the same variety—and filter circuits. Here, again, is a sphere of possibilities which does not necessitate heavy expenditure, but which can provide endless interest combining practical work with valuable opportunities of adding to one's theoretical knowledge.

The design, construction and testing of ordinary tuning coils are items which every constructor should undertake, as such experiments are invaluable for gaining actual experience of such matters as selectivity, efficiency, ratio of capacity to inductance, and frequencies covered by combinations of L and C. High-frequency losses, ratio of diameter of former to its length, self-capacity and resonance curves, all come within the possibilities of this subject, and bearing in mind that the testing equipment need not be too comprehensive, it should be possible for every amateur to attempt one or more of the sections covered by the term inductance.

Most useful guiding details have already been published, but the new series of pages from the "Radio Engineer's Pocket Book" will prove an invaluable reference work.

Circuits

The man who starts his activities with, say, a three-valver is really dodging his apprenticeship and missing the real thrills which, in the writer's opinion, can only be associated with the one- and two-valvers.

A one-valve receiver costs very little to make; its upkeep is practically negligible, and assuming a good pair of 'phones and a reasonable aerial and earth system to be available, the results which can be obtained are really amazing. To achieve maximum efficiency, it is, of course, necessary to bring everything to the highest state of perfection, and that is where the fun, interest and education—so far as radio is concerned — comes in. Far greater satisfaction is secured when a DX station is logged, and the greater the results obtained the greater becomes the desire of the operator to go one better.

The above must not be misunderstood. It is not intended to convey the impression that all other circuits should be shunned, but it is desired to stress the point that every amateur should serve his time with a one-valver and be capable of bringing it to a high state of efficiency and operating it successfully, before passing on to circuits of more elaborate design.

Tone controls, wave-traps, filters, different types of output, intervalve couplings, all form circuits of great experimental value, especially when as many of the components as possible are made by the constructor.

Log Books

Too much emphasis cannot be placed on the value of well-kept log or record books. If all essential details of individual experiments are faithfully recorded, a most handy reference book can be compiled and, as such, it will prove most useful.

A separate one should be kept for normal station logging in which only such details as are intimately related to reception should be written.

Testing Equipment

The average constructor cannot afford to spend unlimited sums on all the test equipment most of us desire; therefore, the only sensible alternative is to make as much of it as possible. Simple voltmeters or milliammeters are really essential in the early stages of a constructor's career, but if instead of buying two low-priced meters one decides to wait a little longer and buy a really good milliammeter having a scale reading of, say, 0 to 1 mA. then it will be possible to incorporate it in one or two very valuable pieces of test apparatus.

Alternating Current Circuits

A Brief Explanation of Current and Voltage in A.C. Systems, and of the Effect of Introducing Resistance, Capacity and Inductance into A.C. Circuits

By FRANK PRESTON

ALMOST every reader is familiar with Ohm's Law and corresponding formulæ as applied to direct-current circuits, but there are no doubt many who do not know how to apply the formulæ to A.C. It may at first appear that there is little need to trouble about this as far as radio is concerned, but there are many applications when more advanced work is undertaken. Those applying for enrolment as radio mechanics in the Services will also be interested to know that questions relating to A.C. theory are not unusual.

It is not possible to cover the matter completely and academically in the space of an article, but an extensive knowledge of the theory is not likely to be required by the average reader. It is important, however, to have some knowledge of the nature of an A.C. supply, if only because it is comparable to wireless waves.

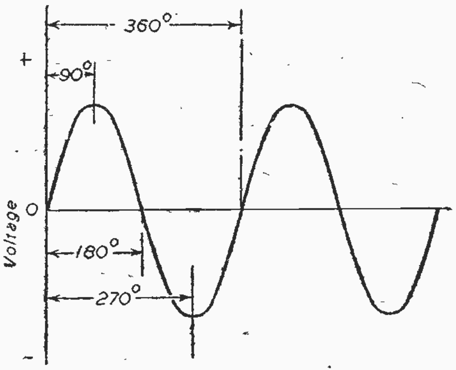


Fig. 1.—A typical sine curve representing an alternating voltage.

The Nature of A.C.

The expression sine curve is often used when referring to A.C., the curve taking the approximate form of that shown in Fig. 1. This merely indicates that the voltage gradually rises from zero to a maximum positive, back to zero, then to maximum negative and back again to zero. The complete cycle is said to take place in 360 degrees—the number of degrees in a complete circle—whilst the intermediate points referred to occur at 90, 180 and 270 degrees.

To see what is meant by these angles it is necessary to have an impression of the method of A.C. generation. In a dynamo or A.C. generator there is a pair (or a number of pairs) of magnet poles, between which a coil rotates. Fig. 2 shows the arrangement in diagrammatic form. It may be seen that as the coil (shown as a simple loop) rotates on its axis, one side moves upward while the other moves downward. And as many readers will remember from their schooldays, when a wire is moved between two magnet poles a current is induced in it due to the cutting of the magnetic lines of force.

Direction of Current Flow

Since one side of the loop is moving downward and the other upward, the current induced in one side flows toward the point marked A, whilst in the other side of the loop the induced current flows away from A. When the plane of the loop is vertical, no current flows, because lines of force are not being cut. But as the loop rotates, current starts to flow and increases until the loop reaches the horizontal position (with its plane in line with the magnet poles). It has then turned through a right-angle, or 90 degrees. As rotation continues current continues to flow in the same direction, but the current falls to zero as the loop again approaches the vertical position. The loop has then turned through 180 degrees; see Fig. 1.

Continued rotation causes that side of the loop which was travelling downward to rise, and that which was rising to fall. Thus, the induced current flows in the opposite direction. Apart from the direction of current flow, the sequence of events is exactly as before. Thus, by the time the loop has made a complete circle, the current (and voltage) has varied from maximum positive to maximum negative and has passed through zero. That should help to make the so-called sine curve more readily understandable.

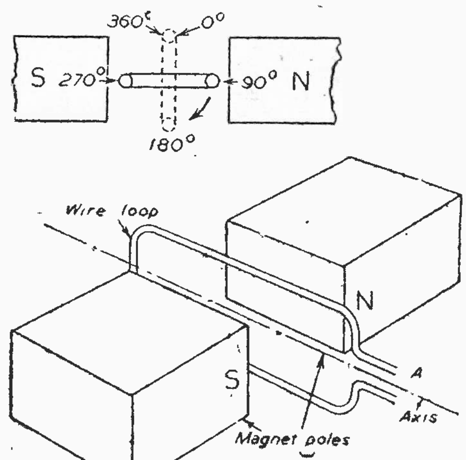


Fig. 2.—Diagram to illustrate the principles of an A.C. generator. The inset illustrates the angular positions of the loop corresponding with the points marked in Fig. 1.

Why the Name?

It is called a sine curve because the voltage induced at any instant is proportional to the sine of the angle through which the loop has turned. The sine of an angle, as known to mathematicians, is the ratio of the vertical height to the hypotenuse of a right-angled triangle, as shown in Fig. 3. Thus the sine of angle a is the length of side AC divided by the length of side AB. The sine of an angle of 45 degrees is one divided by the square root of 2 $\left(\frac{1}{\sqrt{2}}\right.$ or .7071); the sine of an angle of 90 degrees is unity. In the latter case it will be seen that the triangle "closes up" into a straight line.

By using graph paper and plotting the inducted voltage at any instant against the angle of rotation we get a curve such as that shown in Fig. 1, when all the points plotted are joined together with a smooth line.

The R.M.S. Value

For most practical purposes the maximum current reached in an A.C. circuit is of little use. Instead, we make use of what is known as the root mean square (or R.M.S.) value. This is less than the maximum current, and corresponds to the D.C. current which would produce the same heating effect in a wire through which it was passed. From this it may be seen that a hot-wire ammeter calibrated on D.C. would record the R.M.S. value of an alternating current. The actual R.M.S. value is .7071 $\left(\frac{1}{\sqrt{2}}\right)$ times the maximum value.

Resistance to A.C.

When an alternating voltage is passed through a non-inductive resistance the current can be found by applying Ohm's Law; that is, I=E/R. But this simple formula does not apply when the circuit contains capacity or inductance. With D.C. a series capacity, of course, is the equivalent of a break in the circuit, and no current flows. A condenser does not prevent the flow of A.C., however, since it is constantly being charged and discharged. The condenser acts more as a resistance to A.C., the value of the "resistance" (known as reactance) depending upon the capacity of the condenser and the frequency of the A.C.

As often stated in these pages, the reactance of a condenser is $1/2\pi fC$, where π is the standard 3.14, f is the frequency in cycles per second, and C is the capacity in farads. If reactance is substituted for resistance in Ohm's Law it is possible to calculate the current flowing in an A.C. circuit containing a condenser from the formula: I=E/X, where E is the voltage and X the reactance.

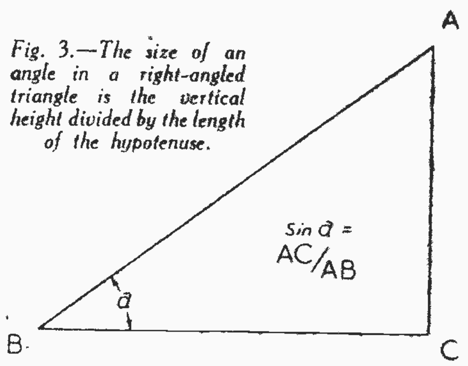


Fig. 3.—The size of an angle in a right-angled triangle is the vertical height divided by the length of the hypotenuse.

An interesting fact about an A.C. circuit containing capacity is that the current "leads" the voltage by 90 degrees. This means that current attains its maximum when the voltage is zero. This is clearly indicated by the curves in Fig. 4, the light curve indicating voltage, and the heavy line indicating current.

The position is similar when an inductance (a choke, for example) is in the A.C. circuit. Current can be found by dividing the voltage by the reactance of the choke, which is equal to $2\pi fL$, π and f being as before, and L being the inductance in henries. In this case, voltage and current are again 90 degrees out of phase, but the voltage "leads" the current.

(Continued on next page)

ALTERNATING CURRENT CIRCUITS

(Continued from previous page)

Series Reactances

When resistance and capacity, or capacity and inductance, or capacity, inductance and resistance are in series, the current can still be found by using Ohm's Law, but in that case the reactance must be taken as the total reactance (and resistance, when included) of all the components in series. Without giving the full mathematics of the case it can be stated that the reactance of a resistance and capacity in series (the combined value being known as impedance) is represented by the expression $\sqrt{R^2+\left(\frac{1}{2\pi fC}\right)^2}$. Therefore in calculating the current this must be substituted for the R in Ohm's Law.

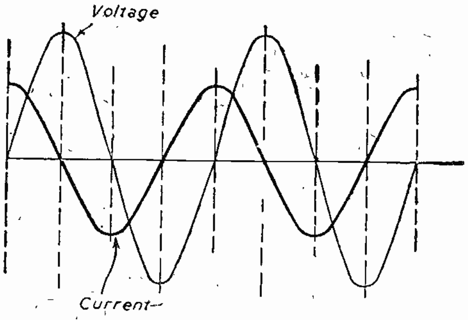


Fig. 4.—In an A.C. circuit containing a series capacity, the current "leads" the voltage by 90°.

When inductance and resistance are in series, the overall impedance is equal to $\sqrt{R^2+(2\pi fL)^2}$.

In both these cases it will be seen that resistance and reactance are added together. The position is different when we have capacitative and inductive reactance in series, since the former is subtracted from the latter. The reason for this is that, since in one case the current "leads" the voltage and in the other the voltage "leads" the current, the two tend to neutralise each other. Thus it will be seen that the reactance of a coil and condenser in series is $2\pi fL-\frac{1}{2\pi fC}$. If we have resistance, capacity and inductance all in series the impedance of the circuit becomes $\sqrt{R^2+\left(2\pi fL-\frac{1}{2\pi fC}\right)^2}$.

In every case, reactance and impedance are given in ohms.

A SIMPLE U.S.W. CIRCUIT

And Notes on Tuned Radio-frequency Working

THERE are many readers who are anxious to carry out experiments on the short and ultra-short waves, but feel that it is uneconomical to build a complete receiver for this purpose. It is argued, quite rightly, that after the detector stage of any set the same form of low-frequency coupling, output circuit and loudspeaker can apply to nearly all the receivers they may desire to use. For this reason many favour an adaptor or converter in order to utilise part of the home set to complete their experimental investigations. This policy is quite a sound one, and although it means that ordinary domestic listening on the medium and long waves is out of the question when the experimenter is carrying out his part of the listening, this is only a case of mutual arrangement with other members of the household.

It is quite a simple matter to build up apparatus so that the signal output can be plugged into the pick-up terminal position of the domestic set, and the designs for this purpose are legion. To meet the conditions of ultra-short wave working, that is below ten metres, a region in which so much interest is manifested, since it provides a good deal of pioneer activities, one of the most efficient schemes is to employ a tuned radio-frequency construction. Associated with this will be the dipole aerial and feeder designed to cover the range of frequencies required, and about which data was furnished in a recent issue for those cases where a non-permanent installation was desired.

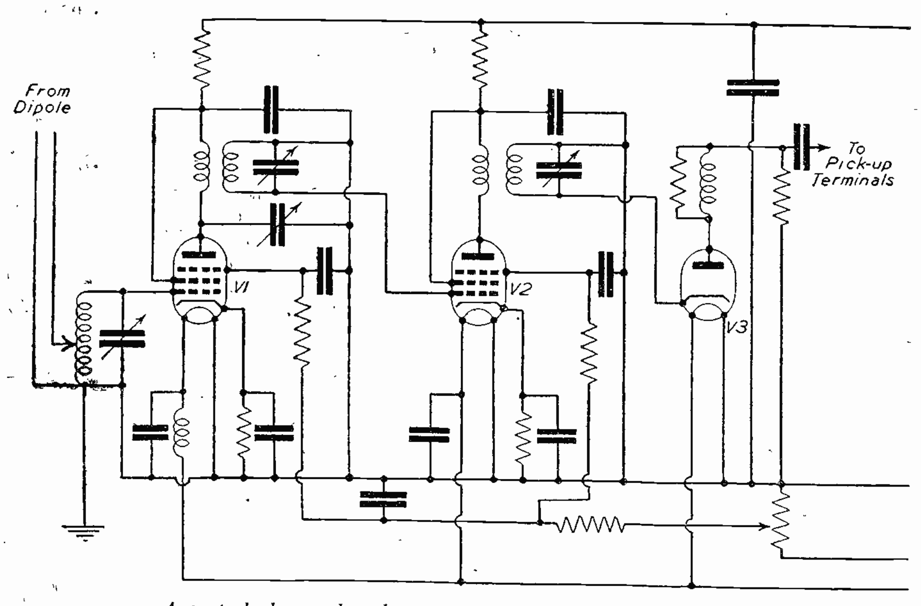
T.R.F. Working

As an example of one circuit which can be employed to meet this requirement, reference can be made to the accompanying illustration. The signal furnished from the feeder cable of the ultra-short wave dipole is tapped across the aerial coupling coil, making sure that if co-axial cable is used the outer braiding which constitutes the second conductor is joined to the earth point of the coil. The tuned circuit is connected across the control grid of V_1 which is a radio-frequency pentode, such as the Mullard EF6, or its equivalent in other makes. In the anode circuit of this valve high-efficiency coils are used to furnish a band-pass coupling over the range required. The tuned secondary feeds into the control grid of a second radio-frequency pentode of the same type as the first valve. It will be noticed that the anode circuits of each of these two valves are identical, except that in the case of the first a primary coil trimmer condenser is suggested.

Gain Control

Appropriate bias is furnished to the control grids via the usual types of resistances and by-pass condensers inserted in the lead from the valve cathode to earth. Furthermore, as a precaution against any radio-frequency getting into the heater circuit of the first valve, an appropriate choke coil is inserted in one leg. The degree of amplification provided by these two valves working in cascade is controlled by the simple expedient of furnishing a negative voltage to the suppressor grids, via the potentiometer shown. The measure of decoupling used is quite standard practice, and the values of the resistances employed will depend upon the voltage feeds applied to the appropriate valve electrodes.

From the tuned secondary coil of the second valve anode transformer a lead is taken to the cathode of a diode detector valve, and from the anode circuit a 0.1 mfd. coupling condenser is linked to the lead which is taken to the appropriate pick-up terminal of the home receiver. An ordinary power pack will furnish the necessary voltages to the three valves, and in many cases experimenters will have available a unit which is capable of linking up for this purpose. If it is arranged that the smoothing for this power unit is on the negative side, then it is a very simple matter to determine the appropriate tap point across which the free end of the potentiometer is joined to give the radio-frequency gain of V_1 and V_2.



A typical three-valve short-wave circuit for T.R.F. working.

Is Full-wave Detection Impossible?

An Interesting Analysis on this Important Subject

By D'ARCY FORD

FOLLOWING on the recent letters regarding the intriguing subject of full-wave detection, and as a suitable successor to the article published last week on the use of the grid-leak, I am prompted to give some further data relative to the subject of rectification.

Fig. 1 represents the orthodox theory of half-wave rectification. This not only applies in the accepted view to the rectification of low-frequency alternating current, but also to the detection of radio-frequency oscillations, by which it will be seen that the negative half-waves are suppressed by the rectifier.

Fig. 2 represents the orthodox theory of full-wave rectification, by which the negative half-waves are permitted to flow, but are reversed in direction and become wholly positive. The process known as rectification of low-frequency alternating current, when applied to radio-frequency oscillations, is better described as *detection*.

In the new theory the accepted view of the rectification of low-frequency alternating current is assumed to be correct.

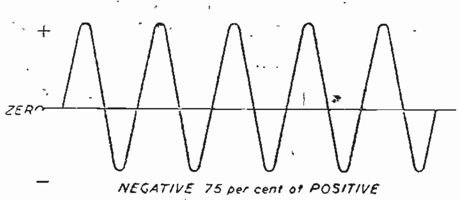


Fig. 3.—This curve shows the waveform with 75 per cent. negative amplitude.

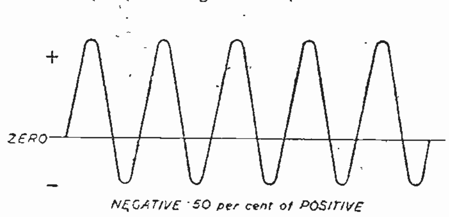


Fig. 4.—In this diagram the waveform shows the negative half-cycle 50 per cent. of the positive.

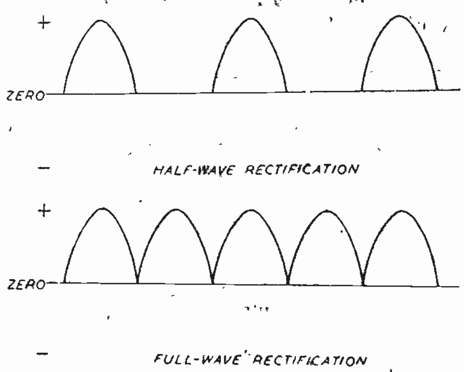
Radio Frequencies

Detection of radio frequencies is a displacement of the base or zero voltage line so that generally the positive amplitude is increased, and the negative amplitude decreased, so that the positive amplitude of the output is greater than the negative. This does not take into consideration any question of detector amplification or losses, which would either increase or decrease both the positive and negative portion of the wave, and would be relatively in proportion. Different methods of detection and different conditions in the detector circuit produce an output which may have a different positive/negative ratio.

In considering the subject of detection of radio frequencies, it is necessary first to consider the detection of an *unmodulated* carrier wave. The question of the modulated wave will be dealt with later.

Fig. 3 shows the waveform of the output from a detector, in which the base or zero voltage line has been displaced so that the negative amplitude is 75 per cent. of the positive. This may be the output from a bottom-bend detector working at one particular point in its characteristic curve. Fig. 3 also represents the waveform of the unmodulated output of a grid-leak detector with a low value of leak (say .025 megohms).

Fig. 4 shows the waveform of the unmodulated output of a detector in which the negative amplitude is 50 per cent. of the positive. This represents the output



Figs. 1 and 2.—These curves show the effect of half-wave and full-wave rectification.

of a grid-leak detector with a leak of say 2 megohms. If the wave were modulated, the audio-frequency output from Fig. 4 would be greater than the audio-frequency output from Fig. 3. This is borne out in practice by the fact that generally the higher the value of leak in a grid-leak detector, the greater will be the volume of output, and the lower the value of leak the less will be the volume of output. Of course it requires a lower value of leak if quality output is required from a more powerful input.

Fig. 5 shows a waveform in which the negative amplitude is only 20 per cent. of the positive. If this were modulated, the audio-frequency output would be considerably increased as compared with Figs. 3 and 4. Fig. 5 may represent the waveform of the unmodulated output of a crystal detector working under average sensitivity.

Fig. 6 shows the waveform of an output which has a zero negative value, and is wholly positive. This may be difficult to obtain in practice. The writer has not carried out sufficient experiments to prove whether the waveform of Fig. 6 is possible to obtain or not. It shows the detector

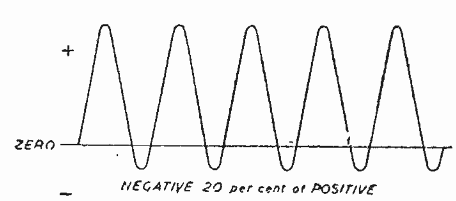


Fig. 5.—In this waveform the negative amplitude is only 20 per cent. of the positive.

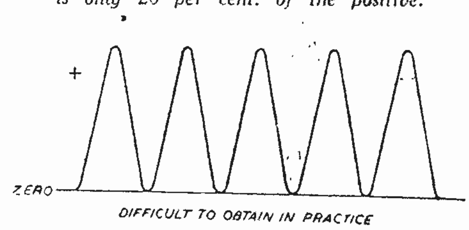


Fig. 6.—A zero negative potential is indicated by the waveform in this diagram.

output of an unmodulated carrier which rises and falls in an increasing and decreasing positive direction with no negative amplitude. If it is possible for this to be obtained in practice, it would enable the full modulated radio-frequency wave after detection to be used as an audio-frequency output. This is not what is understood as full-wave rectification. If it is possible in practice, it could be obtained as the output of a *single* crystal (or other suitable rectifier) in what is regarded as a *half-wave* detector circuit! It is therefore not full-wave detection.

If what appears to be a full-wave detector circuit gives a greater volume of output than a half-wave detector circuit, this would be owing either to increased amplification in the full-wave circuit, or to a more complete detection, so that the negative amplitude is further reduced relative to the positive.

Modulated Wave

We must now consider the question of a *modulated* wave. The new theory is in agree-

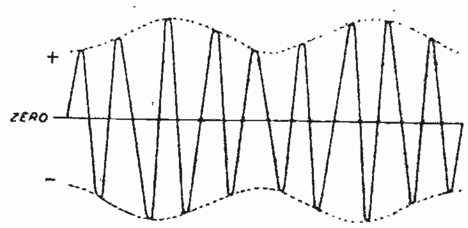


Fig. 7.—This shows the waveform of a modulated wave in accordance with accepted theory.

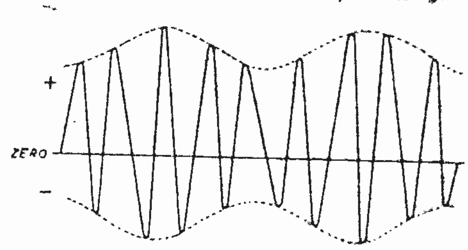


Fig. 8.—This shows the output from a detector by a method of detection which displaces the zero voltage line so that the negative amplitude of the output is 50 per cent. of the positive (refer to Fig. 4).

ment with the accepted view of the question of modulation, although it is not in agreement on the question of sidebands. The output from the detector does not consist of audio frequencies as audio frequencies, and although orthodox theory admits the presence of stray radio frequencies in the output, it is claimed that the whole of the output from the detector consists of a composite radio-frequency wave which has generally a greater positive than negative value, and which varies in accordance with the audio-frequency modulations. *These audio-frequency variations* of the radio-frequency wave make it audible. There is no space here to give a definition of the component frequencies of a wave—that includes the question of sidebands.

Fig. 7 shows the waveform of a modulated wave in accordance with the accepted theory, which rises and falls in accordance with the audio-frequency modulation. What has been stated with reference to the wave-

(Continued on page 220).

Obtaining Maximum Efficiency from a Class AB Amplifier

An Interesting Resistance-coupled Push-pull Amplifier Circuit

IN planning radio receivers having a fairly large power output it is necessary from considerations of economy to design the output stages for maximum efficiency. For this reason Class AB push-pull pentode amplifiers have been developed, and it is interesting to examine a typical R.C.A. amplifier and its method of operation.

The circuit of the amplifier is shown in Fig. 1, and it will be seen to consist of two pentode valves (type 6F6) in the output stage driven by a double-triode (type 6N7) phase inverter. The amplifier is resistance-coupled, which precludes the driving of the output valves into grid current. The anode resistors for the phase inverter may be 100,000 ohms with coupling capacitors of 0.01 mfd. and grid resistors of 270,000 ohms. The bias for the push-pull output stage is obtained from the two resistors in series in the H.T. negative lead.

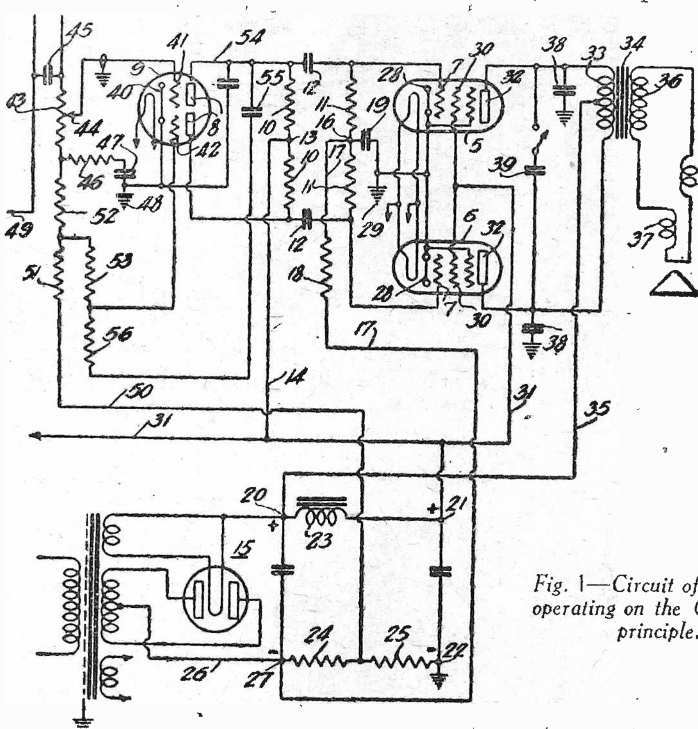


Fig. 1—Circuit of amplifier operating on the Class AB principle.

Load Impedance

For maximum efficiency it is necessary to select the correct load impedance for the output stage as shown in Fig. 2, in which curves 60-64 are plotted for various grid voltages on the two output valves between anode or plate voltage E_p and the corresponding anode or plate current I_p.

The load on the anode circuit of the valves is adjusted to pass the load line 65 of the valves through the points $I_p=O$, $E_p=E_pO$, and $E_g=O$ at the knee 66 of the $E_g=O$ curve 60.

The load line for a single valve is indicated at 67, and the operating point 68 thereon is so chosen that the valves are biased initially, in the absence of signals, close to anode current cut-off, i.e., considerably below that value of anode current lying midway between that corresponding to zero grid voltage, and grid voltage corresponding to anode current cut-off. This is indicated at 68 in Fig. 2. The operating condition established is such that one valve will be cut off before the other valve reaches zero grid voltage, and the amplifier may thus operate Class AB. The operation is prevented from extending beyond Class AB by the fact that the grids are resistance-capacity coupled and include relatively high resistance elements in circuit, which prevent drawing grid current. It is, therefore, a problem to obtain maximum power output without drawing grid current, and for this reason the load line 65 of the push-pull operated valves is caused to pass through the $E_g=O$ curve at the knee 66 of the curve, thereby permitting maximum power output to be developed without grid current. Therefore, resistance-capacity coupling may be used, as shown in Fig. 1, between the driver stage and the output stage. This is advantageous in providing phase inversion between the usual diode detector and the output power amplifier of a radio receiver.

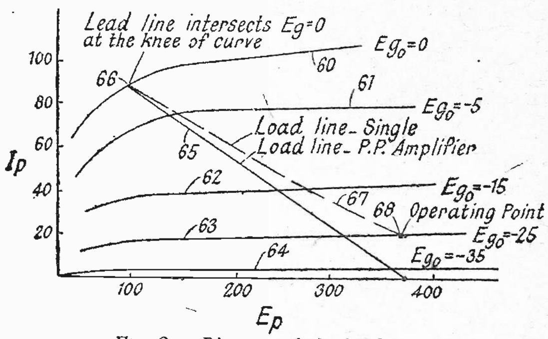


Fig. 2.—Plotting of the load line for different working voltages

Maximum Power Output

To summarise these results, it will be seen that maximum power output may be obtained from a pentode power-output stage having the valves arranged in push-pull relation to each other with resistance-capacity coupling when the load is such that the load line of the two valves in push-pull relation intersects the knee of the zero bias curve of anode current versus anode voltage so that the maximum value of the product of the voltage across the load and the current through the load is obtained, this being in the present example the voltage at the point 68 less the voltage at the point 66 and the current at the point 66, less the current at the point 68.

ON YOUR WAVELENGTH

By Thermion

The Length of Receiving Aerials

I WONDER how many readers have observed that the length of aerial now permitted by the Postmaster-General is 150ft. Formerly, the maximum length permitted, including that of lead-in, was 100ft. The 100ft. limit was of value in the early days in limiting interference caused by oscillating receivers of the detector and L.F. type. With the virtual supersession of such receivers by superheterodyne receivers and sets incorporating a screen-grid R.F. amplifier, interference caused by oscillation was greatly diminished, and it was decided to increase the permitted length of aerial to 150ft., which agrees with the length permitted in experimental transmitting licences. The increase was agreed to in May-June, 1936, and came into force as the forms were reprinted and issued, commencing in early 1937. It should perhaps be emphasised that the wording on the licence refers to "the length of the effective portion of the aerial and the down-lead." A screened down-lead or a special down-lead in which a screened single-core or twin-core flexible cable is connected between the aerial and the receiver by means of impedance matching transformers is not regarded as an effective portion of the aerial and down-lead. I am obliged to the Engineer-in-Chief of the Radio Branch of the G.P.O. for enlightening me on this matter.

The Woman Announcer

JOHN SNAGGE is on the look out for a woman announcer. I hope we do not revert to women announcers. I resent the intrusion of women into an essentially male job. Women announcers have been tried before, and they have failed. I see that one of the radio experts attached to a daily paper claims to have discovered that the bulk of listeners would welcome the reintroduction of women announcers. How has he discovered this? Has he conducted a census or is he merely expressing a personal opinion? And if he has conducted a census, bearing in mind that there are more women listeners than men, is it not obvious that the majority of listeners will be in favour of women announcers in just the same way that the majority of voters are in favour of votes for women? If a census of men listeners could be taken, it would be found, I am sure, that women would not be wanted for such a job. In any case, we do not want the B.B.C. to tell us what we want. It is our job to tell them. And why is the B.B.C. so interested in reintroducing women announcers? Is it because that previously Sir John Reith was anxious that the B.B.C. should be run by young men, and that now that the Army has recruited most of them they are short of a supply of young men? If so, John Snagge should say so, not wrap it up with statements about the majority of listeners wanting them. In any case, I think that listeners should be left to decide. I suggest that Snagge lines up a dozen of the selected applicants after he has finalised them and invites listeners to answer two questions: Do you want women announcers, and if so, which of this dozen? It would make an interesting programme item, anyway.

Price Control of Radio

MAJOR LLOYD GEORGE, Parliamentary Secretary to the Board of Trade, has announced that the Prices of Goods Act will be applied to a wider range of manufactured goods than those scheduled last December. The profits on radio sets are now limited and controlled by the Act.

Ganged Inductances

I AM informed by the Ekco Company that in their three new bandspread-tuning superhets shortly to be announced, the ganged condensers will be replaced by ganged inductances. The tuning unit is of new design and construction, and has been developed by the Ekco Company. They claim that it will provide bandspread tuning on all wavebands, thus making possible short-wave station names throughout the 31-metre band, and a 300 degree movement of the scanning pointer; as well as single tuning sub-assembly, carrying coils, ganged inductances, wavechange switch, trimmers and padders, which may be detached as a unit for service or replacement. This is another development of permeability tuning which, introduced a few years ago, did not prove so popular as was at first supposed. The release of these models is dated for early June.

Happy Landing

ONE of the most extraordinary incidents of the war so far, was the case of "the air gunner who did not jump." It happened following a reconnaissance flight.

The aircraft became iced up and unmanageable. The order went back to "bail out," but the rear gunner did not hear the order because his telephone was iced up also. His companions obeyed the order, ignorant of the fact that the other member of the crew had not heard the command. They believed he, too, had started to float down.

Still at his post, however, the gunner in the tail felt glad that they were making a good course and nearing home. By the queerest streak of good fortune, the aircraft finally pancaked in safe territory. The gunner, although badly shaken, rushed as he thought to the rescue of his friends.

Imagine his consternation when he found that they had disappeared. He had "brought the plane home" alone.

B.B.C. Symphony Concerts at Bristol

IT is interesting to note that a series of seven public Orchestral Concerts will be given by the B.B.C. Symphony Orchestra in the Colston Hall, Bristol, during the fortnight of May 22nd to June 5th.

The scheme comprises three Wednesday Symphony and two Sunday Popular Concerts at 7 p.m. on May 22nd, 26th, 29th and June 2nd and 5th, and two Lunch Hour Concerts to be given at 1.15 p.m. on Fridays, May 24th and 31st. Two of these concerts will be conducted by Sir Adrian Boult, B.B.C. Director of Music, one by Clarence Raybould, Chief Assistant Conductor of the B.B.C., and the remaining four by Sir Hamilton Harty, Julian Clifford, Basil Cameron and Albert Wolff, all of whom, with the exception of Sir Hamilton Harty, will be making their first appearance in Bristol.

Albert Wolff, who is coming specially from Paris to conduct a concert of French music on May 29th, is the conductor of the famous Lamoureux Orchestra and of the Opéra Comique in Paris, and his visit to this country to conduct the B.B.C. Symphony Orchestra will be reciprocated a month later by Sir Adrian Boult, who has been invited to Paris to conduct the leading French Radio Orchestra on June 28th.

Another feature of these Bristol concerts will be the inclusion of two entire programmes devoted to works by Tchaikovsky, in commemoration of the first centenary of the birth of the great Russian composer, who was born on May 7th, 1840. The first of these Tschaikovsky centenary programmes will be given at the opening concert on May 22nd, and the second, of a more popular character, on Sunday, June 2nd.

The soloists taking part in the series will be Solomon, Moiseiwitsch and Louis Kentner (piano), Laelia Finneberg (soprano) and Ida Haendel (violin).

The Home Front in France

MANY feature programmes have had as their subject the Home Front in Britain. The corresponding effort being made by the man-in-the-street in France should prove of equal interest to many listeners. The term "man-in-the-street" is now, perhaps, a misnomer, as Robert Kemp discovered during a recent tour of France in search of material for three feature programmes to be produced under the general title of "The Home Front in France." Paris, in common with the rest of the country, is practically denuded of men under the age of fifty, as the majority of the younger men are serving with the French Forces and their work is being carried on by their womenfolk. The title of the first programme, which is to be heard on May 29th, is "Paris Goes to War," and among subjects to be dealt with will be rationing, A.R.P. services and the black-out. The second feature will focus attention on the war-time work of the women of France, particularly in the big agricultural centres, and the third programme will tackle the problem of evacuation.

Comment, Chat and Criticism

Musical History—1

A Sketch of the Evolution and Progress of Music from the Earliest Times, by Our Music Critic, Maurice Reeve

IT can be assumed, without fear of contradiction, that music existed as far back in past ages as speech, and side by side with it. Unfortunately for the historian, it was not codified and drawn up with laws and rules governing its usage for centuries after speech and other arts were. Consequently, whilst we have amazing examples of painting and sculpture, and of primitive articles of domestic use and weapons of war, etc., from the earliest days of the cave dwellers, still in a state of perfect preservation, and of literature from the earliest Egyptian dynasties and Hebrew chronicles recorded for posterity, as well as many other ancient arts and crafts, there is no recorded music for centuries. All we know for certain is that it has been used as a means of self-expression for as long as the spoken word itself. The most ancient writers testify to its use as part of the pagan celebrations in the dawn of history, and the frescoes on the caves and tombs of the ancient world show men playing weird and long-extinct instruments in accompaniment to the rites of religion, the chase, the dance, etc. But, as already mentioned, ages were to pass before it could be reduced to a system which would enable it to be "composed" and recorded on paper. It must have consisted of the most elementary sounds, expressive of such emotion as worship and adoration, fear, and pleasure, and as an accompaniment, with the tom-toms and other forms of "tympani," to the dance.

Examples of how "God Save the King" would sound if written in (A) the Dorian Mode; (B) in the Phrygian; and (C) in the Lydian style.

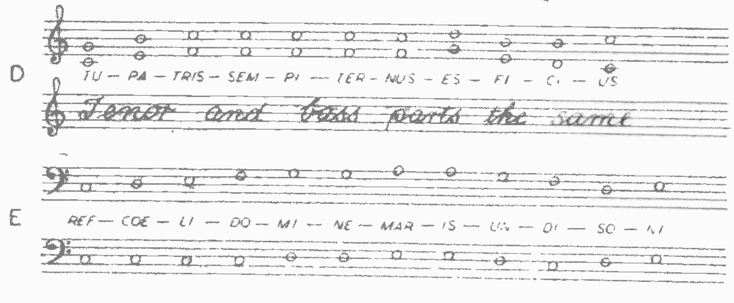
First System of Notation

It was widely practised by the ancient Egyptians, Greeks, Romans and Chinese, the Greeks using it in conjunction with the presentations of their wonderful Drama. Terpander (670 B.C.), a flautist and theoretical musician, is credited with devising the first system of notation for recording music, instead of having to have recourse to memorising it, as before. The Greek scale was founded on a system of tetrachords, a series of four notes with a compass of a perfect fourth, each containing two tetrachords. The four modes were Dorian, Phrygian, Lydian and the Mixolydian. They were later increased to seven. One can play these modes by starting on any key and following the white notes on the piano upwards: the Dorian, for example, starts on D. These modes have exercised an appeal on composers of all ages, and the reader will recall that Beethoven wrote one of the movements of his great quartet, Op. 132, in the Lydian mode, as a thank-offering for his recovery from a severe illness. Other musicians of this period worthy of mention are Pythagoras (560 B.C.), Aristoxenus (340 B.C.) and Euclid (277 B.C.).

Early Musical Instruments

Their favourite instruments were the flute, syrinx, horn, trumpet, lyre, cithar, psalter, lute and harp. All of these, however, have subsequently been modified, some almost beyond recognition, so that when we talk of, say, the harp of those days we mustn't think of the harp of modern times. The progress of music during all this period was necessarily very slow, which fact can probably be attributed to the failure to found any satisfactory system for recording it, unlike the spoken language, and the consequent absence of any concrete foundation from which its study and development could proceed. What we would call its "notation" consisted of a series of dots, dashes and signs undecipherable to all but the pedagogue. Two other points must be noted. Ancient music was chiefly vocal, the instruments being used mainly to "double" a line, to emphasise a rhythmic beat, and even to cover up a mistake by one of the singers. Also its extreme ugliness, judged by any standard that we know to-day. Two examples, taken from "Burney's History," will amply prove this.

It must not be forgotten, however, that music possessed no laws or grammar, and that it was almost exclusively used for chanting and facilitating the reciting of the services.



Two examples of early musical notation taken from Burney's History.

The Tonic Sol-fa

Although it is incorrect to attribute the invention of the tonic sol-fa system to Guido of Arezzo (995-1050) he was responsible for its spread and subsequently universal use. In reality, however, it is nothing but some of the syllables from a Latin hymn to St. John the Baptist:

UT queant laxis REsonare fibris
MIra gestorum, FAmuli tuorum
SOLve polluti LAbii reatum
Sancte Joannes.

UT was later substituted by DO, which is more suitable for singing, and the final syllable SI was not introduced until later still. Space prevents us from quoting the music which Guido used in teaching his choirs singing.

Hebrew music, probably derived from the Egyptian, was largely Eastern in character. The Old Testament is full of proof that the Jews were, musically, far in advance of the Greeks, or any previous civilisation. Sir W. H. Hadow says: "It is not too much to say that the Old Testament is saturated with a love of music. Its most primitive history contains the figure of Jubal: the passage of the Red Sea is celebrated by Miriam, and the defeat of Jubin's army by Deborah: Saul's melancholy is soothed by David's harp; Elijah, called upon to prophesy, asks for a minstrel to inspire him. The Temple services were magnificent outbursts of music—the historical and prophetic books made frequent allusion to wedding songs and funeral songs, to songs of the reapers and vintagers.

Recorded Notes

Although notes were by now recorded, including the use of distinguishing colours, no laws as yet existed for either the variation of the sounds produced in unison or of measuring the length for which they were sustained. Music was still without harmony or time. Franco of Cologne, who lived at the end of the twelfth century, was the first to devise a system for the recording of and naming of various time lengths with their equivalents in rests, and his system, with additions and enlargements, remains in use to this day.

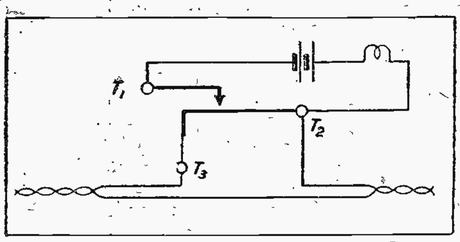
Bar lines were not used, but lines were drawn across the stave to mark the end of a phrase. There were two styles of time, perfect and imperfect. The perfect proceeded by multiples of three, and was deemed perfect by comparison with the Holy Trinity. The sign used was the complete circle O. The "imperfect" progressed in twos, and was shown by a broken circle, or C, which sign is still in use.

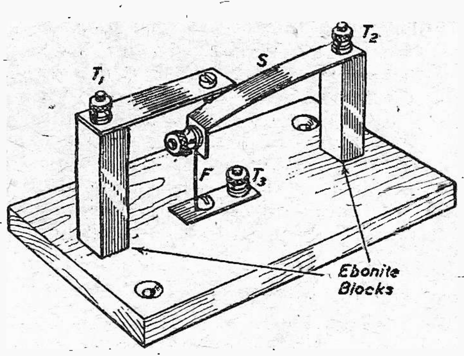
Mention should be made of the earliest examples extant of part singing as we know the term to-day; a piece of music containing the elements of harmony, melody, time and rhythm as now universally practised. It is the celebrated "Reading," "Rota," or "Round" "Summer is icumen in, lhude sing cuccu," written for four tenor voices with a "ground" for two basses.

Practical Hints

An Automatic Emergency Light

WHILE working in my radio den I am constantly blowing the fuses and leaving myself in darkness. This caused





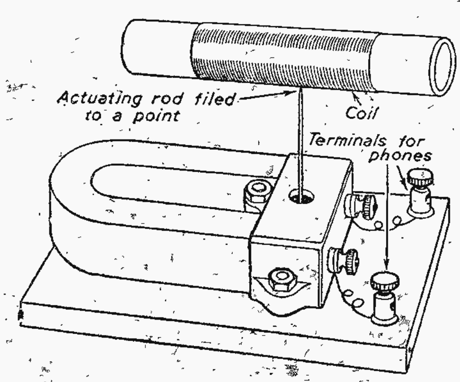
A novel switching arrangement for emergency lighting.

me to devise the following dodge. A piece of clock spring was mounted on an ebonite block, as in the sketch, and a piece of fuse wire was fixed to the end of the spring and to a terminal on the base. The spring was adjusted so that when the wire melted, the spring moved upwards, closing a circuit consisting of a battery and bulb mounted near by. Thus, when the device is fixed to the mains as in circuit diagram, and the fuse wire is blown, a lamp lights up, thus enabling me to find a torch to replace the fuse.—W. T. GLASSPOOL (Hounslow).

Counting Coil Windings

I RECENTLY wanted to count the number of turns on a finely wound medium-wave coil, and devised the simple, but accurate, device shown in the accompanying illustration.

In my junk-box I found an old but sensitive moving-iron speaker. After removing the cone I filed the reed to as fine a point as possible, and fastened the



An improvised counter for fine coil windings.

THAT DODGE OF YOURS!

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

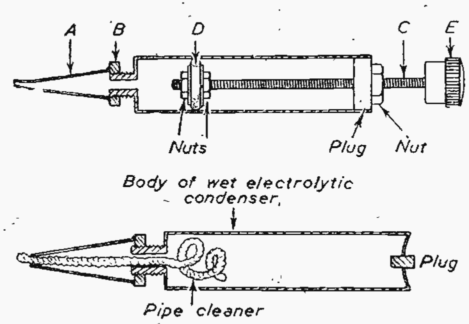
SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page 228.

unit (as shown in diagram) to a piece of wood to act as baseboard. I then connected a pair of 'phones to the speaker unit. To count the number of turns of a coil, draw it slowly over the pointed reed, and note the number of clicks in the 'phones.—J. S. WALKER (Kirton).

A Flux Gun and Switch Cleaner

A FLUX gun, handy to use, combined with neatness, is described below. The barrel is made from a discarded electrolytic condenser. Fig. 1 is a sectional diagram of the gun, and the parts required are a spout taken from an oil can, a rubber washer D, two metal washers, a length of screwed rod C, and knob E. The spout is soldered to the fixing nut of the electrolytic. The rubber washer is

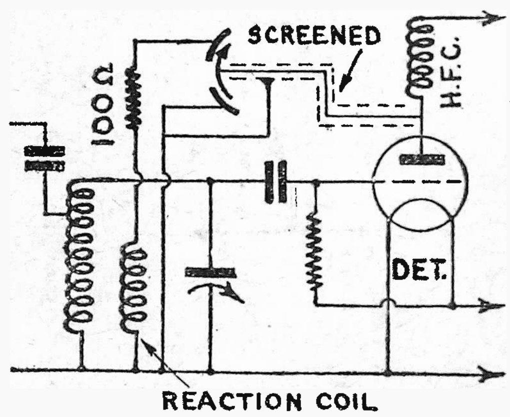


This handy flux gun and switch cleaner were contrived from old condenser cases.

sandwiched between two metal washers, and two nuts on the screwed rod. The tightness of the fit of the rubber washer in the barrel can be adjusted by the two nuts. A fairly tight fit is desirable. The nuts are soldered firmly to the screwed rod and metal washers to prevent working loose in action.

A nut is soldered to a metal plug made to fit tightly in the end of the barrel or, alternatively, the metal plug itself could be tapped. The rest of construction is clear from the diagram.

The switch cleaning device is similar in construction, but in this case a wet electrolytic condenser is best. The condenser will usually be found to be sealed with a rubber valve. This is cut away and the contents emptied. A spout is fitted as in the flux gun. The positive contact screw is either pulled out or pushed inside the can, but the foil contents can remain. A pipe cleaner is pushed through the spout, the can is filled with carbon tetrachloride, and a small wooden plug seals the small filling hole.

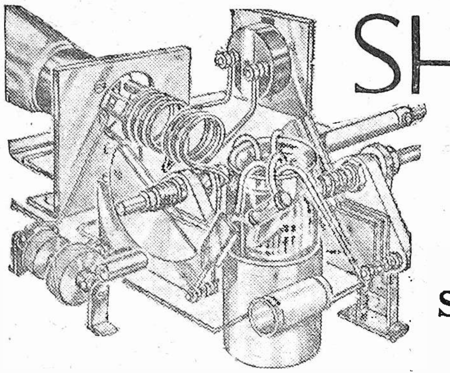


Circuit diagram showing how a reaction difficulty was overcome.

This device will be found invaluable in getting into awkward corners, as the pipe cleaner can be bent into any shape.—E. NEWBAULD (Middlesbrough).

Smoother Reaction

I RECENTLY made up a simple detector short-wave receiver with home-made coil. Whilst results were very good there was one serious drawback and that was that reaction was not smooth enough to enable me to pull in some of the very weak stations. I made several trials with different condensers and reaction windings (and also the disposition of the windings), but none of the modifications had any improvement. Finally, I adopted the arrangement shown in the accompanying theoretical diagram. I used a differential condenser in place of the standard reaction component, and added a half-watt 100 ohm resistance. This was at first put on the anode side of the reaction winding in accordance with standard practice, but its effect in my case was more marked when it was put on the other side, with the reaction condenser connected as shown. Although the moving vanes were not earthed, the hand-capacity effects were removed by screening the reaction lead as indicated. This also proved more efficacious than with the orthodox connection having the moving vanes earthed.—D. WALDE (Plymouth).



SHORT-WAVE SECTION

USING A SHORT-WAVE CONVERTER

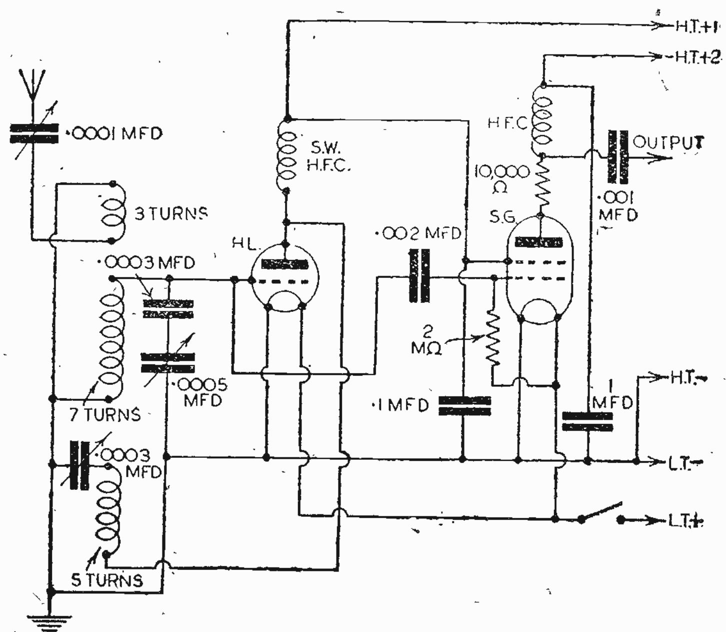
How to Ensure Maximum Results from a Converter-receiver Combination.—By W. J. DELANEY.

THE majority of listeners know that a broadcast receiver may be adapted for short-wave use by using an adapter or a converter. The first is merely a substitute for the tuning section of the detector stages, whilst the second is an add-on unit which converts the broadcast receiver and unit combination into a superhet. When properly used this combination is ideal for all normal uses, but there are a few pitfalls which appear to crop up from time to time and prevent listeners from obtaining the desired results. The converter is, as already stated, an add-on unit, and it is usually provided with an output terminal or lead, as well as an aerial and earth socket strip or terminals. In addition there may be provisions for the necessary battery supplies. In all normal cases the aerial and earth are removed from the receiver, and are connected instead to the terminals on the converter, the output terminal or lead on the converter then being taken to the aerial terminal on the receiver. There are two points here which should be attended to if you are unable to obtain satisfactory results after making the usual adjustments. Firstly, it may be necessary to join the earth terminal on the receiver to the earth terminal on the unit, so that both are earthed. On the other hand, the necessary earth connection may be obtained through the battery supplies.

Battery Connections

If the necessary supplies are obtained by means of a plug-in adapter, which is intended for insertion between one of the receiver valves and its holder, it may be worth while to try alternative positions for it. Inclusion of the adapter on the L.F. side of the receiver may result in some form of L.F. instability, although it may be advised that the L.F. section be used, as it will generally have available higher H.T. voltages. The ideal arrangement is undoubtedly the use of separate battery leads, especially in the case of the pentagrid or similar valves, as then the appropriate voltages for screen and H.T. are readily found and the valve will give its maximum performance.

A large number of broadcast receivers are provided with a series-aerial condenser, and this is generally wired direct inside the receiver. Consequently, when the output from the converter is fed to the receiver it will have to pass through the condenser. As there is already a condenser in the output lead this means that you will be using two condensers in series, and the value of the receiver aerial condenser may affect results. It should therefore be short-circuited in order to see if results are improved thereby. Similarly, certain commercial receivers, especially those of the superhet type, have whistle interference eliminators or similar devices included in the aerial circuit and these may prevent an S.W. converter from giving its best or even prevent it from working entirely. If, therefore, you are using a commercial receiver with an S.W. converter and results are disappointing (or are thinking of getting a converter for such a receiver, and are uncertain as to its suitability), the makers of the receiver should be approached for their recommendations on the matter.



Circuit of a typical 2-stage S.W. superhet converter.

Double Tuning

With a converter the receiver is generally tuned to the long-wave band and the dials adjusted to some pre-arranged position and there left. All subsequent tuning is then carried out on the converter. If the tuning controls of the receiver are moved, then the settings of the converter will also be upset, and thus for accurate logging it is essential always to see that the receiver controls are set to the same position. A point which often confuses the beginner is that all stations with the standard type of converter will be found to tune in at two points on the converter dial. However, if one or two stations on a given band are located it will not be found difficult to mark off the scale according to the band of frequencies covered by the coil, and thus any doubt as to the correct setting will be overcome.

Tuning Range

In the ordinary way the converter is designed for use with plug-in coils, and thus the range is restricted according to the coils in use. The receiver may, however, be given greater scope if one of the multi-range coils which are now available is fitted. These coils, such as the Bulgin five-range or similar components, may be mounted in the converter, and if the medium-wave and long-wave sections are also included, then the set may be converted into a superhet, although the results may not be so good as those obtained with a superhet which has been properly designed. If, however, the tuning circuits in the receiver are properly screened and the set is quite stable, then there is no reason why it should not perform exactly in the same manner as a standard superhet, and if care is used it may even have advantages in that the intermediate-frequency, that is, the frequencies to which the receiver section is tuned, may be correctly adjusted, and any drift due to stray capacities, etc., may be overcome. It should be remembered, however, that if a converter unit is made up on the lines of a modern superhet frequency-changing stage, and one of the standard oscillator coils is used, then it may be necessary to modify the coils in the broadcast receiver in order to tune to the intermediate frequency for which the oscillator coil is designed. There is a possibility that this frequency may not be covered by the coils in the receiver, and therefore the combination will either fail to work or, at least, will work very inefficiently.

HOW MUCH HIGH TENSION?

The Importance of the H.T. in Regard to Obtaining Maximum Performance and Effecting Economies

In spite of all that has been written concerning the desirability of providing a receiver with an ample supply of high-tension energy, cases are constantly arising in which poor reproduction results from either misdirected high-tension economy or from sheer lack of knowledge on this important subject.

The value of a liberal allowance of high-tension voltage can be grasped very easily by a study of the various stages in a multi-valve-operated receiver. Consider first of all the high-frequency amplifying stages. Like all amplifying valves, radio-frequency types, whether of the screen-grid or the high-frequency pentode variety, depend for distortionless reproduction on being worked over the straight portion of their grid-volt anode-current characteristic. If, in an endeavour to economise in high-tension current, the anode voltage is reduced considerably, the effective grid bias is correspondingly shortened, and the valve will therefore fail to handle strong signals without distortion.

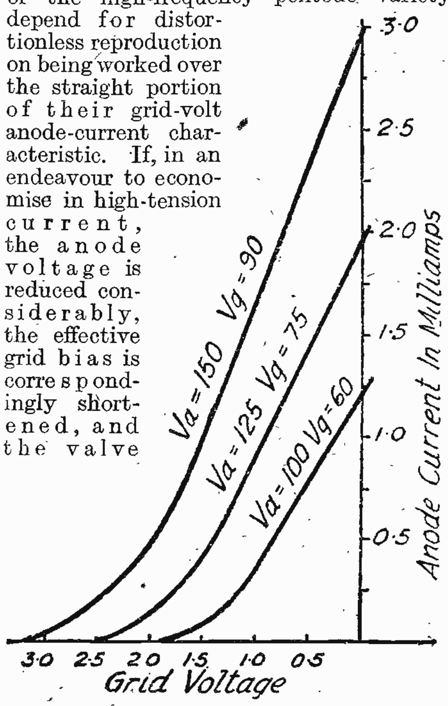


Fig. 1.—A family of static characteristic curves for a screen-grid valve.

Affecting Over-all Performance

This point is illustrated in the diagram reproduced in Fig. 1. Here is shown a "family" of static characteristic curves for a typical screen-grid valve of the fixed-mu type, and the way in which the maximum permissible signal is limited by the value of the anode voltage can be readily appreciated. First of all, over-all performance is affected in several ways. For example, it is clear that at a reduced anode voltage there is a considerable risk of overloading the valve on strong signals, and the only alternative is to reduce the input, which in its turn will reduce the amount of power available at the output stage to operate the loudspeaker. In this connection, it must not be forgotten that many modern speakers lack considerably in quality when operated at low power. Then the characteristic curves themselves show that the mutual conductance of the valve, as represented by the slope of the curve, is considerably greater at high anode voltage than at low.

In the case of the detector stage, the value of liberality in the matter of high-tension voltage is equally marked. In the old days, when the leaky-grid triode detector valve with magnetic or capacity reaction was used almost universally, the guiding precept in designing the detector stage was to use the minimum high-tension voltage which gave adequate output combined with effective and smooth reaction. Those were the days when two or more stages of low-frequency amplification followed the detector, and when, moreover, the efficiency of high-frequency amplification was far below what it is to-day, with the result that only comparatively small grid inputs were applied to the detector valve.

To-day, however, thanks to the screen-grid valve, and to the high-frequency pentodes, large stage gains are possible on the high-frequency side, and very seldom is it necessary to interpose a low-frequency amplifying stage between the detector and the output valve. This means that the detector must be able to handle comparatively large input signals and must, in addition, add its full quota of amplification in order to load the output valve.

Best Detector Conditions

With a triode-detector valve this can be achieved only by operating the valve under what is known as "power-grid" conditions. In this arrangement, the anode voltage is increased, if possible, to the maximum value for which the detector valve is rated, and as a result the anode current is correspondingly increased.

Operated under these conditions the valve will rectify quite powerful signals without distortion, and its amplifying powers are also exploited to the full. But since power-grid detection necessitates a somewhat heavier anode current, its benefit cannot be enjoyed unless the listener is prepared to accept this additional drain upon his high-tension supply.

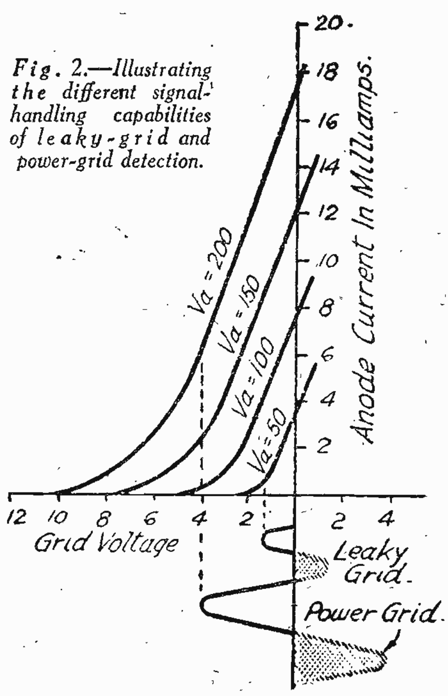


Fig. 2.—Illustrating the different signal-handling capabilities of leaky-grid and power-grid detection.

Fig. 2 illustrates the effect of power-grid detection when compared with the ordinary leaky-grid system, the difference in signal-handling capabilities and in anode-current consumption being illustrated very clearly.

It is, however, in connection with the output stage that the ill effects of parsimony in high-tension supply are perhaps most noticeable. It should be borne in mind that in the output stage is generated the actual power required for driving the loudspeaker. In all other stages the only effect required is to produce in the anode circuit of the valve as large an alternating current as possible; the power question does not enter into the matter, and the consumption of anode current is merely incidental and perhaps unfortunate. But the output valve must provide a considerable amount of alternating power, as represented by the product of alternating voltage developed across the "load" in the anode circuit (speaker or output transformer) and the alternating portion of the anode current.

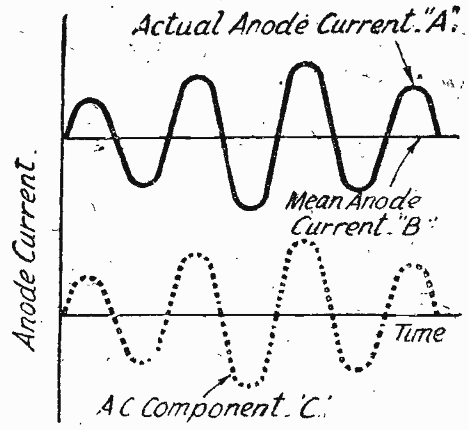


Fig. 3.—The steady or mean output current with the alternating component superimposed.

Insensitive Large Speakers

Many speakers which are noted for the fidelity of their reproduction are comparatively insensitive, that is to say, they require a larger power input to produce a certain volume of sound than some of the more sensitive but somewhat less faithful reproducers.

Most listeners know that with the normal or Class "A" output valve the A.C. component of the anode current consists of variations of current strength above or below a steady or "mean" value, which latter represents the normal anode current as measured by an ordinary milliammeter. This is shown in the familiar diagram reproduced in Fig. 3, where the top horizontal line represents the "rest" value of the anode current, while the curved line represents the actual anode current when signals are being received, and the dotted curved line shows the equivalent A.C. component. It is not difficult to understand that the actual anode current marked "A" is equivalent to a combination of the steady value "B" and the A.C. component "C." It is also clear that the amplitude of the alternating component will be limited by the value of the steady current, since the full "modulation" value is given by this mean current.

If, therefore, a really large output is

HOW MUCH HIGH TENSION?

(*Continued from previous page*)

required from a Class "A" valve it must be of a type having a fairly large anode current in order to accommodate large variations. It is for this reason that the general quality of reproduction in mains receivers is usually so very much better than in battery sets. With mains power at a few pence per unit only, the listener can afford to be generous with high tension. With battery operation, however, the total H.T. consumption must be limited at least to the economic maximum discharge ratio of the high-tension battery employed.

Question of Cost

This brings to the front another aspect of the question of providing generous high-tension supply. The difference in cost between expending 20 milliamps, and, say, 50 milliamps, in the high-tension circuits of a mains receiver is a mere detail—a matter of a few pence per week only.

In considering the case of the listener who has no alternative but the dry H.T. battery, it can at once be said that he will be wise to allow as heavy a consumption as he feels to be justifiable, bearing in mind the two facts that liberal H.T. makes possible improved performance all round, but at the same time adds to the cost of listening.

Most high-tension batteries, even the "standard" types of quite low capacity, will give quite a big current for a limited time, but only the battery designed for heavy discharge currents will stand up to such service for a reasonable time.

Battery Types

The "standard" type of battery should not be called upon to give more than 6 or 8 milliamps, and under this duty their life is quite satisfactory. "Power" types or so-called double-capacity batteries are usually rated for drains of the order of 12 to 15 milliamps, while the heavy-duty-triple-capacity type may be used where currents up to some 20 milliamps are required. Each type of battery will give a reasonable life provided its recommended duty is not exceeded. The costs of the various types are in proportion to their capacities, but even so it definitely pays to use a battery at least one size larger than that indicated by the total anode current required by the set. The reason is that the useful life of a battery is not strictly inversely proportional to the drain, so that with a loading of, say, 10 milliamps, a double-capacity battery will give more than twice the life of a single-capacity battery.

IS FULL-WAVE DETECTION IMPOSSIBLE?

(*Continued from page 213*).

forms of the unmodulated carrier forms the basis of the detection of the modulated carrier.

Fig. 8 shows the output from the detector by a method of detection which displaces the base or zero voltage line so that the negative amplitude of the output is 50 per cent. of the positive as is the case of Fig. 4. Other methods of detection will give a different positive/negative ratio. The greater the excess of positive voltage over the negative, the greater will be the audio-frequency output.

In the absence of evidence to the contrary, it is clear that half-wave and full-wave rectification is impossible. A full-wave detector circuit can, of course, be used, but that does not mean that full-wave detection is obtained. There may, of course, be points of detail which may have to be revised, but it is thought that the general principles remain.

B.L.D.L.C. The British Long-Distance Listeners' Club

Disappointing News

As many members may already know, the existing conditions are likely to restrict their activities concerning the sending of veri's and reception of QSL cards from countries overseas. Although we are not using official phrases, it should be noted that it is no longer permissible to send reports of transmissions out of this country or to receive QSL cards from overseas. It is, therefore, up to *all members of the B.L.D.L.C.* to assist the authorities by making careful note of this statement, and to refrain from such practices in the future.

Although this will be very disappointing news to those who make a big feature of collecting QSL cards, it does not in any way affect or restrict the activities of the genuine amateur.

DX Contest

As this copy goes to press some weeks in advance, it is too early for us to say what the actual response is going to be to the proposed DX contest, but judging from correspondence already received, it would appear that the majority of the members are very eager to take part in such a competition. There are, however, a small percentage who have the impression that to take part in a long-distance reception contest it is absolutely essential for them to own an elaborate receiver. This idea is absolutely erroneous, and we would strongly advise those who have it to remember our remarks, and that special provision would be made so that the station using a single-valver would have as much chance of scoring top marks as the communication receiver operator. If you have not already let us know whether you are willing to take part in the contest, please let us have your views as quickly as possible.

An Interesting Point

Member 2603 has raised a very interesting point connected with the proposed DX contest, and we would certainly welcome other members' views, as we quite appreciate that it is a matter which can affect all who take part.

The member says: "Re DX contest, I think the zone idea is O.K., and would give it all my support. I have one suggestion to make, however. It should not be expected during existing conditions that members should have to sit up half the night to log DX stations, as most of us are on war work or that which requires us to get all the sleep we can. The period 23.00 hours to 06.00 hours should be definitely left out. If some members can listen all night it gives them a definite advantage over those whose listening is restricted to normal hours."

Diversity Receivers

It is possible that many members were not familiar with diversity receivers until they read the articles in our issue of May 11th, but such circuits are by no means new to American amateurs. Now that mention has been made of them, it is hoped that we shall hear more about them in the near future, as they can provide most interesting material for experimental work, particularly on the short waves.

The receiver described in the two issues commencing May 11th is, of course, designed for use with a single aerial and, primarily, for the reception of a medium-wave station which is transmitting on two wavelengths. The alternative system, and the one most suited for short-wave work, is that which operates in conjunction with two separate aerials, and where space permits, it is this arrangement which we would recommend to all members who are looking for a fresh field of experimental work. If anyone has already compiled any practical observations from their own work, then perhaps they will send them along so that all members can share the benefit of their experiences.

Station Equipment

There seems to be a great divergence of opinion as to what constitutes the correct or essential equipment for the average amateur station. If many of the photographs of American amateurs' installations are examined, one cannot help getting the opinion that a small fortune has been spent on securing rather elaborate test equipment which would seem more suited for a professional service man than the average constructor. However, while it is the desire of most of us to obtain a fine range of testing instruments, it is possible to let our enthusiasm over-ride practical considerations, and make or secure apparatus which is not really essential. There are no hard-and-fast rules as to what constitutes the equipment of a station, as so much depends on the particular work being undertaken by the owner, but every member should make every endeavour to construct a reliable universal meter, suitable for measuring a wide range of voltages and currents, modulated oscillator for ganging circuits and checking up the L.F. response of a receiver or amplifier, and finally, one of the simple types of valve voltmeter which enables measurements of great interest and importance to be obtained.

With the Services

We feel sure that all members will join us in wishing the best of luck to Member 6331, who has just notified us that he is now a radio-operator in the R.A.F.

Contacts Required

West Croydon: Member No. 6,663, 42, Oakfield Road, West Croydon, Surrey.

Folkestone: Member 6,364, Strathmore, 121, Surrenden Road, Folkestone, Kent.

Saffron Walden: Member 6,461, 18, Debden Road, Saffron Walden, Essex.

Birmingham: Member 6,676, "Oakfield," Kendal End Road, Barnt Green, near Birmingham.

Thames Ditton: Member 6,690, "Ashbourne," Orchard Avenue, Thames Ditton, Surrey.

Redditch: Member 6565, of 43, Batchley Road, Redditch, Worcs.

Brighton: Member 6689, of 48, Freshfield Street, Brighton, 7, Sussex.

Clayton-le-Moors: Member 6696, of 65, Grange Street, Clayton-le-Moors, nr. Accrington, Lancs.

Summer-time Overhaul

Now is the Time to Go Over Your Equipment so as to Make Sure of Getting the Best Out of it During the Summer Months

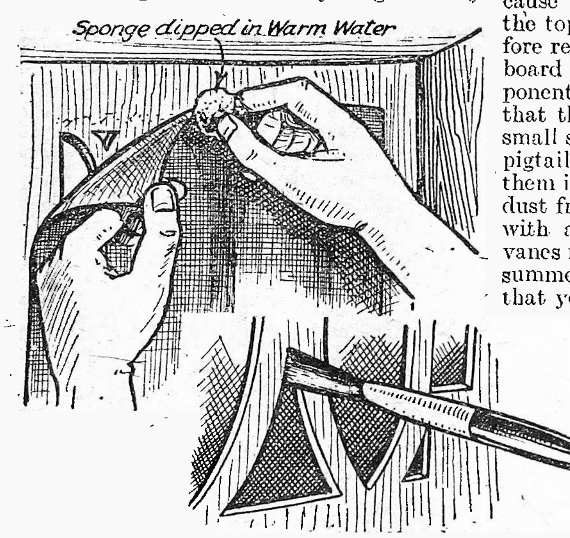
WINTER time is the station hunter's paradise, but in the summer time he is confronted with conditions for distant reception entirely different from those ruling in the cold-weather period. During the winter, foreigners roll in one after the other with monotonous regularity and even the modest one-valver can be credited with a performance. But during the summer months conditions are vastly different and more difficult. By the time July is out it will have to be a well-maintained three-valver which will give its owner a fair bag of Continental programmes. The main reason for this falling off is, of course, the absorbing effect of the sun's rays which are more powerful in the summer time than in the winter, and, further, hours of daylight are very much longer. Although a station may radiate the same power, the waves which reach the aerial in summer time will be very much weaker than in the winter.

Compensating for Weak Signals

Much of this loss can be compensated for by a well-designed modern receiver, but even then, it will only be possible to get consistent results provided that every part of the equipment is kept right up to scratch. The receiver is not the only part which must be kept in order. Batteries are likely to run down far more quickly in summer due to the loss by evaporation of the electrolyte; the earth will, no doubt, become very dry and the aerial become coated with a hard-baked deposit. Another thing also counts, and that is the loss of skill. In the winter we all become experts at tuning because we sit for hours at the controls, and we become fully acquainted with the individual idiosyncrasies of our equipment, but in the summer we are out of doors far more and the receiver does not receive any attention until we return from our sport or other occupation, very often too tired to meddle with the receiver very much, and in consequence we turn to the local and don't bother to tune in the distant programmes. Atmospherics are also a little more troublesome in summer than in winter, but quite a lot of assumed static can often be traced to a faulty earth which only requires a good soaking to bring it up to standard again. Valves, after hours of continuous life during the winter, begin to lose their emission and although the effect may not be noticed because the loss is so gradual, a new set of valves may easily make all the difference. All these things taken singly during the winter may not amount to much, but a sum total of them during the summer may make all the difference between indifferent and successful reception.

The receiver, being the most important part of the equipment, should receive attention first. Before starting it is as well to remember to provide the family with an alternative before pulling the set to pieces. It is surprising, especially if the receiver is in a room heated with a coal fire, how much dust does accumulate inside the set, even if it is enclosed in a cabinet. Many cabinets are supplied these days without backs, generally for acoustical reasons and these cabinets require special attention. Start with a good "spring clean" of this item, the reason being that it will then be ready to receive the set when that important item has been dealt with, and there will be no necessity to leave it about collecting more dust.

Remove the receiver and the loudspeaker from the cabinet and any other gadgets which may have been fixed to it. If the material which covers the fret looks dirty, take this out and have it washed, or if a change in design is required, fit a new piece. The easiest way to remove the material if it is wanted again is to damp where it is glued (round the edges) with warm water. The glue will soften and the material may be gently pulled away. If the material is not required again, it can be torn out carefully and the excess glue and odd ends removed with a scraper. When everything is clear,

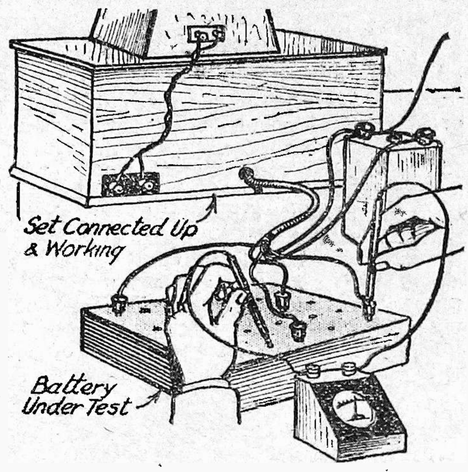


Warm water will soften the glue and allow the speaker fret to be removed. A stiff brush is handy for dusting the fret.

go over the inside of the cabinet and all the interstices of the fret with a small, stiff brush and remove all traces of dust that could not be removed when the silk was in. Go over the outside with a rag doped with a good furniture polish and regain some of the original finish. If any hinges or locks are fitted to the cabinet, these should be cleaned up and treated to a spot of oil. Many broken hinges are the result of not looking after this small point.

Spring-cleaning the Receiver

Having dealt with the cabinet, the receiver should now be dealt with. The most thorough way in which to overhaul a receiver is to pull it to pieces. Subject every individual part to a good scrutiny and if possible give it a test. Remove all the



Test the H.T. battery when the set is working.

components from the baseboard and if of wood, treat it with a coat of varnish or stain, or if of metal with a little metal polish. There can be little chance of an error in replacing the components because the holes in the metal cannot shift and the holes in the wood baseboard will be used again. Then go over all the components, such as transformers and tighten up the bottom nuts, replacing the soldering tags if these have been used, after the old solder has been removed and they have been retinned. If the terminals only are used, clean up the faces with smooth emery paper. Do not trust the plating for a good connection, however bright and polished it may appear, as it is often covered with a film which may be very thin, which might easily cause an indifferent connection. Replace the top nuts and tighten them up hard before replacing the components on the baseboard or the panel. Go over the components with variable adjustments and see that the spindles work freely and apply a small spot of oil if necessary. See that the pigtail connections are intact and replace them if they appear to be weak. Clean the dust from the vanes of variable condensers with a pipe cleaner. Dust between the vanes may account for some of the assumed summer atmospherics. If you feel confident that you can put all the pieces back where they came from, a sound scheme is to dismantle this type of component completely and clean every part separately. Besides doing the job properly you will have learned something of the construction of the components themselves. The more simple components such as valveholders should most certainly be dismantled and the contact springs given a good clean up, and more than summary attention given to all switch contacts. If the springs are of a material which is likely to oxidise easily, the surfaces of the contacts should be given a thin coat of tinning with the soldering iron.

Grid leaks, which often vary after they have been in use for a year or more, should be tested for correct value and replaced if necessary. This also applies to the carbon type of anode resistance to a certain extent, but the trouble usually only occurs either with the higher values or with the low valued resistances used for the grid bias carrying their maximum permissible current. A variation of ten per cent. in the value of the bias resistance may affect the anode current with possible damage to the filament of the valve. The value of anode decoupling resistances

(Continued on next page)

SUMMER-TIME OVERHAUL

(Continued from previous page)

can vary as much as 20 per cent. without seriously affecting the emission of the valve or the performance of the receiver. Re-assemble the components and commence the wiring of the receiver, using new wire and sleeving if necessary. All battery leads should be carefully inspected for perished rubber covering and replaced if necessary with new flex. Carefully inspect all wander plugs and spade terminals to see that the ends of the flexible leads are making good and proper connection. Clean up the pins and the faces of the spade terminals with emery paper.

Attending to the Batteries

The loudspeaker should then receive attention. The simple types of iron armature units can be dismantled, but the complicated types of balanced armature are best left for the attention of the manufacturer, as special tools and jigs are often required to reassemble them correctly. Units should be returned to the manufacturers if any doubt is felt, so that they can thoroughly inspect and re-magnetise if necessary. Moving-coil loudspeakers should be carefully dusted, and if the construction allows, remove the cone and the centring device and clean out the gap with a pipe cleaner. Great care must be exercised in replacing the coil, to see that the windings do not scrape on the pole pieces.

Have the accumulator acid tested and adjusted for correct specific gravity. It is important to note, when adjusting the acid of an accumulator, that the figure given by the manufacturer is for the first charge or for a charged condition, and the acid should be "brought up" when the cells are in a run-down condition. If this is done, the specific gravity of the acid will be higher than that recommended when the accumulator is charged, and this will result in the loosening of the paste in the grids, and a consequent shortening of the life of the accumulator. It is well to remember, too, that the acid in a cell never evaporates, and any decrease in the volume of the liquid in the container is entirely due to loss of water, and therefore only water should be added. If a cell is properly looked after and has been charged correctly in the first place, it will never require that addition of acid unless, of course, some is spilled. It is, however, advisable completely to change the acid at least once in every two years.

Test, or have tested, the H.T., and the grid bias batteries for voltage, and this should be done whilst the receiver is working, or a wrong reading may be taken. An allowance of about 25 to 30 per cent. of the original voltage of an H.T. battery is allowable, but the battery may still continue to give good service at a much lower figure. The only judge of the battery's real service is the owner, who must rely on his ears to inform him of the change in quality or volume which must, of course, take place, but is very seldom noticed until the receiver fails to respond to the adjustments of the reaction condenser or reveals trouble by low frequency oscillation, which usually takes the form of a high-pitched squeak. It is safer to place a very much higher figure on the grid-bias battery, and it is suggested that when the voltage is 5 per cent. lower than the original it should be replaced.

Grid-bias batteries are cheap, and used properly, save a large amount of H.T. current, and their replacement every six months is an investment rather than an expense.

Aerial and Earth

Having attended to the internal equipment, the aerial and earth should now receive attention. In summer the aerial will become coated with a deposit which it will require hot water and soda to remove, and although a heavier deposit occurs in winter this is usually so soft that a good shower of rain will wash it off. Now is the time to clean the insulators, because the winter deposit can be removed with a dry rag. The earth leads should be thoroughly overhauled to repair the ravages of wind and rain, and all joints remade for safety.

Having rebuilt the receiver and attended to all the accessories, the equipment should be as good as new, and the chances of it giving a high standard of performance in the summer months are much greater than if the points mentioned had not been attended to.

NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 119.

HORSE-POWER

The unit of work (Horse power) is based on the assumption that a horse can travel 2½ miles per hour for 8 hours a day, performing the equivalent of pulling a load of 150lb. out of a shaft by means of a rope. Thus 2½ miles an hour is 220ft. per minute, and at that speed the load of 150lb. is raised vertically the same distance. Therefore, 300lb. would be raised 110ft. or 3,000lb. raised 11ft., or 33,000lb. raised 1ft. high per minute. The latter is the unit of horse-power, i.e., 33,000lb. raised 1ft. high per minute, or 33,000 foot-lb. per minute. Electrical equivalent is 746 watts.

Horse Power of an Electric Motor

$$\text{I.H.P.} = \frac{\text{Volts} \times \text{Amperes}}{746}$$

Horse Power (Indicated) of a Steam Engine (Single-acting)

$$\text{I.H.P.} = \frac{\text{PLAN}}{33{,}000}$$

where P=Mean effective steam pressure in lb. per sq. in.

L = Length of stroke in feet.
A = Area of piston in sq. in.
N = Number of revolutions per minute.

For a double-acting engine the formula is:

$$\text{I.H.P.} = \frac{2\text{PLAN}}{33{,}000}$$

Horse Power of Petrol Engines

R.A.C. Formula: $\text{H.P.} = \frac{\text{D}^2\text{N}}{16.13}$

Dendy Marshall Formula: $\text{H.P.} = \frac{\text{D}^2\text{SNR}}{200{,}000}$

Where S=Stroke in centimetres.
D=Diameter of cylinder in centimetres.
R=Revolutions per minute.
N=Number of cylinders.

A.C.U. Formula: 100 c.c. = 1 h.p.

No. 120.

Wire and Sheet-metal Gauges—4

Number of Gauge	Lancashire Steel Wire Letter Gauge (letter)	Lancashire Steel Wire Letter Gauge in.	Lancashire Steel Wire Letter Gauge mm.	London or Old English in.	London or Old English mm.	Morse Steel Wire Gauge for Drills in.	Morse Steel Wire Gauge for Drills mm.	Music Wire Gauge, English in.	Music Wire Gauge, English mm.	Music Wire Gauge, Washburn & Moen in.	Music Wire Gauge, Washburn & Moen mm.
13	N	.302	7.67	.095	2.413	.185	4.697	.027	0.685	.031	0.787
14	M	.295	7.48	.083	2.108	.182	4.620	.028	0.711	.032	0.812
15	L	.290	7.36	.072	1.828	.180	4.57	.031	0.787	.034	0.863
16	K	.281	7.13	.065	1.65	.177	4.487	.0314	0.797	.036	0.914
17	J	.277	7.02	.058	1.473	.173	4.335	.034	0.863	.037	0.939
18	I	.272	6.90	.049	1.244	.169	4.288	.035	0.889	.039	0.990
19	H	.266	6.75	.040	1.016	.166	4.212	.039	0.990	.041	1.011
20	G	.261	6.62	.035	0.889	.161	4.085	.041	1.041	.043	1.092
21	F	.257	6.5	.031	0.787	.159	4.038	.046	1.168	.046	1.168
22	E	.250	6.35	.029	0.736	.157	3.987	.049	1.244	.048	1.219
23	D	.246	6.24	.027	0.685	.154	3.911	—	—	.051	1.295
24	C	.242	6.14	.025	0.635	.152	3.860	—	—	.055	1.397
25	B	.238	6.04	.023	0.584	.149	3.778	—	—	.058	1.473
26	A	.234	5.94	.020	0.508	.147	3.727	—	—	.062	1.574
27		—	—	.018	0.457	.144	3.651	—	—	.065	1.651
28		—	—	.016	0.406	.140	3.55	—	—	.072	1.828
29		—	—	.015	0.381	.136	3.452	—	—	.076	1.930
30		—	—	.013	0.330	.128	3.243	—	—	.030	2.03
31		—	—	.012	0.304	.120	3.04	—	—	—	—
32		—	—	.011	0.279	.116	2.942	—	—	—	—
33		—	—	.010	0.254	.113	2.866	—	—	—	—
34		—	—	.0095	0.241	.111	2.815	—	—	—	—
35		—	—	.009	0.228	.110	2.79	—	—	—	—
36		—	—	.0075	0.19	.106	2.692	—	—	—	—

No. 121.

Resistance Values for Decoupling and Voltage Dropping

VOLTAGE DROPPED

Current mA	8	9	10	20	30	40	50	60
1	8,000	9,000	10,000	20,000	30,000	40,000	50,000	60,000
2	4,000	4,500	5,000	10,000	15,000	20,000	25,000	30,000
3	2,500	2,500	5,000	7,000	10,000	15,000	17,500	20,000
4	2,000	2,500	2,500	5,000	9,000	10,000	12,000	15,000
5	1,500	2,000	2,000	5,000	7,000	9,000	10,000	12,000
10	1,000	1,000	1,000	2,000	2,500	5,000	5,000	7,000
15	500	500	1,000	1,500	2,000	2,500	5,000	5,000
20	500	500	500	1,000	1,500	2,000	2,500	2,500
25	500	500	500	1,000	1,500	1,500	2,000	2,500
30	300	300	500	1,000	1,000	1,500	2,000	2,000
40	250	250	300	500	1,000	1,000	1,500	1,500
50			250	500	500	1,000	1,000	1,000

3 watt 2 watt 1 watt

1 watt 2 watt 3 watt

The values given above are correct to the nearest standard value.

No. 122.

Resistance Values for Decoupling and Voltage Dropping (*Cont.*)

VOLTAGE DROPPED

Current mA	70	80	90	100	125	150	175	200	Rating
1	70,000	80,000	90,000	100,000	125,000	150,000	175,000	200,000	
2	35,000	40,000	45,000	50,000	62,500	75,000	87,500	100,000	
3	25,000	30,000	30,000	30,000	40,000	50,000	50,000	75,000	1 watt
4	17,500	20,000	25,000	25,000	30,000	40,000	40,000	50,000	
5	15,000	17,500	20,000	20,000	25,000	30,000	40,000	40,000	
10	7,000	9,000	9,000	10,000	12,000	15,000	17,500	20,000	2 watt
15	5,000	5,000	6,000	7,000	9,000	10,000	12,000	15,000	3 watt
20	5,000	5,000	5,000	5,000	7,000	9,000	9,000	10,000	4 watt
25	2,500	2,500	5,000	5,000	5,000	5,000	7,000	8,000	5 watt
30	2,500	2,500	2,500	5,000	5,000	5,000	7,000	7,000	6 watt
40	2,000	2,000	2,500	2,500	2,500	5,000	5,000	5,000	8 watt
50	1,500	1,500	2,000	2,000	2,500	2,500	2,500	5,000	10 watt

4 watt 5 watt 7 watt 8 watt 9 watt 10 watt

The values given above are correct to the nearest standard value.

Notes from the Test Bench

Output Measurements

WHEN using an output meter for testing receiver adjustments, it is sometimes difficult to get an accurate reading owing to the fact that the output has to be made rather large. There are several ways of overcoming this difficulty, the simplest being to feed the output meter from the anode through a condenser. A much better idea is, however, to make use of a standard output transformer and use this between the meter and the secondary of the normal output transformer. In this way the actual voltage on the speech coil may be measured, provided that the extra transformer is of the special tapped variety, as this will enable the load to be accurately matched on both sides of the coupling transformer. Furthermore, no part of the meter is at high D.C. potential and there is thus no risk of a shock.

Identifying Leads

SOME constructors may have purchased surplus mains transformers, or removed these components from old chassis, and experienced some difficulty in ascertaining the rating of the various windings—in the absence of identifying tags or markings. It should be pointed out right away that it will not be possible to ascertain the current rating of any winding, as the gauge of wire cannot be seen in many instances owing to the use of separate leading-out wires. It is possible to ascertain the voltage output of the windings, however, and for that purpose all that is necessary is to connect the primary to the mains and use a good meter to measure the output of the secondaries. This will give an unloaded reading, and it may be necessary to make calculations to ascertain the appropriate rating when the windings are loaded. For instance, the L.T. windings may read about 6 volts, whereas they may be 4-volt windings. By shunting resistors across the winding so that 2 or 3 amps. are taken, a more accurate reading could be obtained.

"Britain and the Mediterranean"

AN important new book called "Britain and the Mediterranean" has just made its appearance and is in great demand. The author, Kenneth Williams, who served for several years in the Middle East, is in intimate and constant touch with all Mediterranean affairs and is a frequent broadcaster in Arabic. This book is of interest to everyone at this time, for it tells all there is to know about our position in the sea that links us with the East and makes clear our vital strategic interests. It is obtainable through all Booksellers at 3s. 6d., or 3s. 9d. post free, direct from the publisher, Messrs. Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

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).

A Good S.W. Log

SIR,—Other enthusiasts may like to know of my progress in our hobby under the auspices of PRACTICAL WIRELESS.

I first began seven years ago and, until January of this year, concentrated my energies on the medium-wave band, trying out many circuits and suggestions appearing in P.W. Incidentally, I have filed all articles of reference value during the last seven years. These, together with several of the P.W. books, give me a good reference-library.

In January I built my first short-waver, an 0-v-pen, battery-operated, designed from articles appearing in P.W. The connections are soldered throughout. The aerial is a home-made vertical copper-tube type, 8ft. long and 25ft. high.

My log for the first twelve weeks of operating, excluding French, German, Italian, and Russian stations, is as follows. These are broadcast stations:

25-*metre band:* SBP, LKQ, HBO, CSW6, WPIT, WCBX, WRUW, MTCY, XGOY, VLQ2 (Sydney), ZPI4 (Villa Rica), CXA? (Montevideo). [This last is an experimental transmission on 25-metre band and I should say the wavelength is about 25.7m.]

31-*metre band:* CSW7, CS2WA, EAQ, OFD, SBU, TAP, YUA, JZI (Tokyo), VLQ (Sydney), WGEO, CR7BE (Lourenço Marques), WGEA, WBOS, WCBX, WCAB, WRCA, and Radio Eireann.

49-*metre band:* HVJ, SBO, YUB, Lahti, WCBX, and VP3BG (Georgetown).

You will observe that all continents are covered and new stations are being logged every week so far.

My only regret is that enlistment will postpone my activities for the meantime, but I hope to go on filing P.W. for many years to come. Thank you for a fine paper.—E. A. COLLINS (Ashtead).

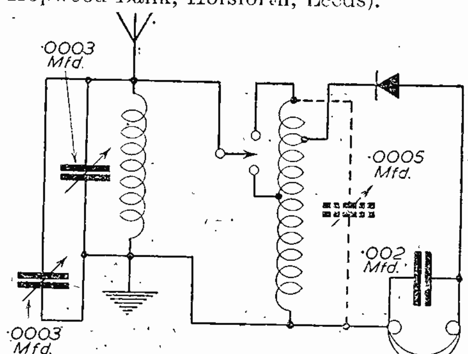
Novel Circuit for a Crystal Set

SIR,—I enclose a circuit for a crystal set which has proved very efficient. In my locality, the present broadcasting arrangements are well received, but owing to the power of the "Overseas" transmission I have found that crystal sets will only separate the "Home" and "Overseas" with an acceptor wave-trap. After many tests with different condensers and coils I find that this circuit gives me the strength that I require plus the separation of the two stations.

The aerial coil is an adaptation of the medium-wave section of the coil used in the "A.W." 150-mile circuit. Wishing to use small components I decided to use a 2¼in. diameter former and double the number of turns to 76, and use 30 S.W.G. instead of 28 S.W.G., as this was the nearest size I had. On trying it out I included a .0005 tuning condenser, but found that this was detrimental and acted only as a volume control.

The wave-trap coil is the aerial winding of a coil shown on page 131 of PRACTICAL WIRELESS, October 28th, 1939.

I trust that these particulars will be of interest to other readers who, like myself, prefer to experiment with the different types of crystal detector circuits. Should anyone wish to write me regarding this circuit I shall be pleased, and if they will enclose a stamp their letters will be replied to by return.—ARNOLD S. LONG (29, Hopwood Bank, Horsforth, Leeds).



Circuit diagram of Mr. A. S. Long's crystal set. Wave Trap Coil; 60 turns 30 S.W.G. enamelled copper wire on a former 1⅕in. diameter. Aerial Detector Coil; 76 turns of 30 S.W.G. enamelled copper wire on a former 2¼in. diameter. Crystal tap at 10 turns. Aerial tap at 40 turns. Variable condensers preferably ganged, .0003 or .0005 mfd. The .0005 tuning condenser is not required, as in the 150 mile circuit, the wave-trap serves the same purpose.

An Efficient Three-valve Circuit

SIR,—I have been taking PRACTICAL WIRELESS for over a year now and feel I must write to express my pleasure regarding the fine performance of a receiver, the circuit of which was published in the "P.W. Encyclopædia" and also "Sixty Tested Wireless Circuits"—both of which I find most useful and instructive. The set is a simple straight three-valve battery set (Det.-L.F. Pow.), and is transformer coupled. Tuning is extremely simple with three plug-in coils. Incidentally, I have not adhered exactly to the components specified, and yet after a few improvements, such as a wave-trap, etc., it works admirably. I get the Home Service, Forces Programme and Overseas Service at remarkable strength.

I would like to communicate with any young reader about my own age—13 years.—A. H. BURKILL (18, Raglan Court, Curzon Crescent, Church Road, Willesden, N.W.10).

"Dead Spots"

SIR,—I would like to make a correction to my letter published in PRACTICAL WIRELESS, No. 399.

The times of transmissions in English from HCJB are not altered by the recent change over to Daylight Saving Time in America, and they remain as previously, 12 midnight-1 a.m. and 3-4 a.m. B.S.T.—G. FILLEUL (Gosport).

A 14 mc/s Log from Wandsworth

SIR,—I append my 14 mc/s log of stations heard during the month of April in the hope of interesting other readers. The RX is an 0-v-2 and antennæ are:

1. 66ft. indoor, N.W.-S.E.-S.W.-W.-E.
2. 45ft. E.-W. under the eaves of the roof.

and 3. 16ft. V-beam directed on Asia (N.E.).

Fone and C.W.:

AC4MI, CE1AR, 1AS, 3CZ; CO2GY, 2LY, 2OY, 5BA, 6OM, 7CS, 7CX, 8MP; CX2CO, D6AWY, EA7A, 9BA; EK1AF, ES1E, 4G, 5C, 5D, 6E; HA1I, 2P, 3B, 6K, 7N, 8B, 8S, 8T; HH2HB, HI1P, 3N, 5RC; I1KTG, 7AA; K6NYD, 6PLZ, LU4KO, 5CK; LY1BE, 1DD, 1G, 1J, 1MB; LZ1ID, OK3ID, 3ZN; OQ5BF, PY1GJ, 1ME, 2CK, 2ET, 2MI, 5AD; TG5JG, 9BA, U3BM, 3BX, 3DS, 5YH, 8IL, 9MJ; UE2GB, 3KP, 3KQ; UK3AH, W1ADM, BCX, ISB, IKU, JA, JFG, KJJ, LPY, OR; W2AD, BCK, PBC, CRB, ECR, HFM, IXY, LBK, LLB, MTC; W3BXC, EOZ, EQZ, FAM, HFD, HGN; W4ARW, DCQ, FUT; W5AKZ, BEK, SMO, W6BGW, ITH, MRB, MYO, NJV, PCV; W7ACD, EKA, GMV, HIA (Oreg.); W8ACY, BYR, CRA, CUO, JSU, LA, NJP, PMP, RHP; W9AKI, DAY, ELK, NDA, TI; YU7AY, 7LX; YV1AQ, 1AV, 4AE, and 5ABE.

Station MTCY ("The Voice of Manchukuo") has been heard at R9 (QSB to R5) on 11,775 kc/s, giving out news in English from 22.00-22.15 B.S.T., and continuing with a talk entitled "Prosperous Manchukuo" from 22.15-22.30, which is to be continued every day!—LEONARD F. CROSBY (Wandsworth).

Prize Problems

PROBLEM No. 401.

BLACK had a three-valve receiver which suddenly ceased to function. He made tests with his voltmeter and found that H.T. was in order. He next used a milliammeter and found that the output and detector stages were passing normal current, but when the meter was joined between the top cap of the H.F. valve and the lead he could obtain no reading. He assumed that the valve was faulty and ordered another one. When plugged in the set still failed to work. Where had he gone wrong? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 401 and must be posted to reach this office not later than the first post on Monday, May 27th, 1940.

Solution to Problem No. 400.

When Melville made the change in valves he should also have modified the anode circuit of the detector, as an S.G. valve requires a much higher anode load than a triode. Accordingly, the simple transformer coupling failed to provide a suitable load for the valve and thus it gave very little more amplification than the triode. He should have used an R.C. or resistance-fed transformer coupling.

The following three readers successfully solved Problem No. 399 and books have accordingly been forwarded to them:

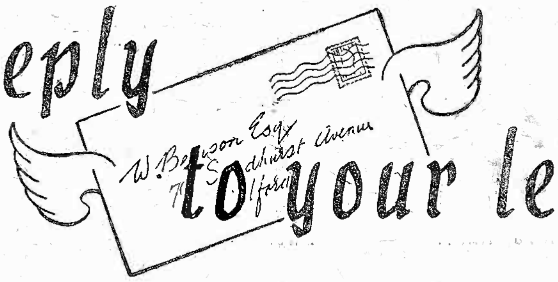
A. Pick, 55, Middleton Street, Spring Bank, Hull.
E. B. Beard, 6, Alfred Street, Shrewsbury.
W. Whitfield, *H.M.T. City of Florence*, c/o G.P.O. London

Correspondents Wanted

A. G. EAMES, of 93, Dukes Avenue, New Malden, Surrey, would like to get into touch with a reader who has a copy of *W. M.* for June, 1934.

D. S. Deller, of 24, Chadway, Becontree, Essex, would like to get into touch with any reader concerning experiments with an H.F. receiver, having H.F. reaction with a separate triode valve.

In reply to your letter



Superhet Design

"I have purchased a surplus chassis which contains a number of valveholders, components and wires. I also have a mains transformer. The circuit which has been used on the chassis is obviously a superhet, but my mains transformer is rated for two valves more than the chassis. I wonder if you could give me any idea as to the best circuit to build up. I know you would not be able to supply a blueprint, but the circuit on the chassis is obviously frequency changer, I.F., second detector, L.F. and push-pull, and I am afraid I cannot see any suitable change to suit my transformer. I might mention that I have plenty of valves."—J. W. R. (Oldham).

THERE is some difficulty in making a change in a circuit especially if much wiring is in position. Further, it may not be necessary to add valves to compensate for the high secondary rating of the transformer. A simple bleeder resistance would enable you to dispose of the extra current. However, one change is apparent in the circuit which, whilst using the extra current might also lead to better results and would at least give you more scope for experiment. We refer to the use of a separate oscillator valve and also a phase inverting valve so that you could use R.C. coupled push-pull amplification. These changes would lead to very little material alteration in the circuit wiring or design, but would give improved results.

Direct-coupled Amplifier

"I was interested in the recent direct-coupled amplifier design, and wonder if such a scheme could be successfully employed in a push-pull amplifier. I wonder if you can supply any details in this connection. I might mention that I tried out the direct-coupling idea some years ago and was impressed, but think that push-pull would give still better results."—L. F. (N.W.5.).

AN amplifier of the type you mention has been produced in America as a commercial proposition. Microphone or pick-up input is fed to the grids of two L.F. pentodes in the usual way and the two anodes are taken direct to the grids of two beam tetrodes. 300 volts is applied, through a 100,000 ohm resistance to each input anode and output grid, thus giving approximately 150 volts on the grid, and the two output anodes are fed to an output transformer in the usual way. The cathodes of the output valves are 170 volts positive, and the anodes 420 volts, the arrangement resulting in the grid actually being biased to −20 volts. Perhaps these details would be of interest to you. The input valves are 6SJ7's and the output valves 6L6's.

U.S.W. Tuning

"I have been experimenting with some U.H.F. circuits and receivers, but must confess that I have not had much success. The main point seems to be in the way of obtaining a really smooth reaction circuit, and although I have tried most valves, even removing the base from one to try and reduce losses, I am unable to get smooth results. Could you help me in this connection?"—C. P. S. (Wood Green).

WE assume that you are using a standard arrangement, and in that case you should attend to the removal of the damping in the detector stage. Use a loose-coupled aerial, with a movable aerial coil so that coupling may be adjusted for best results, and use tapping clips so that not only the anode (reaction) point, but also the grid point may be adjusted for the removal of damping. We do not know exactly what waveband you wish to use, but no doubt something on the above lines will enable you to obtain the desired results.

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.

H.F. By-passing

"I send you a circuit of a receiver for short-waves and should be glad if you could explain the H.F. by-pass arrangement, where they show a normal .1 mfd. H.F. decoupler, with a .0001 mfd. mica in series. You will see that this occurs in several parts of the circuit and I should like to know the reason."—G. R. (Farnborough).

THE arrangement is merely a safeguard, the mica condenser being capable of withstanding a higher voltage load and thus, in the event of the tubular condensers breaking down, the mains section will not be damaged due to a short-circuit. There should be no need to use the mica condensers, provided that the other condensers are chosen with a suitable voltage rating.

Making Astatic Choke

"I wish to make up a good H.F. choke for a standard receiver, but do not wish to go to the expense or trouble of making a screened component. I believe it is possible to obtain a similar effect by a special form of winding, and if that is so, would you please give me instructions for carrying it out? I have plenty of ebonite rod, tube and wire."—M. B. A. (Radlett).

THE arrangement you refer to is known as an "astatic" winding, and in it the total winding is divided into two sections which are wound in opposition. In this way the fields cancel out. The simplest construction would be to obtain two short lengths of your ebonite rod—say about 2ins. in length and wind about 750 or 800 turns of wire on each former, taking care that the windings on the two formers are in opposite directions. They are connected in series. Suitable wire would be 36 S.W.G. enamelled.

Weak Output

"I have just completed a small A.C. gramophone amplifier, but am disappointed with the result. I used a 3 watt pentode and a good L.F. valve, with transformer coupling and a good make of pick-up. I have tested the voltages (H.T. and G.B.), and they are correct according to the maker's instructions. The speaker is a good one and has not had much use. I should like some idea as to where to turn for improvement in this instance."—S. A. (Ilford).

ALTHOUGH we have not seen a theoretical diagram and are without quite a lot of data relative to the circuit we think that the most likely cause of the trouble is that you have overlooked a fundamental regarding design. The amplifier is probably working quite well and correctly but by using an output valve rated at 3 watts you have expected to get 3 watts output. This does not necessarily follow, and you will only obtain that output when the valve is fully loaded. For that purpose you would no doubt need a further stage of amplification between the two existing valves. Your pick-up may be quite a good one but giving a small output and thus the output valve is considerably underloaded.

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.

J. H. (Bangor). Aluminium cannot be used in the manner indicated. Your main difficulty would be in making good contact as the material is not easily soldered.

S. P. (Manchester). The interaction is undoubtedly due to the aerial positions. Try to move one of the aerials, and if it is not possible to obtain a very acute angle, each aerial should be moved slightly to increase the effect.

B. W. S. (Steyning). The two pentodes would be quite satisfactory except from the point of view of battery consumption.

T. G. (Heston). The burning of the wire in order to clean it has no doubt annealed the wire and may also have resulted in some chemical deposit from any insulating material which was on the wire covering.

S. F. (Ilchester). The knobs may be obtained from Messrs. Bulgin. Various patterns are available.

F. M. T. (Harrogate). We do not recommend the procedure. A good S.W. converter is much better and would be more reliable.

C. S. F. (Fareham). The cheaper component is, in this case, preferable, as it has a lower D.C. resistance.

G. C. M. (Surbiton). Full details were given in the issue dated December 9th last.

H. W. J. (Aylesbury). Ordinary bell wire may be used, but the special stranded flex is more suitable and has a lower H.F. resistance.

F. R. D. (Gilmorton). Have you tried the standard arrangement? We suggest you do this first to make certain that the wiring is in order.

R. G. (Berwick). Use tinned copper wire, about 22 S.W.G. would be suitable. An article on the subject will appear shortly.

H. B. E. (St. Albans). The box may be of aluminium or wood covered with metal foil.

L. D. (Carfax). We have not tested the model and cannot therefore give you a criticism.

S. L. K. (Ilfracombe). Ordinary fabric is preferable as the metallic material may cause resonance or coloration to the reproduction.

M. A. H. (Manchester, 20). The coil unit as well as the tuning condenser may be transferred to the new set as they are quite standard.

The coupon on page 228 must be attached to every query

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.

Issues of Practical Wireless ... 4d. Post Paid
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/3 " "

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

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

PRACTICAL WIRELESS

CRYSTAL SETS

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

STRAIGHT SETS. Battery Operated.

One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three ((SG, D, Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90

Mains Operated

Two-valve: Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve: Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-Valve: Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

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

SHORT-WAVE SETS. Battery Operated.

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

PORTABLES.

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

MISCELLANEOUS.

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

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

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

STRAIGHT SETS. Battery Operated.

One-valve: Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve: Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve: Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF, Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve: Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.

Two-valve: Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve: Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve: Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386

SUPERHETS.

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

PORTABLES.

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

SHORT-WAVE SETS. Battery Operated.

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

Mains Operated.

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

MISCELLANEOUS.

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

LATEST PATENT NEWS

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

NEW PATENTS

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

Latest Patent Applications.

7530.—Baird Television, Ltd., and Sommer, A. — Photo - electrically sensitive electrodes. April 26th.

7712.—Electrical Research Products, Inc.—Method and means for the production of vocal, etc., sounds. April 30th.

7713.—Electrical Research Products, Inc.—Method and means for the production of vocal, etc., sounds (Cognate with 7712). April 30th.

7657.—Marconi's Wireless Telegraph Co., Ltd.—Fading compensation. April 29th.

7658.—Marconi's Wireless Telegraph Co., Ltd.—Microphones. April 29th.

7668.—Philips Lamps, Ltd.—Radio-receivers adapted to be automatically tuned to a plurality of predetermined stations. April 29th.

7783.—Philips Lamps, Ltd.—Radio receiving-sets comprising a wave-range switch. April 30th.

7784.—Philips Lamps, Ltd.—Electric glow-discharge tubes. April 30th.

Specifications Published.

520531.—Radioakt.-Ges. D. S. Loewe.—Television transmission station, and method of carrying out a complete television transmission service.

520412.—Kolster-Brandes, Ltd., and Smyth, C. N.—Means for mounting cathode-ray tubes.

520489.—Fernseh Akt-Ges.—Deflecting-circuits for use with cathode-ray tubes.

520552.—Murphy Radio, Ltd., and Balean, J. H.—Tuning of superheterodyne radio-receivers.

520462.—General Electric Co., Ltd., and Sloane, R. W.—Electric circuits comprising thermionic valves incorporating guiding-grids.

520609.—Carpmael, A. (Telefunken Ges. fur drahtlose Telegraphie).—Directional radio-receivers.

520622.—Philips Lamps, Ltd.—Superheterodyne radio-receivers supplied by alternating current.

520623.—Mullard Radio Valve Co., Ltd.—Electric discharge tubes for the optical indication of voltages.

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

Push-button Receiver Refinements

THE pre-tuned circuit type of push-button tuning is now very popular, but its application to receivers having more than two tuned circuits is complicated by the fact that three pre-tuned circuits have to be provided for each push-button. The number of extra components required is consequently large, so that the cost of the receiver becomes excessive, and in addition there is likely to be trouble due to couplings between the three banks of circuits, unless elaborate screening precautions are taken.

As the stations selected by push-buttons are invariably strong, it is permissible to sacrifice a little selectivity and gain, and a convenient way of reducing the number of components is to render one of the tuned circuits aperiodic when push-button tuning is used.

In the case of a superhet receiver having an H.F. stage preceding the mixer, the tuned anode circuit may be replaced by an aperiodic coupling, as shown in the illustration. It will be observed that on switching over to push-button tuning, the switch 1 inserts a coupling resistance 5 in the anode circuit of the H.F. amplifier valve 2 in series with, say, the medium-wave coil 6 and its associated trimmer capacity, and the switch 3 disconnects the manual tuning condenser gang 4. The coil 6, and its trimmer capacity, will tune to a wavelength a little below the medium-wave band, and will serve to increase the gain towards the high-frequency end of the medium-wave band where the efficiency of the resistance coupling 5 is beginning to fall off.

The switches 1 and 3 may either be arranged to be actuated by each push button or, alternatively, by the wave-band switch if the latter is arranged to convert the receiver from manual to push-button tuning.

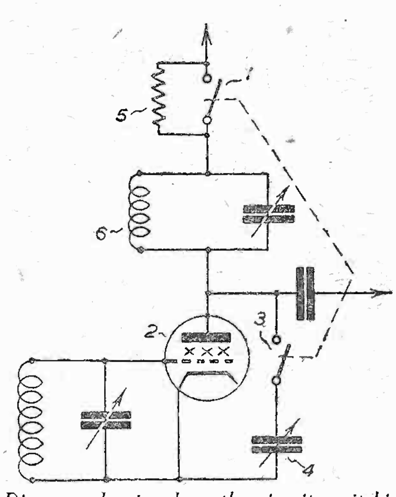


Diagram showing how the circuit switching is carried out.

CORRECTION

OWING to a printer's error, the capacity of condensers C5, C6 and C17 for the Diversity Receiver described recently was given as .01. This should have read 0.1 mfd. It should also be noted that the dials, type IP8, specified for the Short-wave Four, are manufactured by Messrs. Bulgin and not by Messrs. Stratton.

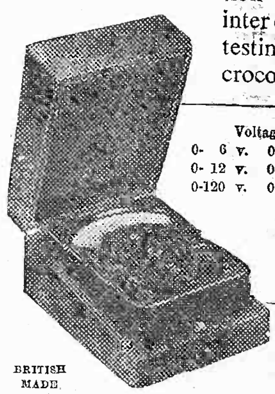
Get back that PUNCH in your Set! *with the D.C.*

AvoMinor

Regd. Trade Mark

ELECTRICAL MEASURING INSTRUMENT

This precision-built moving-coil D.C. instrument, with 13 ranges covering 0-120 m/A, 0-600 volts, and 0-3 megohms, provides adequate testing facilities for checking valve performance, batteries and power units, etc. It reduces trouble-tracking to its simplest terms. In case with instruction booklet, leads, interchangeable testing prods and crocodile clips.



Voltage		Current
0- 6 v.	0-240 v.	0- 6 m/amps.
0- 12 v.	0-300 v.	0- 30 m/amps.
0-120 v.	0-600 v.	0-120 m/amps.

Resistance
0-10,000 ohms.
0-60,000 ohms.
0-1,200,000 ohms.
0-3 megohms.

BRITISH MADE

Write for fully descriptive leaflet.

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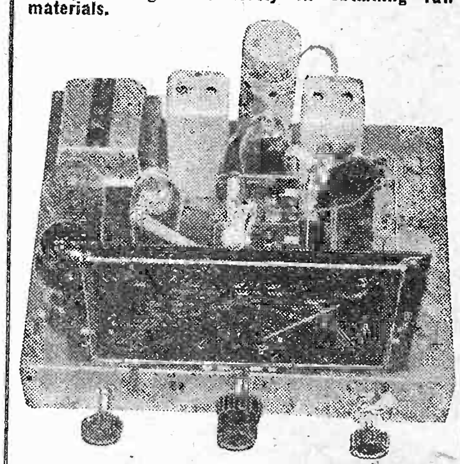
Automatic Coil Winder & Electrical Equipment Co., Ltd.,
Winder House, Douglas St., London, S.W.1. *'Phone: Victoria 3404/7*

ARMSTRONG

Apologise for delay in delivery of some models, this unfortunately has been unavoidable owing to the present great difficulty in obtaining raw materials.



MODEL AW38. 8-valve All-wave Superheterodyne chassis. This All-wave Radiogram chassis has resistance capacity coupled push-pull output capable of handling 6 watts, and gives good quality reproduction on both radio and gramophone, for an economical price of **8 gns.** Plus 5% war increase.

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LITERATURE

NEW Edition. American Amateur Relay League Handbook. 500 pages of up-to-the-minute technical information, 7/- post free. 1940 Jones Handbook; approximately 700 pages dealing with every aspect of Short-wave Radio, 8/6, post free.—Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089.

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REPAIRS to moving coil speakers. Cones/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service.
L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

MISCELLANEOUS

PRINTING.—1,000 Billheads, 3s. 9d.; Memos, Cards, etc. Samples free. — Creteway Press, 24, Buxted, Sussex.

MORSE EQUIPMENT

FULL range of Transmitting Keys, Practice Sets, Oscillators, Recorders and other Radio Telegraph Apparatus, designed and manufactured by T. R. McElroy, World's Champion Telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

MORSE TRAINING

WIRELESS Code Courses. "Book of Facts" Free.—Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised 4in. to 14in. including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

PUBLIC APPOINTMENTS

AIR MINISTRY.
AERONAUTICAL INSPECTION DIRECTORATE.
Vacancies exist for unestablished appointments as Examiners in the General Engineering, W/T and Instrument Branches.
QUALIFICATIONS.
All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.
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(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.
(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.
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