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Edited by F. J. CAMM

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Practical Wireless and PRACTICAL TELEVISION

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EVERY WEDNESDAY

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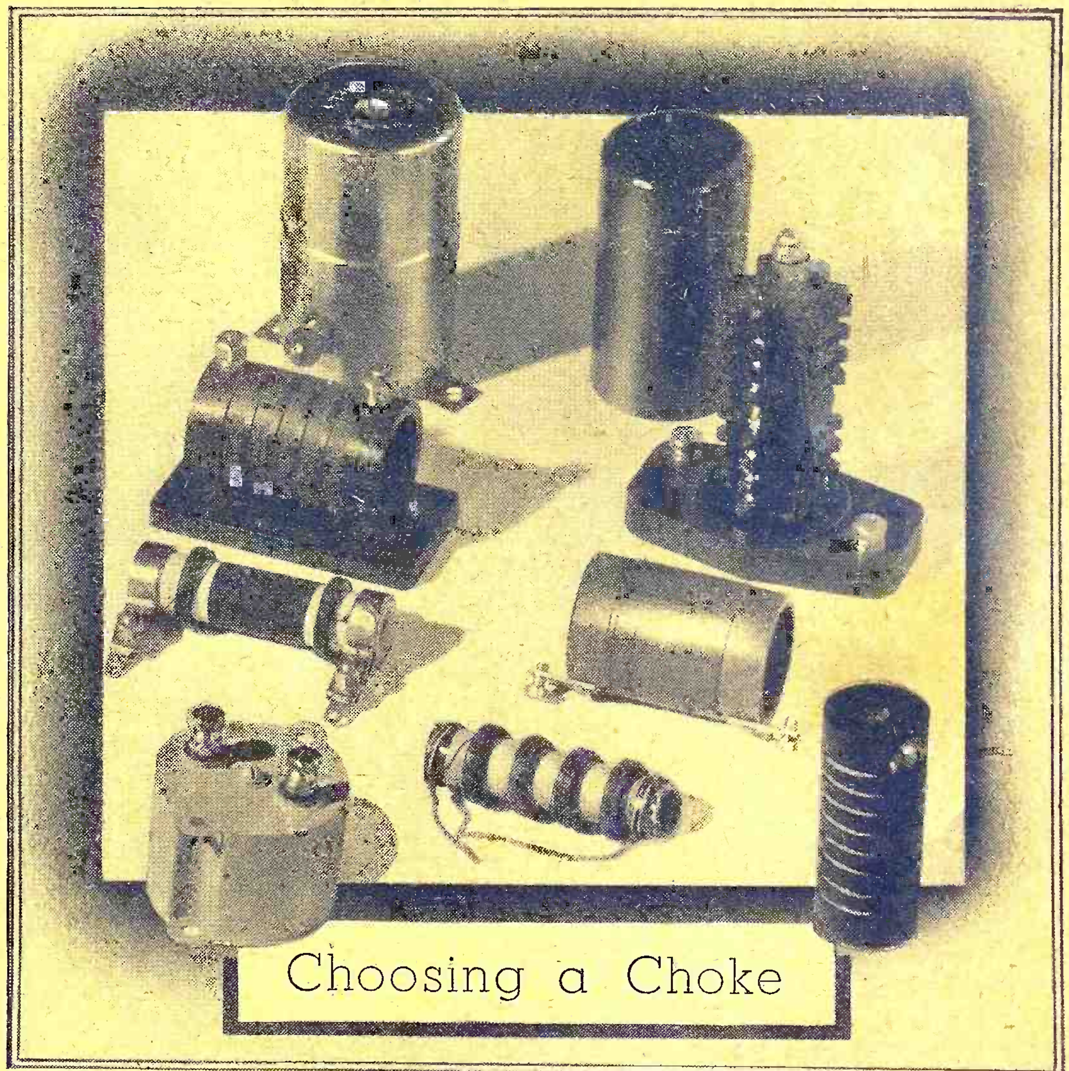
Contents



Choosing a Choke

Practical Wireless
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PRACTICAL WIRELESS

	Date of Issue.	No. of Blueprint.
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All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
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Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
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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
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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
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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
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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
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"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
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A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
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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.		
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One-valve : Blueprint, 1s.		
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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.		
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AMATEUR WIRELESS AND WIRELESS MAGAZINE

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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
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£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
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Minitube Three (SG, D, Trans)	Oct. '35	WM396
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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
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The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	Apr. '36	WM404
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New Class B Five (2 SG, D, LF, Class B)	—	WM340

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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.

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Family Portable (HF, D, RC, Trans)	—	AW447
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Rome Short-Waver	—	AW452
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Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
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Four-valve : Blueprints, 1s. 6d. each.		
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De Luxe Concert A.C. Electrogram (1/-)	Mar. '36	WM403
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Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
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EDITED BY
F. J. CAMM
Staff:
W. J. DELANEY, FRANK PRESTON,
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Choosing a Component

MANY beginners are confused when looking through radio catalogues by the wide ranges offered in some single lines. Coils may be all classed under one heading and all modern coils are designed to cover a given range, being wound to inductance values set out by the Component Manufacturers' Federation. L.F. transformers, however, are available with various ratios and inductance values and these confuse some constructors. Similarly, there are many different patterns of H.F. choke, and this is a most important item in some circuits. Accordingly, in this issue, and also in the next, we endeavour to explain the functions of chokes in various circuits and how to determine the type of component for separate purposes. Resistances also have various ratings and this again offers some confusion. The values are, however, fixed according to the voltage to be dropped or the purpose for which they are required and the wattage may easily be calculated. It is the same with most other components, but the choke is undoubtedly the chief stumbling block and we think the various difficulties will be easily overcome when the facts are properly understood.

Thirsty Work

THE fourth in the series of Maurice Brown's "Thirsty Work" programmes is to be broadcast to the Forces on June 14th. This time, Brown has taken the B.B.C.'s mobile recording unit to a village on the borders of Northamptonshire and Rutlandshire where he found some excellent singing in the local inn. This programme will be slightly different from the three previous ones in so far as it will not be purely local. The songs listeners with the Forces will hear are of a more general character and one number includes animal noises. The artists in the programme will include a gamekeeper, a forester and farm-labourers.

Second Film Festival

ONE of the richest scores in film musicals of the last few years belongs to the recently released "The Wizard of Oz." It is possible that Jack Beaver's radio version of the score was even more colourful than the original; certainly it contributed considerably to the success of the broadcast. The revival of the radio version of this odd but successful adaptation of a classic American fairy tale will be broadcast on June 17th, within three months of its first production, and will be second in the impressive list that makes up "Film Festival." Douglas Moodie will produce and it is expected that Celia Lipton will again delight with her singing of "Over the Rainbow," in the part of Dorothy, the little girl who is whisked away on the crest of a tornado, to the wonderful land of Oz.

A modern portable field radio transmitter and receiver. Note the aerial-earth arrangement and battery supplies.

Editorial and Advertisement Offices:
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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.

My Day's Work

SPEAKERS in the series entitled "My Day's Work," to be broadcast on June 15th, will be Albert Jennens, who will describe his job in a big glass works in North-West Worcestershire; Walter Levick, of Tamworth, who will tell how he keeps the "roads" clear in a coal mine; an interview with George Jones (the Warwickshire Miners' Secretary), and H. Van Bylevelt, manager of a cycle depot in Birmingham, who will give some hints to those who, owing to the petrol control, are riding a bicycle for the first time.

"Rhapsody in Black"

"THE Music Goes Round—And Round" came to the end of a most successful run a few weeks ago, and listeners to afternoon programmes have probably missed this weekly spot of sparkle and sophistication. However, Roy Speer, its producer, and James Dyrenforth, its new-style compère, have put their heads together and already announce a successor called "Rhapsody in Black." This series, which begins on June 19th, will bring to the microphone the Negro in all his moods—from the splendid simplicity and intensity of the spiritual to the amazing rhythms and other manifestations of Harlem and New Orleans.

Maurice Winnick and His Band

MAURICE WINNICK has just finished his successful season at the Dorchester, where he has won high praise from the connoisseurs on his particular rendering of swing; and on June 16th he will broadcast as the band of the week. This is Winnick's first visit to the particular B.B.C. provincial studio from which he is to broadcast, though probably not his first engagement in the city itself, as he is a much travelled man, who had toured most of the music-halls of Britain with his own band before he was twenty-one years old. Perhaps he developed his taste for travel in his first job in a cinema orchestra, and made up his mind as he accompanied with appropriate music the exotic scenes of the silver screen before him, that he would visit those scenes himself. Anyway, Maurice took on the job as band-leader on one luxury liner after another, and his job took him three times round the world. He studied dance music in New York, and learned there to play the clarinet and the saxophone; but the violin is the instrument which he prefers, and with that he leads the first-class band he is conducting to-day.

A Simple Capacity Tester

A Handy Bridge for Measuring the Values of Condensers and Other Capacities

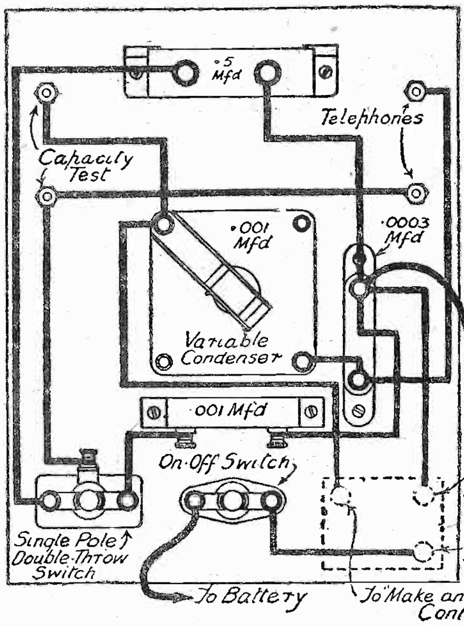

Fig. 1.—Wiring diagram of the simple capacity tester.

THE necessity for some simple form of apparatus for capacity measurement, such as that described here, must have been felt at one time or another by every wireless enthusiast. The time and labour of fault location in service work on commercial receivers may be reduced with such gear. To the experimenter, of course, there are innumerable ways in which the ability to measure capacities will prove of interest and value.

The bridge described here is extremely effective, employing as far as possible parts which constructors are likely to have on hand, or which, at any rate, may be purchased with very little outlay.

How It Works

The action of the instrument is very easy to understand. If an alternating or intermittent potential such as that obtained from a buzzer is applied across the points A and B of the bridge circuit, shown in Fig. 2, the current may be considered to take two paths—one through the point C and the two condensers in this arm, and the other through D and the two condensers in this arm. Now it is possible by so arranging the values of the four condensers to obtain a condition when the potential at C is the same as that at D.

In this case no current will flow through the telephones which are connected across these points, and no note will be heard. This is actually secured when the capacity AC bears the same ratio to the capacity CB as the capacity AD does to DB. Thus, if AC is .0003 mfd. and CB three times as much, AD could be practically any value, and so long as DB was three times the value of AD no note would be heard. By making the capacity in AC variable it is possible to calculate any unknown capacity connected in AD, provided AC has a suitably calibrated scale and the unknown condenser is within the working range. The range of measurement available by tuning AC from zero to maximum will depend upon the choice of the value of DB.

The values used here have been chosen by calculation and experiment to give two ranges of capacity measurement most useful for receiver test work while using the condensers which are most likely to be on hand. So long as the circuit arrangement and capacity values are adhered to, it matters very little as to the actual layout or form of the unit. The variable capacity must have a maximum of .001 mfd. to give a sufficiently wide range, and in the case of the original model two .0005 mfd. mica dielectric ganged condensers were used, but one of the old straight-line capacity type of .001 mfd. would be equally suitable. These are very often to be had from wireless stores.

Use a "mosquito" or high-note buzzer for preference, and one which is not too noisy mechanically, otherwise the note in the earphones will be drowned by the vibration of the armature.

Construction

Wiring and construction should present no difficulties, since there is surprisingly little complication about the unit. It should be possible to assemble and complete the whole job in an hour or two. When the bridge is ready for work the scale must, of course, be calibrated on both ranges, and while this presents no difficulties, suitable fixed condensers of marked capacity must be available. For the first range two or three or more condensers between .0001 mfd. and .004 mfd. are required. These should be connected in turn to the "capacity test" terminals, starting with the smallest capacity and increasing in steps. Switch on the buzzer and set the single-pole double-throw switch for the right range (the .001 mfd. in circuit for the lower range, and the .5 mfd. for the higher), then tune the .001 mfd. variable for minimum signals.

Each zero position obtained should be marked accordingly. For the second range values between .1 mfd. and 2 mfd. are required. It should be noted that with three or four condensers practically the whole of the range may be covered by series and parallel connections. For example, a .0002 mfd. and a .0003 mfd. will give readings for the individual values, and also for .0005 mfd. when joined in parallel. Two .5 mfd. condensers will give .25, .5 and 1 mfd. readings, and so on.

The scale may be calibrated directly, that is, the actual capacity values written on the scale, or, alternatively, a scale divided into degrees can be used and the readings plotted in the form of a graph. The first method is somewhat simpler and quicker to read, while the second method enables intermediate values to be estimated from the curves plotted with three or four points. Where the first method is used it is a good idea to make the pointer double ended, in which case one half of the circle may be used for the lower range, and the opposite half for the higher range, thus avoiding confusion between the two sets of figures.

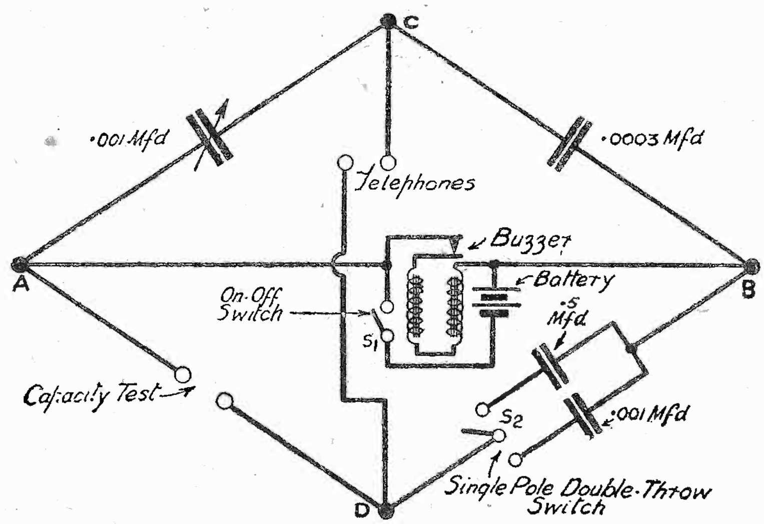

Fig. 2.—Theoretical circuit diagram.

For The Beginner

CHOOSING A CHOKE—1

Details of Various Chokes, and Their Importance in the Circuit

AMONG the various types of components which go to make up a radio receiver, there is one class which seems to be rather neglected—namely, chokes. This may be due in part to the somewhat insignificant form of its diagrammatic representation, and in part to the fact that in many cases—though not in all—the exact value of its electrical properties is not so critical, so far as circuit efficiency is concerned, as those of, say, a tuning coil or a variable condenser.

But, however this may be, chokes of one type or another do play rather important parts in the receiving equipment of to-day, and when it is desired to purchase one it is well worth choosing a type which is in every way suitable to the job in hand and likely to give long and satisfactory service.

Functions of a Choke

In order to be able to make a wise selection, however, it is necessary to understand exactly what a choke is, and what are its functions in a circuit, as well as the different kinds of chokes, which have been evolved for different purposes. To begin with, then, a choke is, essentially, a coil of wire, and its principal property, on account of which it finds application in radio circuits, is impedance. This at once calls for further explanation.

You all know that when a direct current is passed through any piece of apparatus, the value of the current flowing is limited by what is known as the *resistance* of the apparatus, resistance being the opposition which the apparatus offers to the flow of current. If, instead of passing a direct current through the apparatus, we apply an alternating current, the apparent resistance may, or may not, be the same as when a direct current was applied. If the apparatus consists of or contains a coil of any kind, the apparent resistance to alternating current will be much greater. In fact, it is possible to design a coil which has a very small resistance to direct-current flow, but a very large apparent resistance to the passage of an alternating current—and such a coil is called a choke.

Impedance

Now why should a coil offer a higher opposition to alternating current than to direct current? The answer is, because it possesses the property of inductance. As the alternating current grows from its zero value to its maximum value, a magnetic field is built up in the coil and its neighbourhood, and the growth of the magnetic field within the coil *induces* another electromotive force in the coil, in opposition to that originally applied, and thus tending to prevent the original current from flowing. Similarly, when the alternating current is dying away, a back "E.M.F." is self-induced, tending to maintain the flow. The coil thus presents a different form of opposition from that due to pure resistance, although its effect is precisely similar, that is to say, it limits the value of the current. This opposition is termed "impedance," and it is measured in ohms in the same way as resistance.

One point must be made clear—every choke has, in addition to its impedance, which is only operative on alternating current—a certain amount of resistance, which is effective with both direct and alternating current. The resistance, apart from any increase owing to high-frequency effects, is unvarying in value, and depends entirely upon the length, diameter and material of the wire. The impedance, on the other hand, is not constant in value—it varies according to the frequency of the alternating current, being higher at high frequencies than at low frequencies. This is because the "back E.M.F." depends upon the rate at which the magnetic field changes, and the rate of change is, of course, greater when the frequency is higher.

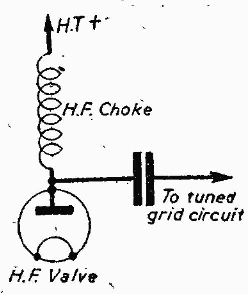

Fig. 1. — The position of the choke in a standard H.F. stage.

It is for this reason that a choke should never be specified as a choke of so many ohms impedance, because although it is possible to measure the impedance, it is necessary to state at what frequency the measurement is made. It is customary, therefore, to specify a choke as of so many henries or microhenries inductance, for, knowing the inductance, it is possible to calculate the impedance at a given frequency. This is, however, seldom necessary on the part of the constructor, as in most set designs the correct inductance is quoted.

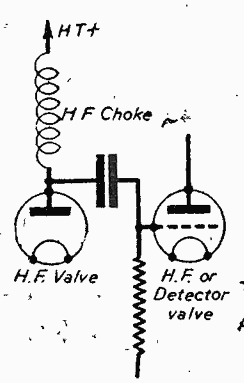

Fig. 2. — Aperiodic H.F. coupling includes a choke as shown here.

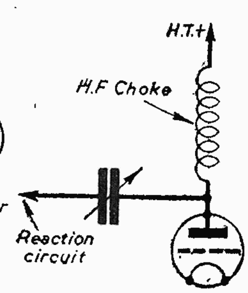

Fig. 3.—The standard reaction H.F. choke.

H.F. Chokes

Now let us see in what ways the special properties of chokes are employed in radio circuits. Chokes are used for various purposes in both the radio-frequency and low-frequency portions of receivers, as well as in power supply units. We will begin with high-frequency chokes. Their applications are many, but in all cases they are used primarily to "choke back" or block the passage of high-frequency currents—hence their name. For example, a choke is frequently inserted in the anode circuit of a high-frequency valve, between the anode and the H.T.+ terminal (Fig. 1), its object being to permit the flow of the mean anode current, but to oppose the flow of the radio-frequency variations, which are by-passed via the coupling condenser to the tuned grid circuit of the detector valve. Of course, it is not absolutely necessary to use choke-fed tuned-grid coupling—the older tuned-anode circuit is just as effective, but tuned-grid coupling has the advantage that the moving plates of the tuning condenser may be earthed because the coupling condenser isolates the tuned circuit from the H.T. supply.

Then a high-frequency choke is often used in the anode circuit of a high-frequency valve without a tuned-grid coupling, in such sets as portables (see Fig. 2). Its action is very similar to the first application except that the extra amplification obtainable with the tuned circuit is not achieved. A third use for a high-frequency choke is in the anode circuit of a detector valve, as indicated in Fig. 3. Here its function is to pass the direct current component of the anode current and also the low-frequency modulation, at the same time, due to its high impedance at radio frequency, choking back the radio-frequency component which is thus diverted through the reaction coil.

Special H.F. Chokes

It is clear that chokes for any of these purposes should have as high an impedance as possible at the frequencies at which they will be operated. As the range of frequencies to be covered in radio reception is very wide, it has been found impossible to design one type of choke which can be used indiscriminately on all frequencies. There have, therefore, been developed what may be termed "general purpose" high-frequency chokes, suitable for use on either the medium or long broadcast bands. These are the chokes usually specified in normal broadcast receivers. For short-wave working, special short-wave chokes are marketed.

On the other hand, for use in superheterodyne receivers, on the intermediate-frequency side, owing to the lower frequency, it is necessary to employ chokes of higher inductance than for ordinary straight broadcast receivers. For use in the anode circuit of a detector valve as in Fig. 3, a choke of the standard type is correct.

The first point to make certain when choosing a high-frequency choke, therefore, is that it is of a type suitable for the frequency upon which it will be used—or rather the band of frequencies. This will be clearly stated by the maker, and you can hardly go wrong on this score if you tell your dealer for what purpose you require to use the choke. Practical values for H.F. chokes are given in the table overpage.

Next, we must pay attention to the design of the choke. In order to obtain

(*Continued on next page.*)

CHOOSING A CHOKE

(*Continued from previous page.*)

the necessary amount of inductance, a large number of turns of wire have to be wound on the choke. These turns act as the plates of small condensers, so that there is a tendency for the high-frequency current to pass from turn to turn through this self-capacity, thus defeating the object of the choke, which is to block off one circuit to the passage of the high-frequency current and shunt it along another path. The higher the frequency the easier it is for the radio-frequency current to take this short cut past the choke; so another feature of a good high-frequency choke is low self-capacity—or what is termed low-loss construction. This is particularly important in the case of short-wave chokes.

Purpose	*Inductance*	*Self Capacity*	*D.C. Resistance*
Coupling for S.G. valves ..	200,000/500,000	1/3 mmfd.	200/500
Standard H.F. Coupling..	100,000/200,000	2/4 mmfd.	300/800
Ordinary reaction ..	50,000/200,000	1/3 mmfd.	200/700

The next point calling for attention is the matter of interaction. It is obvious that a choke comprising a number of turns of wire will produce a considerable magnetic field of its own, and the magnetic effects may cause unwanted coupling with other parts of the circuit, resulting in instability. Conversely, the windings of the choke may in their turn pick up either by magnetic or electrostatic coupling, impulses from some other part of the set, which again might introduce unstable operation.

Reducing Interaction

The self-field of a choke can be reduced by winding the coil in binocular form, i.e., as two coils side by side. This results in a much more concentrated field, having very much smaller external influence. For many purposes, however, especially in modern sets, it is desirable to screen the high-frequency chokes by enclosing them completely in metal cans or covers. Here, however, a further risk may be introduced, for if the screen is so designed as to be close to the choke winding, the screen and the choke will in their turn act as the plates of a condenser, and valuable high-frequency energy will be by-passed to earth and lost. Hence in selecting a screened H.F. choke, choose one in which there is generous spacing between the windings and the case.

Finally, the general mechanical design of the choke should be sound. We must usually trust to the maker to see that all internal connections are well made, and the winding properly insulated between sections and between the wire and the case. But we can select types which have sensible terminals or connecting-lugs, and fixing holes which are in convenient positions, and will take screws or bolts of reasonable size, and we can see to it, too, that the choke we buy is of a general design which will withstand normal usage without damage.

Converting or Adapting?

Clearing Up a Present-day Problem

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

IN PRACTICAL WIRELESS, dated May 25th, some interesting practical notes were furnished concerning the use of a short-wave converter, and at the same time mention was made of the use of an adapter. There always appears to be a certain measure of confusion existing concerning the exact functions of these two units, and as at the present time there are many people who are turning their attention to the short-wave end of the spectrum it is useful to examine the position in regard to the two ways in which the home receiver may be made to function, although the normal range is only medium and long waves. There is little doubt that for the very best results it is preferable to employ a short-wave or ultra-short wave receiver designed solely for this purpose, but questions of expense arise, and provided the home set would normally be inactive during those periods when short and/or ultra-short wave listening is to be indulged in, then on the face of it there seems no reason why this set should not play its part.

Different Functions

Regarding the two units themselves an adapter is usually a short-wave detector which is designed to cover the short or ultra-short wave band, or both, and is plugged into the detector stage of the ordinary broadcast set so as to adapt it to its new purpose. The term converter, on the other hand, is used when the device functions as a result of changing one frequency into another frequency which comes within the scope or range of the home set. The double combination then becomes a superheterodyne receiver, the high frequency side of the home set working as the intermediate frequency amplifier.

With these two facts clearly in one's mind it is now a much simpler matter to see which method is better suited to meet individual requirements. Turning to the adapter first, since only the low frequency side of the home set is to be brought into commission, the quality of the results obtained will depend very much on the degree of audio gain existing, and also the frequency response. One thing that must be guarded against is insensitivity in the adapter unit. If long range working is not desired then a straightforward detector circuit alone, similar to those which from time to time have been featured in these pages, will suffice. A series of plug-in coils may be used to cover the necessary band, but it is neater and less troublesome to use a multi-range coil, provided it has efficient switching incorporated, and is properly screened. So many of these units fail because of poor switching, so be sure to obtain a coil from a manufacturer of repute.

Increasing Range

When it is felt desirable to increase the listening range of the adapter, then a stage of high-frequency amplification can be made to precede the detector valve, and this two-valve combination can then work in conjunction with the audio-frequency side of the home set. Give the adapter a good chance to prove its efficiency by using a satisfactory aerial installation, and if working on the ultra-short waves study the notes published recently in PRACTICAL WIRELESS in order to ensure that any dipole arrangement falls within its correct category. Pay particular attention to the disposition and length of interconnecting leads between the adapter and set, otherwise instability will mar the working. If the home receiver is A.C. mains driven, remember that by cutting out the normal H.F. and detector loads the volts from the rectifier unit will rise. This may cause trouble, and if the same rectifier unit is not employed to feed the adapter, then it may be found advisable to introduce a dummy load to equal the watts consumed by the non-working part of the home set.

Converter Unit

Coming now to the converter unit, it must be remembered that this functions by making the high frequency section of the domestic set into an intermediate frequency amplifier of a superheterodyne set. This part of the home set should therefore be very efficient, and as a general rule the receiver itself is left tuned at some position on the long-wave band—the best setting is found by experiment—and all ordinary tuning is undertaken with the converter unit. This can be a first detector only, or when higher sensitivity is desired, and more distant listening is necessary, then the detector stage can be preceded by a high frequency stage. For useful working details the reader is referred to page 218 of PRACTICAL WIRELESS, dated May 25th, where a typical H.F. and detector converter unit circuit was described.

On the score of cost it is generally found that the adapter is cheaper, but when performance is of the greatest importance the converter is usually capable of providing the better results. Very useful operating knowledge of the short and ultra-short wave bands will be acquired, and this will pave the way to the ultimate desire of constructing a special complete set which can be used independently of the one doing duty for domestic listening.

ON YOUR WAVELENGTH

By Thermion

Car Radio Taboo

THE Postmaster-General has announced that a Defence Regulation dated May 29th provides that apart from certain authorised exceptions, no person shall use, or have in his possession, or under his control, any wireless receiving apparatus installed in any road vehicle. Any wireless receiving apparatus, even if it is not fixed in position—for example, a portable set —will be deemed for the purpose of the regulation to be installed in a vehicle if it is in the vehicle in such circumstances that it can be used or readily adapted for use. On May 31st the Postmaster-General cancelled all ordinary wireless receiving licences for the installation and working of wireless apparatus in road vehicles. In the absence of special authority, therefore, all persons who have wireless apparatus in motor-cars, or other road vehicles, must take immediate steps to remove all such apparatus, including aerials, from these vehicles. As the time limit set was June 2nd, no doubt all motorists have complied with this new regulation by this time.

The regulation applies whether the vehicle is in use or laid up, but the wireless licences in respect of these vehicles should be retained by the owners. No refund of licence fees can be made, but the question whether any allowance can be made in respect of their unexpired periods will be considered when the time comes to remove the present embargo, and to issue fresh licences for the use of wireless apparatus in road vehicles.

I am surprised, however, that the Minister has ignored the possibility of bicycles carrying portable transmitting and receiving apparatus. Such vehicles should have been included in the Order, in my view. Also, it seems to me that it will be highly dangerous for a member of the public to purchase a portable set and carry it home by car. I do not know whether this will restrict the sale of portables, because people will be apprehensive that the possession of such an instrument may land them into trouble. Obviously, a picnic party seen strolling towards some fields with a hamper and a portable wireless set would be suspect.

Reserved Occupations

THERE seems little likelihood that the schedule of reserved occupations will impose higher age limits on those engaged in the skilled sections of the wireless industry. I mention this because some newspapers have been indulging in wishful thinking, and spreading false information about the intentions of the Ministry of Labour.

Licence Figures

THE U.I.R. (Union Internationale de Radiodiffusion) recently published a table giving the number of licences for wireless receivers issued in each country. Here it is: Belgium, 1,148,659; Denmark, 834,565; Dutch East Indies, 90,385; Estonia, 90,876; Germany, 13,945,022; Hungary, 511,410; Iceland, 16,755; Ireland, 169,392; Italy, 1,135,000; Japan, 4,666,058; Latvia, 154,106; Lithuania, 79,081; Palestine, 43,777; Portugal, 90,856; Rumania, 319,708; Switzerland, 605,574; Yugoslavia Belgrad, 107,785; Ljubljana, 22,151; Zagreb, 35,433.

Radio Engineers' Manual

THE "Radio Engineers' Manual" which we are publishing in pocket-book form will be issued very shortly. I make this statement in reply to those readers who are anxious to obtain a copy. When it is ready the usual announcements will be made in this journal.

Fourpence a Week

THERE has been a gratifying number of letters from readers thanking us for increasing the price to 4d. rather than adopting the alternative of reducing the number of pages. All readers seem aware of the difficulties with which publishers and editors have to contend at the present time.

An All-dry Receiver

HITHERTO all-dry valves have not been available to members of the public. I understand, however, that they are now released, and that the Editor is designing a receiver incorporating them. Such a receiver will be of immense use to our readers in the Army, to air-raid wardens, and to others who for one reason or another are without accumulator charging facilities.

Newly-trained Citizen Airmen

SOME months ago a Second-Class Aircraftman arrived at an R.A.F. Initial Training Wing. He was then merely a transported civilian; to-day he is a transformed Service man. He is a finished product of the "I.T.W.," and as a Leading Aircraftman awaits his posting to a Flying School.

What has happened to this man since the day he walked into the Service? He has learned the new and improved foot drill syllabus. He is no guardsman, perhaps, but he is a smart airman and that, in itself, is a credit both to himself and his instructor. He has completed a physical training course from which he has learned that the business of maintaining a healthy body can be effected under the guise of thoroughly enjoyable exercise.

He has revised his mathematics up to matriculation standard. He has learned to receive and transmit morse code messages at useful working speed. He has become thoroughly acquainted with the operation and mechanism of the more widely used Service armaments. He has learned the rudiments of air navigation. And, more practical than any of these, he has completed a course on the visual Link Trainer, and so has a theoretical knowledge of the proper handling of an aircraft.

Moreover, he has been imbued with a spirit of discipline which has not robbed him of his individuality, or his initiative, but has brought home to him a keener realisation of the trust that has been placed in him. At the same time he has been taught Service etiquette and the *modus vivendi* of Service life. He is not an automaton; he is one of the thousands of new citizen-airmen of the British Empire.

Air Force Require Radio Men

MEN up to 50 can now serve in the Royal Air Force provided they have experience in radio work. A new class of entry has just been created to provide personnel for the maintenance of Air Force wireless equipment of various types. The age limits for radio trade entrants are from 18 to 50.

Large numbers of pilots, air observers and wireless operator/air gunners are required for the R.A.F. at the moment. Young men of good education, with dash and initiative—especially those in age groups which have not yet been registered—are asked to volunteer now.

Application can be made at any Combined Recruiting Office; or to any local Labour Exchange.

Jamming Haw-Haw

I SEE that one of the daily papers has worked itself into a fine frenzy over the amusing broadcasts of Lord Haw-Haw. The daily paper seriously suggests that the time has come for the ruthless and continuous jamming of Haw-Haw. This, they think, will choke the pestilential lies thrown so glibly into the air by Goebbels. They go on to suggest that even if the Germans retaliated by jamming our radio, we could still, through our telephones, listen to our own broadcasts. This suggestion is too ridiculous to need much comment. Haw-Haw broadcasts in English, and as I have yet to discover any Englishman who takes the slightest serious notice of him, except when we want a little light entertainment, I cannot see why we should run the risk, even if that were possible, of retaliatory jamming measures. To suggest that we should listen over our telephones to our own broadcasts is just too absurd. In the first place, less than half of the listeners have telephones, and in the event of air attacks, we should not be able to listen in, as all telephonic communications will be suspended, as of course, will be the broadcasts. I suggest that newspapers should investigate the possibilities of their suggestions before they make themselves, as well as this country, look ridiculous. As most of them have a radio expert on the Staff, why are they not permitted to advise? Is it because some of the alleged experts themselves propound these amusing theses?

Comment, Chat and Criticism

Musical History—4

The Music of Bach and Handel, by Our Music Critic, MAURICE REEVE

At the close of the seventeenth century, music had "attained its majority"; it was now about to reach its maturity. It was to be launched on a course which it has followed down to our own day, only diverting from it to its own peril. Many of the writers already mentioned had produced works which have since achieved immortality. Harmony and melody of ineffable sweetness were at composers' command. The forms they fashioned in were for the most part small, and it was in this sphere that the coming century was to mark the greatest advance and achievement. The Beethoven Symphony had still a hundred years to wait, and Don Giovanni and the Chromatic Fantasy almost as long.

Range of Colours

The musician's palate had acquired a wide range of colours. The modern diatonic scale had reached its definitive form though chromatics were sparingly used. The dominant seventh, without preparation, was common in modulation, and figured bass was brought into practical use. Monteverdi is credited with being the inventor of the perfect cadence, and other writers as well as himself used the diminished triad. The orchestra did not yet include the violin, which may sound rather like talking of strawberries and cream only to find that there is no cream! But it was taking an ever larger part in things with the growth of opera, and the erection of opera houses and their permanent orchestras. The madrigal declined, and with its eclipse came that great wave of church music so indissolubly linked with the two names of Bach and Handel. But once the works of Couperin, Monteverdi, Scarlatti, Purcell, etc., had been assimilated, music could look forward with confidence and assurance to producing the men capable of leading it up to the heights which were so apparently destined for its occupation. It was not to be disappointed.

Bach and Handel were two such men. By the greatness of their vision and their grasp of the problems before them, they created work, far in advance of anything previously fashioned, or even conceived. Bach, in particular, was a most daring harmonist, and he has, to this day, remained the greatest of contrapuntists, and his organ works are still the pride and glory of all that instrument's repertoire, never having been surpassed in grandeur, nobility or technical resource.

Handel's Music

Whilst much of Handel's music remains unknown to all but the connoisseur, the "Messiah" has obtained such a unique position in the hearts and affections of the English-speaking peoples that Sir Henry Hadow does not exaggerate when he says that it might almost be regarded "as a part of Holy Writ." Whilst Bach was the great master of elaborate and complicated texture. Handel was one of the greatest melodists who ever lived. This is not meant to suggest that the one could not write fugues, nor the other beautiful melodies; far from it. But, broadly speaking, that is where their two styles lay. Both men's work is on the loftiest imaginative plane, Bach's perhaps especially owing to his lifelong association with the Church.

Although so closely associated in the minds of most people, and always thought of together and analysed as a pair, neither man ever met the other. In fact, there is no record of either having ever heard of the other or of the other's music!

Speaking idiomatically, these two great masters may be said to have conquered the musical world for Germany. It was certainly a conquest that lasted far longer than most of Germany's conquests in other domains! Actually, a dynasty of German giants followed them right down to Wagner and Strauss, and only to-day does German music show an appreciable decline from this supreme standard. The sequence of great names that Germany produced from Bach to Strauss is extraordinary, and not even the great lines of Italian or Dutch painters, or of English men of letters, surpasses it. The German musicians of the eighteenth century rescued music from the disgrace that was rapidly overtaking it at the hands of unworthy men elsewhere. As almost all of them were associated with the Church, it was but natural that their work should lay chiefly in the domain of church music or of music with a "churchy" flavour such as Bach's organ masterpieces.

Although this led to extremes of conservatism at the other end of the scale, it was just what music wanted to free it from the base and impure elements that had entered into it. After the pendulum had swung with equal violence in both directions, the even greater masters of the late eighteenth and early nineteenth centuries were to restore the equilibrium with a series of master works each containing a perfect amalgam of all that was best from the past plus their own genius and prophetic visions, balanced to an exact nicety, and to remain supreme for all time.

Of even greater importance to the future of music than the mere writing of magnificent works was Bach's insistence on "equal temperament" of the strings of the harpsichord. We have noted the establishment of major and minor keys, and the great increase and variety of modulation which they rendered possible. But a great difficulty still remained to be overcome. If a diatonic scale is exactly in tune, only the most closely related keys can be blended with it; any remoter relationship would sound intolerable. If you play on your piano these notes: C, E, G sharp, and the octave of C, you will notice that, on your keyboard, the top C is the exact octave of the bottom one, and that the intervals between each two notes is the same. But the true major third from G sharp is *B sharp* and not C, which are not one and the same note as you can prove by singing the notes instead of playing them. Furthermore, if you begin the sequence with B sharp instead of with C, you will get further and further away from the original tonality until any combination with it becomes impossible. Therefore, to modulate from D major to D flat major is impossible if both scales are accurately in tune, as one requires F sharp and the other G flat, which are not one and the same note.

Perfect Intonation

In Bach's day there were two ways of facing this problem. One was to merely accept "perfect" intonation together with the many restraints that it imposed on musical thought and development. The other was to abandon exact purity in order to obtain the enormous benefit of being able to employ every key within the framework of the one piece. Very much in the same way as in "summer-time," where we call twelve-o'clock eleven, in order to enjoy certain advantages which are denied us otherwise,, so "equal temperament" calls G flat and F sharp one and the same thing, for the sake of increasing the range and scope of musical composition. By "flattening" here and "sharpening" there—by telling a few "fibs," as one might say—everything that music has to offer is brought within the range of those big enough to use it. The rules governing whether a note shall be deemed G flat or F sharp are very strictly observed grammatically. But both are now combined in the one string, and the same key on the piano keyboard.

Bach took the side of the reformers, and proved his wisdom by writing his immortal "48 Preludes and Fugues in All Keys for the Well-tempered Clavier," works which display a range and variety of harmony, modulation and contrast that would have been impossible of achievement under the old rules, but which set the standard for all future ages.

Frequency Response

A Simple Explanation of Response Curves and Their Meaning, With the Methods of Drawing Them

RESPONSE, as applied to a receiver or amplifier, is generally understood as the variation in output for an input of given voltage over a range of frequencies. Thus it is customary to give a response curve or graph on which the output (or a factor representing variation in output) is plotted against the frequency of the input signal. It would be possible to show the output in milliwatts and the input in cycles per second, but it is more usual to plot frequency against a decibel scale. The graph would then be of the form shown in Fig. 1, which would indicate that the receiver or amplifier was in the "quality" class, since the output remains constant over a wide range of frequencies.

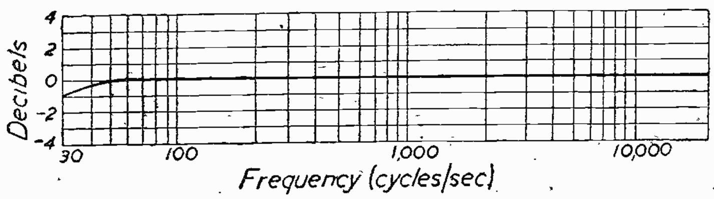

Fig. 1.—Response curve (practically "straight line") for a high-fidelity amplifier.

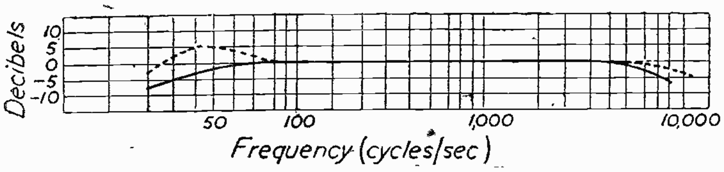

Fig. 2.—Curve for a well-known parallel-fed L.F. transformer. Broken lines show how the curve can be modified by changing circuit constants as explained in the text.

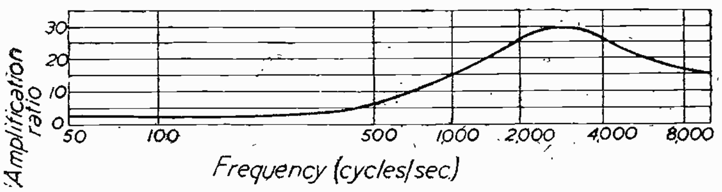

Fig. 4.—This transformer curve is of different form from that shown in Fig. 2, since frequency is plotted against amplification ratio.

The input is provided by means of a modulated oscillator, which must be a precision instrument if useful results are to be obtained, while the output may be read on an accurately calibrated output meter or valve voltmeter.

In addition to the complete set, individual components such as transformers, pick-ups and speakers can be tested for response, and curves drawn. Here again, it is now customary to plot frequency against a decibel scale.

Frequency Compensation

For present purposes it is not essential that the decibel system be fully understood (it was explained in our issue dated May 11th), for we are mainly concerned with the variation in output over the range of audible frequencies. Theoretically, a "straight-line curve"—consisting of a straight horizontal line—would indicate a perfect receiver, amplifier or component. In practice, however, that may not represent the ideal, since measurement of output might be made without the use of the speaker to be used with the set. And if the response curve of the speaker "dipped"

by The Experimenters

below, say, 150 cycles and above 2,000 cycles the audible output would fall below and above these points.

On the other hand, if the output from the receiver went up below 150 and above 2,000 cycles, the sound output may remain constant over the whole frequency band, due to the receiver compensating for the losses in the speaker. This principle can be applied to almost every component used in a receiver, for it is obvious that if losses in one component are evened up by corresponding gains (or negative losses) in another the output may still be "straight line."

There is another important point which should be considered. This is the scale to which the graph is drawn; if the scales are "open," variations in response are far more pronounced than if the divisions are "crowded." It is customary to use a logarithmic scale for frequency. This means that the distance from zero to 100 c/s is equal to that from 100 to 1,000 c/s, and from 1,000 to 10,000 c/s. Thus, the scale is more "open" at the lower frequency end.

Fig. 2 shows a response curve for a well-known L.F. transformer of the parallel-fed type. It will be seen that it gives uniform amplification to audio frequencies between approximately 110 and 12,000 c/s, but that the amplification falls off at either end of this range. That is usual in all transformers in the lower-price range, but it is possible to obtain transformers which give "straight line" output from as low as 50 cycles to well over 10,000 cycles. Although components of this type are excellent when used with valves for which they were designed they may be no more satisfactory than others costing far less if used in conjunction with any other valves or in a circuit other than that for which they were primarily intended.

Aural Effects

In considering frequency response it is also necessary to bear in mind that, for practical purposes, the ear plays an important part. Its sensitiveness is comparatively low at frequencies below about 100 cycles and above about 6,000 cycles. The importance of this is especially pronounced at the low-frequency end of the audio range. Because of this, frequencies below 100 cycles are almost inaudible to many people, and particularly when accompanied by harmonics. For example, the frequency range of a piano is from 70 to 6,500 cycles, but few people would recognise any difference if, in reproducing piano music, a receiver did not respond to frequencies outside a range of about 100 to 5,000 cycles.

There is another important aspect of the question, which is concerned with the setting of the volume control. If the volume seemed (to the ear) to be constant over the frequency band between, say, 50 and 10,000 cycles with the volume control turned full

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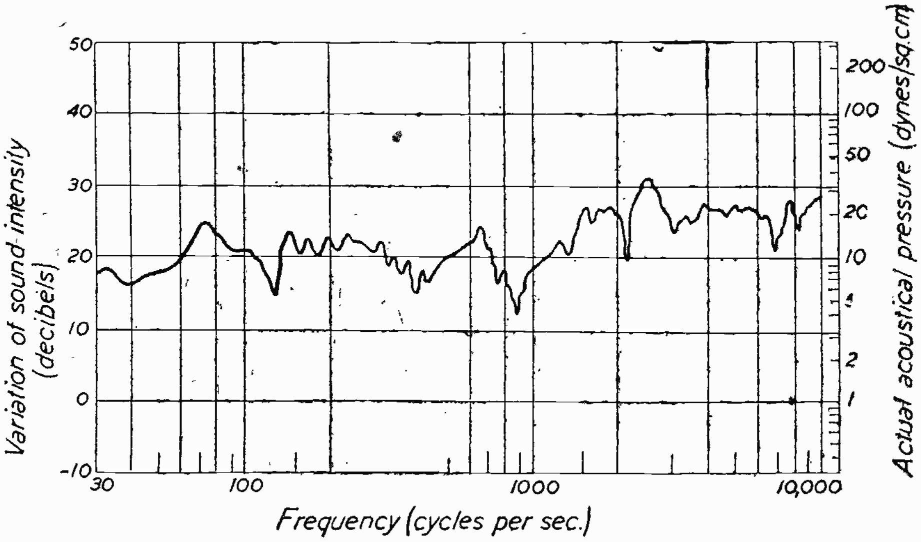


Fig. 3.—A scientific method of plotting a response graph for a high-grade loudspeaker. This is more "detailed" than usual, for in most cases the graph is drawn as a smooth curve.

FREQUENCY RESPONSE

(Continued from previous page)

on, this condition would not apply when the control was turned down. In fact, if volume were reduced so that a 1,000-cycle note (to which the average ear gives maximum response) were just comfortably audible, frequencies below 25 cycles would probably be completely inaudible, whilst frequencies over about 3,000 cycles would scarcely be heard. This is the reason why various methods have been employed with "quality" amplifiers to combine a tone control with the volume control. It also helps to explain why it is often claimed that good quality reproduction is impossible when the output is less than 5 watts, even for a receiver used in the home.

Sound Output as Air Pressure

It is not an easy matter to measure output in terms of sound, or rather in terms of air pressure, which is a measure of sound as it strikes the ear drum, but by the use of special apparatus such measurements can be made. Thus we may have a graph similar to that shown in Fig. 3, which is a copy of one prepared by the National Physical Laboratory for a certain loudspeaker. It will be seen that variation in sound intensity is plotted against a frequency scale, whilst on the right of the graph there is a scale referring to the acoustic pressure. Despite the fact that the response curve in this case is a very wavy line the speaker to which it refers is a high-grade instrument. This becomes more evident if a mean or average line is drawn through the wavy one, or if it is noted that the variation in acoustic pressure does not fall below 5 or rise above 35 dynes/sq. cm. The latter expression, by the way, is simply a measure of pressure corresponding to the much larger units of lb./sq. in.

Modifying the Response

As another sidelight on frequency response it is interesting to refer to Fig. 2, where broken lines are shown as "offshoots" of the main curve. These show how the frequency response of the parallel-fed transformer represented can be varied by changing the capacity of the feed condenser. The full line shows the response when using a condenser having the usual capacity for this position of .5 mfd., whereas the broken lines at the bass end of the scale shows the change brought about when the capacity is reduced to .1 mfd. This means that, in this case, the use of the lower capacity gives a "bass lift." The broken line extending to the right of the curve shows the effect of connecting a .5-megohm resistor across the secondary terminals.

Another method of drawing a transformer response curve is shown in Fig. 4, where it will be seen that the vertical scale represents the amplification ratio, the base line showing frequency, as before. Fig. 4 actually refers to a poor transformer. The curve rises steeply to about 3,000 c/s and falls almost to zero at 50 c/s. A curve for a good transformer, correctly used drawn to this scale would be very similar, in shape to that given in Fig. 2.

How Frequency Modulation Works

A Simple Explanation of the New Transmitting System

MANY listeners have heard that a system of broadcasting has been tried out and adopted in certain parts of the U.S.A. which is claimed to be a great improvement on existing systems. This new arrangement is known as frequency modulation, and in view of the increasing interest which is being shown in it the following details will, no doubt, prove of interest. They are taken from a talk by Lee McCanne, of the Stromberg-Carlson Mfg. Co., and are reprinted from the American publication "Radio To-day."

Just what *is* Frequency Modulation? And how does it differ from Amplitude Modulation, the kind of radio broadcasting we have all been hearing up to now? It is simply a different method of superimposing the programme on to the carrier wave. Let us see what it looks like on the charts on these pages.

Now whether we are dealing with Amplitude Modulation or Frequency Modulation, we start with the same kind of radio carrier wave, and also the same kind of telephone current "programme wave" as picked up by the microphone. With Amplitude Modulation, the programme wave is combined with the carrier in such a way as to change the *power* of the resultant wave. It adds to the power part of the time, and subtracts from the power another part of the time so that the wave radiated by the broadcasting station appears as shown at (c).

Broadcast Advantage

In Frequency Modulation the same programme wave does not change the power of the carrier at all but is made to change its *frequency*, speeding up the carrier-wave part of the time and slowing it down another part of the time so that the resultant wave from a Frequency Modulation station looks like (d).

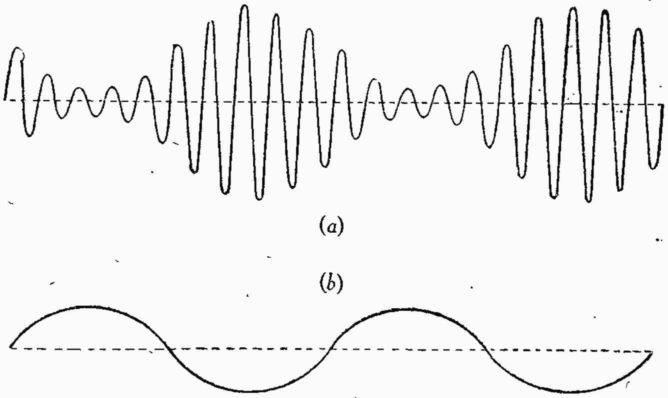
The chart shows you immediately the advantage which Frequency Modulation offers to the broadcasting station. The programme is superimposed on the carrier without changing its power. In other words, the broadcasting station operates at full power all the time. That means that it can be much more efficient, use less valves, less current and even save man power—because the management can let the transmitter run "wide open" all the time and does not have to have an engineer who is also a trained musician constantly watching a volume indicator, ready to turn the volume up when the programme level gets lost in the background noise, and to turn it down when a soprano hugs the microphone or the orchestra plays too loud.

In Amplitude Modulation, the broadcasting station has to be built to handle *four times the rated* power of the station on volume peaks. The Stromberg-Carlson station WHAM, for example, is rated at 50,000 watts but it has to be built with a large enough power supply, valves, tuning system, and aerial to handle 200,000 watts, and it would even go above *that* if the engineer was not there to turn the volume down when he sees his volume indicator needle swinging too high. This compressing of the "dynamic volume range" in itself affects the musical quality of the programme. Suppose that an orchestra has enough instruments to make a maximum noise equivalent to "100 decibels" volume level when everyone is playing his hardest; an Amplitude broadcasting station might have to squeeze that volume range down to, say, 50 decibels, in order to keep the quiet passages up above valve noise and studio noise, and to bring the loud passages down within the capacity of the transmitter. In Frequency Modulation there are no volume peaks as regards the power being radiated; all that volume does is to swing the carrier frequency. So a 50,000 watt Frequency Modulation transmitter can be built to deliver 50,000 watts all the time, and handle the full dynamic volume range of the music.

"Limiter"; "Discriminator"

In a Frequency Modulation broadcasting station the microphone amplifier is made to affect the oscillator valve directly, changing the frequency of the carrier rather than being indirectly added to it by a mixer. At the receiving set you have the same six valve functions and two more; the detector circuit in a Frequency Modulation receiver uses *three* valves instead of one. One of these extra valves is called a "limiter" valve, and its purpose is to fix upon and assign control to the *strongest signal coming in* at the particular wavelength or frequency to which your receiver is tuned. Thus the strongest signal gets control.

The other extra valve is called a "discriminator," its function being to *wipe out any noise or signal* other than the strongest signal coming in. The discriminator also wipes out rather effectively any Amplitude Modulation station that might be broadcasting on the same wavelength to which you have tuned your Frequency Modulation



(a) Is a radio carrier wave of constant amplitude; and (b) is a programme or audio wave for modulating (a).

receiver and, since most static is essentially an Amplitude Modulation signal, the discriminator wipes that out, too. The effect is to eliminate natural static, man-made static, in fact, practically any kind of noise. A good Frequency Modulation system eliminates the carrier "hiss" and most of the valve noises from the broadcasting station as well as any hum modulation and valve noise in your receiver. You do not even know a Frequency Modulation radio is turned on until the music plays.

Static-free

That shows how little residual noise there is in this system. As one writer put it, this kind of radio can "transmit silence." (Of course, noise in the studio may still be picked up by the microphone. Also when Frequency Modulation stations are broadcasting gramophone records there may be some needle noise.) But in eliminating most of the noises and distortion that might occur, Frequency Modulation brings radio—from a tone quality standpoint—down to a simple static-free long-distance telephone system.

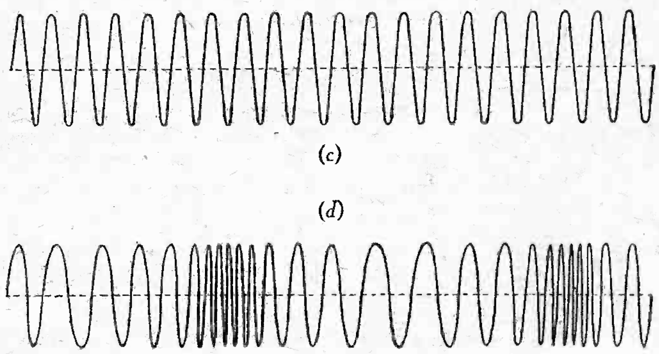
To show you how quiet and clear and static-free this new system is let me say that movie producers are interested in Frequency Modulation to give better sound recordings on their films. Under this plan, rather than taking portable sound-recording apparatus out "on location," which may be miles away from Hollywood, they will use the best sound recording equipment at the studio and will transmit the programme to that point by Frequency Modulation radio.

Before leaving this subject, let me point out why a Frequency Modulation receiver must be a little more expensive than an ordinary radio. Remember there are two more valves in the detector circuit, and a tuning eye is also desirable, so that a good Frequency Modulation radio should have eight or nine valves minimum. To take full advantages of the better FM tone, the audio amplifier stage must be a good Class A distortionless amplifier. The loudspeaker must be designed to respond to high tones and overtones beyond the range of many of the loudspeakers being produced to-day, and it must have a suitable baffle.

In Frequency Modulation, if the broadcasting station is an Armstrong wide-swing transmitter sending out high fidelity, then the *tuning system* of your receiving set must be designed to admit or *accept the full frequency swing* of that transmitter. Up to the detector valve, that receiver has to be good. Otherwise the whole reception is distorted. The receiver ought to be selective, too, against interference from the next FM channel, but it must accept the wide band of frequencies on each channel. That means, if you want a cheap FM receiver, the maker can economise on the cabinet, on the loudspeaker, and on the audio amplifier, but the *tuning system* must be good. And, since the tuning system is one of the most expensive parts of the whole receiving set, you might as well make the rest of it good enough for eight-octave reception.

No Station Clashes

Moreover, an eight-octave FM receiver is *worth* the extra cost because you will be able to get the full high-fidelity programme *without* static and *without* interference. That is the odd thing about FM. Frequency Modulation transmitters broadcasting *on the same channel* just do not interfere with each other unless possibly you are on the fringe area of both stations, right on the ragged edge of their service range. Otherwise, the strongest signal takes control and the other one is wiped out. To prove this, *three* FM transmitters all broadcasting different programmes on the *same* channel were set up. One was at Albany, another at Troy, the third at Schenectady—all 12 to 17 miles apart. Engineers went out with a receiver on a truck, trying to find a place where they could get interference—bring in two of these stations at once. They could not find it. In fact, that got down to a space of a few *inches*, that outside this space they would get only Troy or Albany or Schenectady—depending on which direction they moved the truck, while inside this small area the programme would flop back and forth from one station to another.



(c) is the carrier and audio wave combined in Amplitude Modulation, whilst (d) is the same combination in Frequency Modulation.

Two to Four Horizons

In the ultra-short waves, Frequency Modulation radio acts like light, and acts much like television as regards the range of the transmitters. Given enough power and a high aerial, Frequency Modulation stations seem to have a fairly reliable range up to two horizons and a possible service range (to listeners not located behind buildings or mountains or in valleys) up to four horizons. Height of the receiving aerial is important, as well as the height of the broadcasting aerial. This distance limitation is the one limitation to good Frequency Modulation broadcasting; it will be necessary to erect transmitters in every large population centre before we can all be assured of this new and better kind of reception.

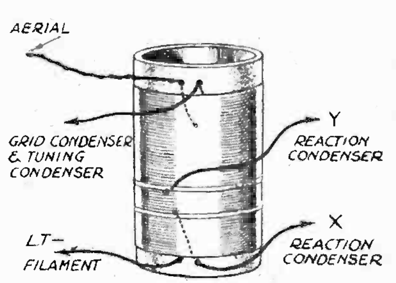
On the other hand, within its service range, a Frequency Modulation station gives *reliable* reception, day or night, even through thunderstorms. Listeners located at a distance from the city but within range of its FM transmitter will probably get better and quieter reception than they would from an AM transmitter in that same city. Listeners located beyond the range of the FM transmitter will, of course, have to rely on the AM station the same as heretofore. High-power cleared channel AM stations will probably always be needed, as will the International short-wave AM stations. For that reason the system proposed to the Communications Commission by the FM Broadcasters, Inc., is a combination of AM and FM stations whereby the cleared channels on the regular broadcast band will be used for long-distance and rural coverage, and FM channels will be used for reliable local service.

Coil for the Gas-mask Box Receiver

OWING to the fact that the constructional details of the coil used in the Gas-mask Box Receiver (which was described in our issue of May 11th, 1940) were given in our issue of September 30th, 1939, and that a great number of our readers appear to be without this particular copy, we reprint below the essential details. It will be noted that we have varied the original specification to suit the receiver mentioned above, by increasing the diameter of the coil former from 1⅝in. diameter to 2in. The length should be 2½in. A piece of ordinary postal cardboard tubing, or, better still, a length of paxolin tubing, can be used for the former. If cardboard is used, it is absolutely essential to see that it is perfectly dry; in fact, it is advisable to impregnate the tube after drying it in a slow oven for a few minutes. Ordinary shellac may be used for the impregnation.

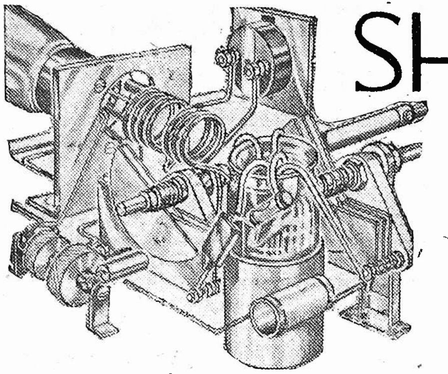
Winding Details

The actual winding is carried out with 22-gauge enamel wire, winding this with 70 turns close wound, that is, each turn lying close up to its neighbour. After 23 turns have been put on a tapping loop has to be made for the aerial and this is accomplished by doubling a length of the wire and pushing it through a hole in the former. It must be kept taut whilst the rest of the coil is wound. After the winding has been finished a length of paper or Empire Tape ½in. wide should be wrapped round the lower end of the winding, its position being about ¼in. from the lower end of the coil. On this insulator 20 turns of the 34 S.W.G. enamel wire are wound, and these must be in the same direction as the first winding. One way of anchoring the ends of this additional



Coil connection details for the Gas-mask Box Receiver.

winding is by means of sealing-wax or Chatterton's Compound, whilst another way is to pierce holes through the former, between the turns of the first winding. In this case great care must be taken not to scrape off the insulation where the wires cross.



SHORT-WAVE SECTION

S.W. SET IMPROVEMENTS.

Modifications to Existing Apparatus: Using a Mains Unit and Other Details for Obtaining Better Short-wave Results. By W. J. DELANEY.

MANY amateurs, when looking round to find some means of improving their apparatus, start to buy new parts or change components, generally without any idea as to the ultimate result of such modifications. It is worth while in such a case to start by thinking out the lines upon which one wishes to work, so that any changes which are made will

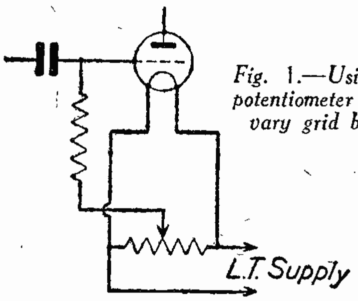


Fig. 1.—Using a potentiometer to vary grid bias.

lead to improved results and not to some doubtful working which may lead to further difficulties. For instance, a change in valves may be thought to give an improvement, but such a change may result in the need to modify a coupling or to use some different H.T. value, and this in turn may lead to inefficient working of another stage. These facts are more important in the case of short-wave apparatus as there is not so much latitude in this type of equipment. Furthermore, as it is desirous always to obtain the maximum performance from short-wave apparatus it is not possible to make do with what might be termed "makeshifts." Such ideas as fitting band-spread tuning have been mentioned many times in these pages, but there are other directions to which the keen experimenter may turn in an endeavour to improve, or "hot up" his apparatus, and the following will give some ideas upon which to draw.

New Components

In the way of new parts, modern short-wave apparatus may always be taken as an improvement upon old parts, especially those which have been primarily designed for normal broadcast use, but which have been included in a short-wave set. Tuning condensers, for instance, will be found in the modern short-wave sphere to have improved insulation, and this is one of the most important factors of short-wave apparatus. Insulation everywhere should be of the highest, and in addition to this, heavy gauge wiring should always be employed. If, therefore, your set is wired with fine wire, especially if this is capable of a fair degree of movement, it should be replaced by rigid wiring, and the leads should be kept as short as possible. Certain by-pass condensers could also be replaced by mica components if you are using those of the paper type. This, of course, would come under the heading of improved nsulation. Better quality valveholders would also be a worth-while change, whilst if terminal connections are employed it might also be desirable to make use of good solid soldered contacts wherever possible.

New Arrangements

The above details concern mainly modifications in parts, but there may also be found that a change in circuit design may be employed. Many amateurs have a circuit which they have found tried and tested, and are not on this account keen to make changes. There are, however, one or two small changes which may be made without affecting the general performance, although leading to an improvement. For instance, the average type of short-wave detector will have the grid leak taken to the L.T. positive leg of the valve. This is a standard arrangement, but it may be found that in certain circumstances it is preferable to vary the bias which is thereby applied to the valve. For this purpose an old idea, but one which works very well, is to use a potentiometer connected across the filaments, and to return the grid leak to the arm of that potentiometer. A value of 400 ohms is quite satisfactory, and in use it may be adjusted so that the reaction is as smooth as desired. Other modifications of this nature, which do not in any way involve drastic changes, are the parallel feeding of the L.F. transformer, differential in place of ordinary reaction condenser, or the fitting of extension controls.

Mains Units

A form of query which is often being put to us is "How can I use a mains unit with my short-wave set?" It is found that when a standard type of mains unit is connected to some short-wave apparatus

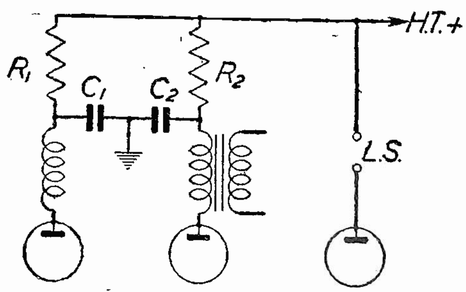


Fig. 3.—The arrangement of Fig. 2, plus decouplers

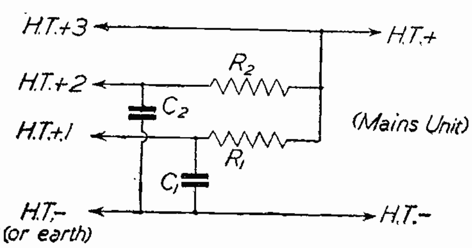


Fig. 4.—How to arrange for the decouplers shown in Fig. 3, so that they may be included between the receiver and mains unit.

(and in some cases to ordinary broadcast equipment) results are very unsatisfactory. It is even found in some cases that the unit cannot be used, mainly on account of instability. As a short-wave receiver is more susceptible to hum than ordinary broadcast equipment the problem is more intense, and it is usually found that the unit is quite satisfactory if another form of feeding the receiver is adopted. The standard type of mains unit is provided with three or four H.T. positive outputs. In some cases one or more of these may be of the variable type, provided either with alternative sockets, or a variable control. It is in the form of voltage dropper which is incorporated inside the unit that the trouble arises. Even if the receiver is provided with decoupling devices the trouble may still arise if two or more of the unit outputs are fed to the receiver. The most satisfactory way of overcoming the trouble is to ignore all the positive outputs except the maximum, and thus to connect only one positive lead to the receiver. This means that you will have to include decoupling circuits in all parts

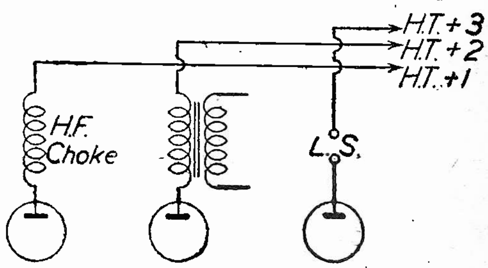


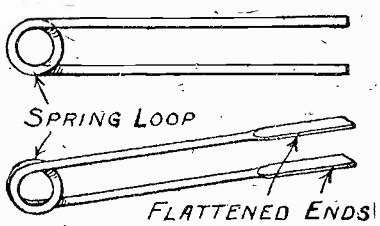
Fig. 2.—A skeleton standard 3-valve circuit showing normal anode connections.

of the receiver so that the appropriate H.T. feeds are decoupled, and the correct or appropriate voltages are applied to each stage. If you do not wish to go to the trouble of modifying the set wiring there is another way out, and that is to make up a small unit consisting of the appropriate decouplers and voltage droppers and to connect this between receiver and mains unit. The advantage of this arrangement is that at any time the unit may be disconnected and ordinary battery supplies used to feed the receiver. For the benefit of those who are not familiar with decoupling arrangements we show in Fig. 2 a three-valve skeleton circuit with battery or separate H.T. feeds, and in Fig. 3 the same arrangement with decouplers added. In Fig. 4 are shown the separate decoupling components wired up for connection between the unit and receiver. In this case, of course, the maximum H.T. tapping or socket is used on the unit. To ascertain the correct values of the resistances it is necessary to obtain a good milliammeter and voltmeter. The batteries are connected to the receiver in the usual way and the milliammeter connected in each positive lead in turn. The current flowing is carefully noted, and then a good voltmeter is connected between the anodes or other points fed by the H.T. line and earth. Next, the voltage supplied by the H.T. unit must be measured, and a slight drop taken into account to compensate for the fall when a load is applied to it. Then by subtracting the required voltage from that given by the unit, and dividing this by the current in milliamps, you will have the value of the resistance required in thousands of ohms. As an example, suppose you calculate that the unit will deliver 120 volts, and you need 100 volts for an L.F. stage. If the current at that anode is 5 mA, then you would need a resistance of 120−100 divided by 5, or 4,000 ohms.

Practical Hints

Easily-made Tweezers

SCREWS and other small parts often drop into awkward corners in a radio chassis that cannot be reached with the fingers, or anything else handy. In such cases a pair of tweezers, like those shown in the sketch, would be found very useful. To make them, take a piece

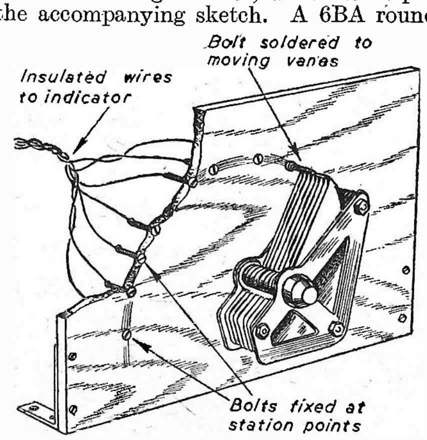


A handy pair of tweezers made from a piece of springy wire.

of hard springy wire about 12in. long, and bend the middle part of the wire round a $\frac{3}{8}$in. bolt to form a loop to give the teezers an opening spring. Flatten out the ends with a hammer, and file the ends square.—R. JENKINS (Caterham).

Illuminated Map Tuning

WHEN tuning on the medium-wave band on a home-made set, it is very convenient to know quickly to which station the set is tuned. This can be done in the following manner, with the help of the accompanying sketch. A 6BA round-



An illuminated map tuning dodge.

headed bolt of about 2in. in length is soldered to the end of the tuning vanes of a tuning condenser, as shown in sketch. A piece of 3-ply wood $4\frac{1}{2}$in. wide and the height of the tuning condenser's highest point when open, is temporarily fixed behind the tuning condenser, so that when the condenser is tuned right through, it describes an arc of 180° on the plywood. The stations wanted are then marked, where the head of the bolt is just touching the plywood. The wood is then removed and drilled where marked. 4BA bolts (flat-headed) are inserted. The plywood is then permanently fixed by brackets behind the tuning condenser, in the exact position as before, so that when the condenser is tuned right through 130° the bolt on the condenser makes contact in turn with each bolt in the plywood. Each bolt has a corresponding bulb, which should preferably be coloured to give an even luminous effect. The bulbs are then inserted in a named cardboard map (either home or ready made) in their right places; connecting wires are joined, one each from these bulbs to their corresponding bolts in the plywood. All the + sides of the bulbs are joined. A switch may be inserted in the + lead if desired. Only one lead will connect to the accumulator as the negative is already joined via the moving vanes of the tuning condenser.—D. ZEID (Bournemouth).

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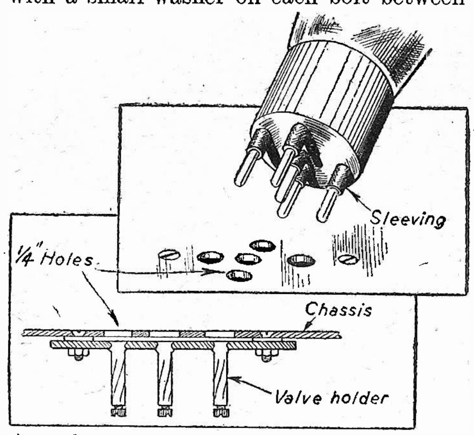
Fitting Sub-chassis Valveholders

HAVING no facilities for drilling 1in. holes for the valveholders in an aluminium chassis, I devised the following method of overcoming the difficulty. The valveholders were bolted in position with a small washer on each bolt between



A novel method of fitting sub-chassis valveholders

the valveholder and chassis, then the holes were marked out on the underside of the chassis. These were then drilled $\frac{1}{4}$in. diameter. Although the valve legs did not touch the chassis, I took the further precaution of slipping a $\frac{3}{8}$in. length of insulating sleeving over each valve leg.—N. DAWTRY (Sheffield).

L.F. Instability

AFTER an H.T. battery has been in use for several months a set may develop a high-pitched whistle and reception becomes distorted. The reason for this is, in the majority of cases, that the H.T. voltage from the battery has dropped, due to a breakdown of one or more of the cells with a consequent increase in the internal resistance of the battery. These defects are sufficient to produce instability in the circuit, particularly in the L.F. portion. Many constructors endeavour to overcome the dropping voltage by connecting a new battery in series with the old one, but, unfortunately, this does not overcome the trouble as the high resistance of the old battery still remains the same. The only satisfactory remedy is to use a new battery.

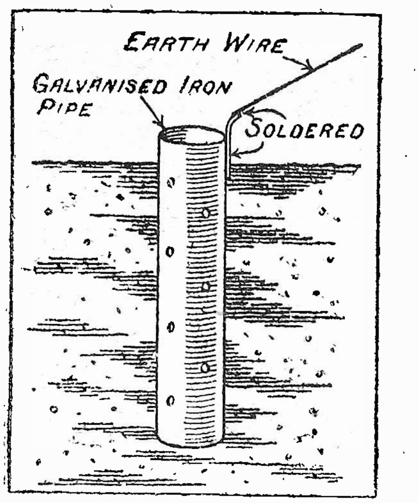
H.F. Choke Losses

A POPULAR method of coupling between a screen-grid valve and a detector is a tuned circuit connected to the detector via the usual leaky-grid arrangement and to the anode of the S.G. valve through another small fixed condenser, the anode of the valve receiving its H.T. through a suitable H.F. choke.

An important point to bear in mind is that there must be few losses in this choke if the full amplification of the S.G. stage is to be obtained. In quite a number of the early H.F. chokes, which were often constructed down to a low price, insufficient wire was employed to provide the required value of inductance, while in many instances the insulation of the wire was often too poor to give adequate insulation. If the utmost efficiency is required, it is absolutely essential to make sure that an H.F. choke of reliable make is employed.

An Efficient Earth

AN efficient substitute for an ordinary earth tube can be made as follows: Obtain a 3ft. length of galvanised iron stove-pipe, about 4ins. in diameter, and round it drill a number of $\frac{1}{4}$in. holes. Solder on a strip of brass or copper, to the end of



A piece of galvanised iron pipe makes an efficient earth tube.

which the earth wire is finally soldered. Dig a hole in the ground, and bury the pipe to within about 2in. of the top, and then ram the earth well down all round the pipe. In dry weather empty a pail of water down the pipe occasionally to keep the ground in a wet condition.—G. DALLAS (Watford).

From Crystal to Valve

How to Use a Valve as an H.F. Amplifier for a Crystal Set, or as a replacement for the Crystal Detector. By L. O. SPARKS

THE addition of a valve or valves for amplification of the signals after rectification by a crystal detector has already been explained, therefore alternative arrangements are discussed in this article so that a very efficient crystal/valve combination can be constructed.

After a reasonable period of experimenting with the original circuit, plus the L.F. amplifier, the constructor will, no doubt, wish to make further progress towards increasing the effective range of the apparatus. This can be achieved in two ways; a valve can be used as an H.F. (high-frequency) amplifier, between the aerial and the crystal set, or an alternative arrangement would be to replace the crystal with a triode valve acting as a simple reacting detector. The first method would increase range and selectivity while still retaining the pure reproduction qualities of the crystal, and, for these reasons alone, many music lovers will be tempted to model a circuit along the following lines. A stage of H.F. amplification, using a modern variable-mu H.F. pentode, a crystal detector, and a good L.F. amplifier employing one, two or three valves according to individual requirements. The second method, i.e., replacing the crystal with a valve detector, will appeal to those who wish to reach out to the more distant stations, and experiment with something more alive and more active than a crystal. The advantages to be gained are these: greater sensitivity, chiefly due to the wise use of reaction, improved selectivity, which can also be put down to the reaction circuit, and considerable increase in output. Against these items we have the possibility of introducing distortion, slight extra drain on the batteries, that is assuming these have already been secured for the L.F. circuits previously described, and the cost of an extra valve. The question of distortion is, in the majority of cases, closely connected with *unwise* use of reaction, unsuitable detector valve and incorrect operating conditions. It will be seen, therefore, that as all these items are within the control of the operator, the whole problem of faithful reproduction becomes far less serious if a little knowledge is applied.

H.F. Amplifier

A suitable circuit for this stage is shown in Fig. 1 where it will be seen that a variable-mu H.F. valve is recommended. In practice, it can be of the ordinary S.G. or pentode type, the latter being more satisfactory if powerful signals from a local station are to be received. Many readers might have a "straight" or non-variable-mu valve on hand, and wish to make use of it. That is quite permissible, although the very fine volume control provided by one of the specified type will, of course, be lost. The only modifications to the circuit shown, to enable a "straight" S.G. or pentode H.F. valve to be used, are the following. Ignore the potentiometer, fixed condenser C.3 and G.B. battery, and their associated connections, and connect the bottom end of the aerial coil direct to the common negative earth line.

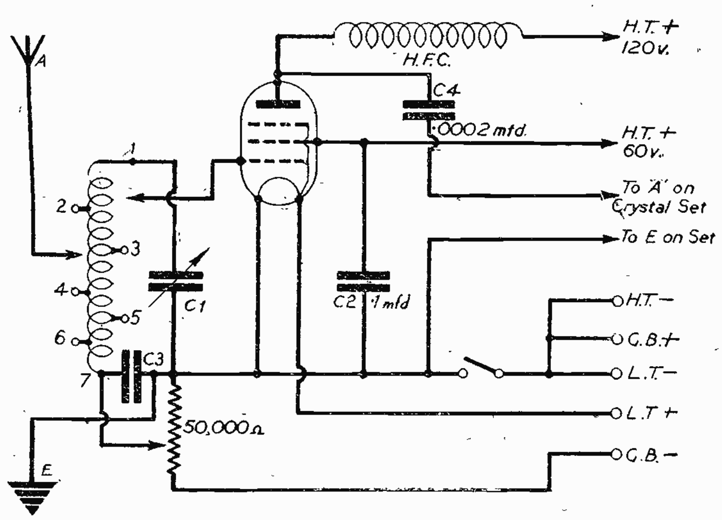


Fig. 1.—An efficient H.F. stage having a wide range of application. An ordinary S.G. valve can be used if so desired.

Aerial Coil

This can be wound in the same manner as that described for the original crystal circuit but, as there will be no need to make provision for a reaction winding, the total number of turns can be reduced to, say, 60 and the number of tapping points consequently reduced to five. The method of connection will be clear from the diagram.

An additional .0005 mfd. tuning condenser will be required, together with a four- or seven-pin valve holder, according to the type of valve used, a .1 mfd. and a .0002 mfd. fixed condenser, and a reliable make of H.F. choke. For those who wish a valve to be specified, I would suggest a Cossor 210VPT.

The circuit shown is the simplest arrangement; it is known as a "tuned-grid" H.F. coupling and, apart from being easy to construct, it is capable of giving very satisfactory results. The output from this H.F. stage is fed into the crystal circuit

(*Continued on next page*)

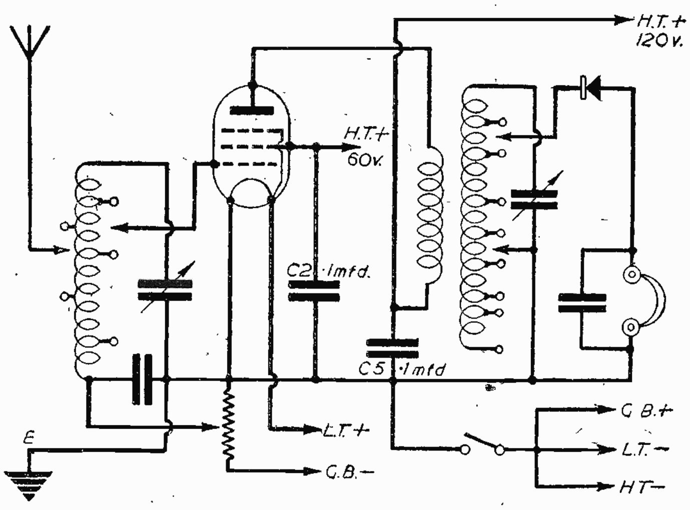


Fig. 2.—The H.F. transformer system of inter-valve coupling is shown in this circuit.

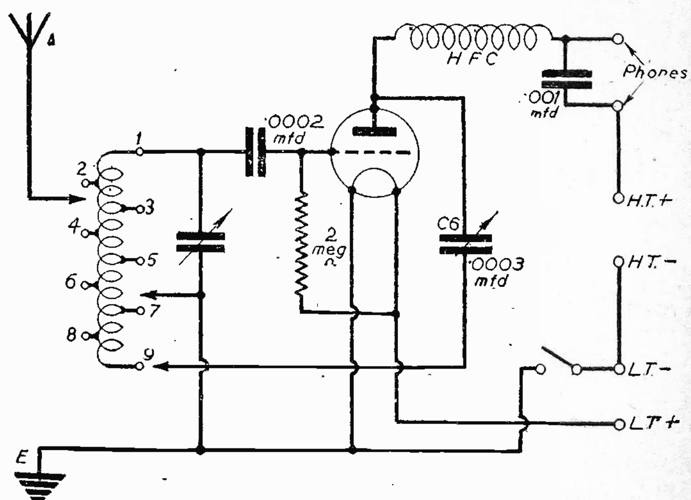


Fig. 3.—How the original coil can be used to form a very efficient one-valver.

FROM CRYSTAL TO VALVE

(Continued from previous page).

via the original aerial terminal and the output condenser C.4. The actual aerial now being connected to the new aerial terminal as shown.

H.F. Transformer

This form of H.F. coupling requires two windings on the inter-valve coil, namely, a primary and secondary. The theoretical circuit is shown in Fig. 2, and it will be noticed that the H.F. choke and coupling condenser of the former system are no longer required. The additional winding, the primary, is connected between the anode of the H.F. valve and its positive H.T. supply, the fixed condenser C.5 being used for decoupling purposes. The winding can consist of, say, 25 to 35 turns of 32 S.W.G. insulated wire wound over the original coil, preferably at the upper end. Between the two windings, two layers of thin, dry paper or other insulating material should be placed, and to this the ends of the primary winding can be anchored with small blobs of sealing wax or Chattertons compound.

An alternative method of making the H.F. transformer is to make a coil former, from two or three layers of stiff, dry paper, having a diameter slightly *less* than the *inside* of the existing former. The coil is then wound on it, the same number of turns as mentioned above, and the completed coil slipped inside the larger one. This, perhaps, is the neater and stronger arrangement.

Valve as a Detector

For those who wish to dispense with the crystal detector, the tapped aerial coil described can be used to good advantage in the circuit shown in Fig. 3.

The majority of connections, and the method of adjusting them, are practically identical with those used for the crystal set, but in place of the crystal a grid condenser is employed to feed the signals to the grid of the valve. The additional connection to the coil is to provide reaction in conjunction with the reaction condenser C.6 which is connected between the anode of the valve and the end of the winding. It should be noted that while this condenser, which is of the variable type, provides the required control of the reaction, the amount of reaction effect obtainable with the condenser specified will be governed by the number of turns of the coil used in this part of the circuit, therefore, by means of the crocodile clips, it is possible to adjust matters until the most satisfactory results are obtained.

A suitable valve would be the Cossor 210HF.

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

Receivers

THE analysis of members' receivers makes very interesting reading, especially in view of the minor controversy which is still going on between the communication receiver enthusiast and the 0-v-1 men. On actual score there is no doubt that the latter are well in the majority, and judging by some of the splendid logs they send in, there can be little doubt that the simple receiver in the hands of an experienced and capable operator can pull in the DX signals.

So many amateurs are inclined to confuse volume with signal intelligibility, and overlook such things as signal-to-noise ratio. For long-distance work it is absolutely necessary to consider the readability of the signal rather than the amount of noise which can be reproduced via the headphones or loudspeaker. Bearing this in mind, it is not usually advisable to add L.F. stages in a haphazard manner, otherwise unwanted noise will be amplified beyond all proportion to the signal. It is in this direction that the simple 0-v-1 scores, and if a member using a circuit of this type is tempted to add another stage of L.F. amplification, he would do well to pause and consider whether the actual gain as regards signal intelligibility will be all that one might expect. Although the untuned stage of H.F. amplification is often treated with contempt by those who have failed to appreciate its true worth, there is much to be said in its favour, especially when one is considering any additions to an 0-v-1 circuit. It is usually far better to employ an additional valve as an untuned H.F. amplifier than as an L.F. stage, as the former will improve the over-all efficiency of the detector by reducing aerial damping, eliminating aerial resonant peaks and likewise allowing the maximum efficiency to be obtained from the reaction circuit.

These remarks are not intended to start the old controversy off all over again; they are only given with the hope that those who have despised the small sets will at least put in a certain amount of active work with them before making a sweeping condemnation.

Correspondence

NOW that the practice of sending reports to transmitting stations overseas is no longer permitted, one has naturally to turn to other items of interest associated with our work, and Member 6732, of Hull, shows us in a very definite manner what great interest he is obtaining. His own words can best explain his activities. "Since the war started I have been keeping an accurate record of the weather each day—i.e., temperature, whether sunny or dull, etc.—and I also maintain a daily log of all the short-wave stations received, noting such things as signal strength, time, frequency and atmospherics. The weather records, and the station log can be compared with most interesting and illuminating results. For example, I have found that certain frequencies and areas are more affected by weather conditions than others. Last Easter, during the aurora borealis, VLQ was received exceptionally well."

Another very interesting letter has been received from Member 6443, of Lisburn, North Ireland, who states, amongst other things: "About a month ago I built an R signal-strength meter. It is composed of a transformer, valve, and an 0-7 moving-coil milliammeter. After spending some time calibrating it I have now got it going very well, and it proves of great value when writing up my log."

We certainly agree that an instrument of this type is most useful, and should certainly form part of the equipment of every member. Why not send us more details, 6443, so that we can pass on the benefits of your experiments to other members?

Member 5767, of Bromley, Kent, also gives details of some of his practical work relating to his aerial experiments. "The aerial here is a half-wave Windom for 20 metres, running N.N.E. by S.S.W. The north end is 37ft. high and the south end 30ft. The Windom is quite a good arrangement for short-wave working once the correct tapping point has been found. When bare wire is used for the aerial, it is a comparatively simple matter to connect a crocodile clip to the feeder and determine the correct tapping point by adjusting the clip until the desired results are obtained. When, however, insulated wire is used, the matter is rather more difficult, but by adopting the following idea the trouble was overcome. I soldered the feeder to a safety-pin, and was thus able to pierce the insulation and make contact with the conductor, and then when I had determined the correct point I was able to make an efficient weather-proof connection."

Member 6232, of Colwyn Bay, writes: "The sudden lack of interest shown by members towards the proposed DX competition stirs my own interest to a wider degree. As yet I have been a 'silent' member, but now I feel that I must have my say on the subject. It is very disappointing that members who have so many times asked for such a competition back out at the crucial moment. Why this state of affairs should exist in such a flourishing club as our own is beyond me. I quite realise that the new drive to increase our industrial output will probably necessitate many of our members having to work overtime; but if they were really keen this would not damp their ardour.

"In the issue of 'P.W.' dated June 1st it is suggested that members could keep in touch with each other by forming different groups in their own area. Personally I would be only too glad to act as a 'go-between' for this district. I shall be here until about the end of July, and during that time I will place myself at the club's service to whip up enthusiasm.

"Wishing you and the club all the very best."

Change of Address

WILL all members please note that Member 6172 has now changed his address to 93, Kinfauns Road, Goodmayes, Essex. His previous QRA was 64, Nicholas Road, Dagenham, Essex.

Stationery

WE are getting so many requests from new members for details of the B.L.D.L.C. stationery available for their use, that we make no apologies for giving the complete list below.

- Pad of 50 verification forms, 1s. 6d.
- Pad of 50 log-book sheets, 1s. 6d.
- Packet of 50 sheets headed notepaper, 1s. 3d.
- White manilla folder for log-book sheets, 7½d.
- Membership badge, 1s.

A Remote Control System

Constructional Details of a Novel Apparatus

By Cecil Andrew, A.M.I.R.E.

WHEN amateur transmitting was closed down, there remained a "void" for many readers as far as experimenting was concerned. This led the writer to turn his attention to the development of apparatus he had been using for the remote control of his transmitter.

It was found that this method of control can be applied to many uses, from transmitting gear to receivers, telephones, fire alarms, bell circuits, television, A.R.P. requirements, and practically every branch of electrical science.

The basis of the arrangement can be seen in Fig. 1, and is constructed from second-hand parts obtained for a few shillings from the many vendors advertising such components. In the first place a number of automatic telephone dials were obtained for about 2s. 6d. each second-hand, as well as what is technically termed a "uniselector switch" sold second-hand for about 7s. 6d. This switch was so adapted to have 50 separate double line circuits, "step by step," any one of which can be selected by choosing the number on the "dial." Upon releasing the last number, a relay automatically switches out the selecting device and places the line calling through to whatever relay or apparatus is connected to that number, thus allowing the operator to control any instrument or, if preferred, place himself in telephonic communication with that point.

Constructional Details

At the bottom of Fig. 1, on the left, can be seen the dialling box, placed there only for the convenience of photographing. Attached to this is a flexible lead connected to a valve base with 3 or 4 pins. This can be taken from point to point, and plugged into a valve-holder, so that the "exchange" can be controlled. Nearly all the relays are home-constructed from old bell coils, etc., with the exception of the bank of relays, seen in the top left-hand of the illustration, which were purchased for about 2s. each. These contain multiple contacts which allow any combination of circuits. The writer used to control his transmitter from any number of points connected to the "exchange" by a pair of line wires and earth connection. By dialling a number the mains were first switched on, another number would light the filaments, another number would bring in the H.T. to any stage, and, finally, any "mike" required could be brought in by dialling the appropriate number. It was found that home-made polarised and "latchet" type relays were the most suitable for this purpose, as one number would hold the circuit closed, and another number dialled would then release it. Fig. 1 also shows two "mercury switches" for heavy mains work.

Several of the home-constructed polarised relays were made from old type loud-speaker magnets, between the poles of which moving from side to side soft iron arms are pivoted. These were wound with a coil connected by flexible leads to terminals. When the current was sent in one direction this arm moved across to one side contacts, and when in the other across to the other contacts.

This relay rack is at present used to remote control one or two communication receivers, and by dialling a prearranged number a small induction type electric motor is operated through very slow worm gearing to move the tuning dial of the receiver. Then another number will connect a morse recorder to the output, and so on.

No doubt there are many other readers who prefer to keep all their apparatus and experimental receivers in their own "den" away from the risk of domestic damage, and it is in this case that remote control is so convenient, enabling one to operate from any room or fireside without loss of time. Further, a simple telephone in workshop and other rooms was found to be very useful, the interconnection being self-controlled.

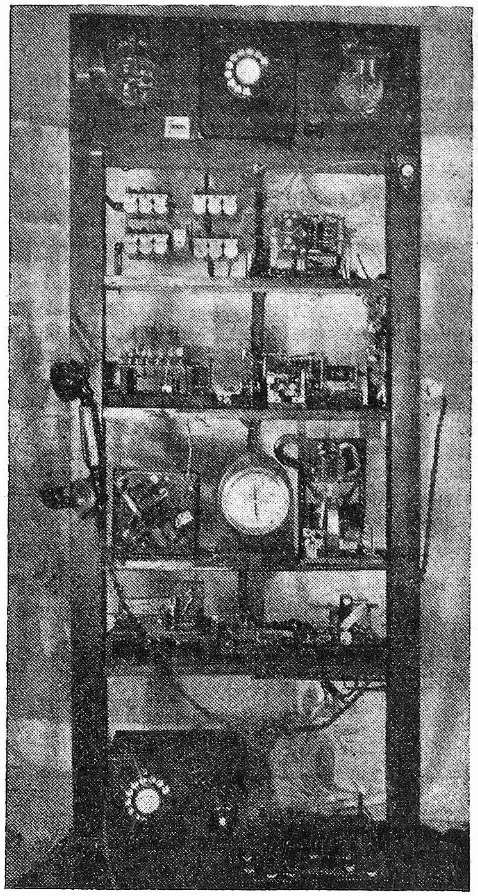


Fig. 1.—The general arrangement of the complete remote control apparatus.

The dials are purchased with contacts normally closed, but these were altered so that they remain open when the dial is at rest, and close as it is rotated. This avoids the need of extra relays, and is much more simple for the purpose. The bottom two rows of contacts on the selector switch are all connected together with the exception of the last one, and this arrangement is used as a self-restoring device. By pressing the white button on the control box, this switch returns to "zero" ready for the next selection. Inside the box is a 4½ volt battery connected to a D.P.D.T. switch so that the polarity can be reversed on the "line" to operate the polarised relays in either direction.

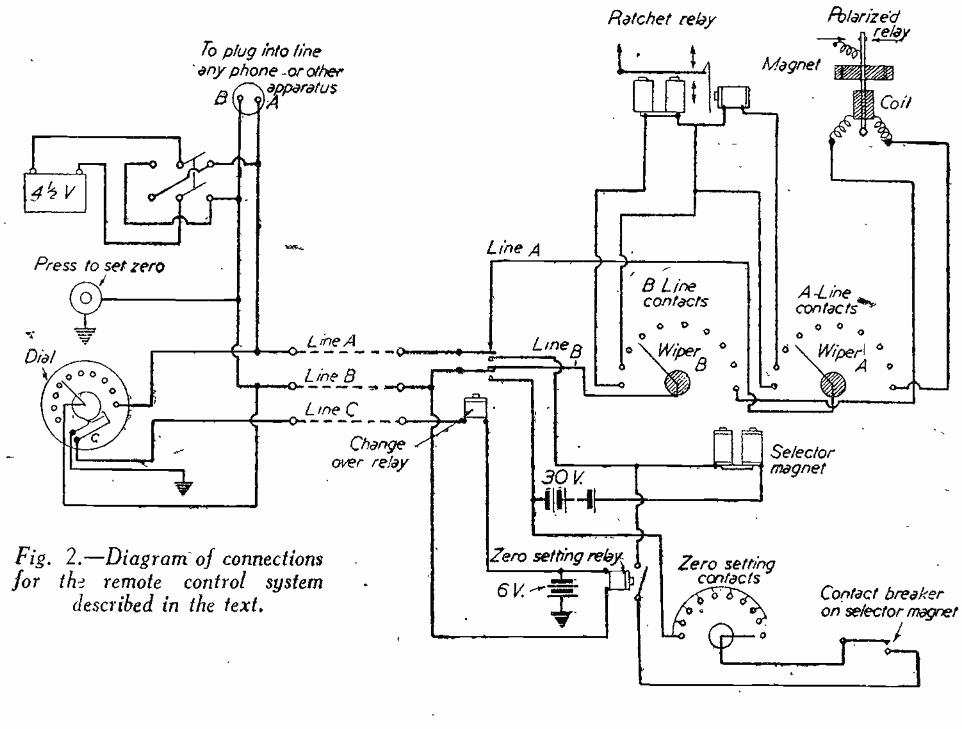


Fig. 2.—Diagram of connections for the remote control system described in the text.

Operation

In the normal position when all relays are at rest, the "A" and "B" lines (Fig. 2) can be traced right through from the D.P.D.T. switch and the line plug sockets to the "A" and "B" contacts upon which the two wipers are resting, so that any current sent through the line or apparatus connected to it will have a through connection to any relay on those pair of contacts on selector switch. Immediately the dial is operated and leaves its normal position, the contacts marked "C" will earth the "C" line through the 6-volt battery and operate the change-over switch, thus pulling the two contacts off the "A" and "B" wipers over to the selector switch circuit, and every time the dial passes a contact number the selector switch is operated once, and moves the wiper on to the next pair of contacts. This cycle of movements takes place for the number dialled, and therefore the selector wipers always move to correspond to the number required. If we want 18 we dial 10 and 8, and we shall find the line through to the No. 18 pair of contacts, which will allow us to operate the relay connected to this number by turning the D.P.D.T. switch which sends a current through the line, or we can plug into the line any apparatus such as a telephone, or radio, etc.

When the use of this number has been completed the zero set button is pressed, which "earths" the "B" line, and by holding down this button for a few seconds, the bottom zero set contacts, which are all connected together except the last one, pass a current through the selector magnet which now has the contact breaker on this selector in circuit. This keeps the rotary wipers moving around until they rest on the last unconnected contact when the circuit is broken, and the selector comes to rest ready for the next dial operation.

There will be found on the "uniselector switch" usually five rows of 25 contacts. The top two rows are used for the line contacts and the bottom row used and connected for zero set. If more than 25 lines are required, it will be necessary to employ the top two rows for "A" line and the third and fourth rows for "B" lines, cutting off the wipers on one side only. This will give 50 lines. All this seems very complicated but is really quite simple in practice with the apparatus described. A ratchet relay is shown connected to numbers 1 and 2. When No. 1 is dialled, and a current passed through the line, the armature is drawn down under the latch which holds this down against the bottom contacts. By dialling the next number this latch is pulled back to release the armature against the top contact. The polarised relay moves from side to side on one number only, according to the direction of the current. The writer has so arranged his relays that only two lines and earth are required for full scale operation, but three lines are shown in Fig. 2 in order to simplify the diagram, but the reader will soon discover many variations for himself.

It might be mentioned that the selector switch can be operated from an old H.T. battery, but the writer uses old wet high-tension accumulators for economy.

LATEST PATENT NEWS

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

NEW PATENTS

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

Latest Patent Applications.

8972.—Amalgamated Wireless (Australia), Ltd.—Biasing circuits for electron-discharge tube circuit arrangements. May 20th.

8762.—Philco Radio and Television Corporation.—Electron-beam deflecting circuits. May 16th.

9077.—Philco Radio and Television Corporation.—Automatic volume control system. May 22nd.

8836.—Philips Lamps, Ltd.—Control mechanism of wireless receivers. May 17th.

Specifications Published.

521278.—Cole, Ltd., E. K., and Shackell, A.—Tuning of radio-receivers.

521209.—Kolster-Brandes, Ltd., and Beatty, W. A.—Radio-receivers.

521350.—Cole, Ltd., E. K., and Robertson, N. C.—Method of making electric connections in radio-receivers or the like.

521367.—Jones, W., and Pye, Ltd.—Television and like systems. (Cognate Application 143539.)

521330.—Philips Lamps, Ltd.—Superheterodyne wireless receiving-sets.

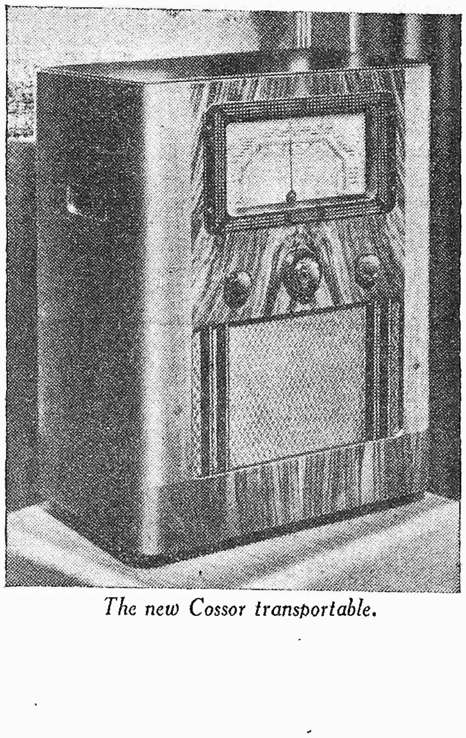
521183.—Philips Lamps, Ltd.—Radio receiving-sets.

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

New Cossor Transportable

THE recent introduction of "all-dry" valves has led to some interesting transportable and portable receiver designs, the latest of which, from the Cossor factory, is illustrated on the right. The new valve dispenses with the need for an accumulator for the L.T. supply, and as a result a more compact and lighter type of receiver is possible. The L.T. supply is obtained either by a small separate dry cell, or by a section of a special type of H.T. battery designed for the purpose. This is the arrangement used in the Cossor receiver, the battery being of the 90-volt type. A self-contained frame aerial is fitted, and there are four valves in the receiver. The output stage is a pentode, and the circuit is of the superhet type with permeability-tuned I.F. transformers. Automatic grid bias and A.V.C. are included in the circuit refinements, whilst the output is fed to an 8in. P.M. moving-coil speaker. There are three controls, the centre being a slow-motion tuning with concentric tone control, the others being wave-change and volume controls. Normally no earth is required with the receiver, but sockets are provided so that when desired an external aerial and earth may be employed. There are also sockets for the inclusion of an external loudspeaker, these sockets being provided with switching.

The wavebands covered are from 190 to 560 and from 830 to 2,000 metres, and the cabinet measures 20in. by 16in. by 10in. deep. The price of the receiver is £9 17s. 6d.



The new Cossor transportable.

PROGRAMME NOTES

Wedding Group

PHILIP WADE, well-known member of the B.B.C. Repertory Company, is also familiar to listeners for his work as an author and an adapter of works for broadcasting. It will be recalled that a recent adaptation of his was of scenes from "Pickwick Papers." One of his plays, which is to be produced in the Home Service programme on June 14th, by Howard Rose, is "Wedding Group." This is a revival of a work which was originally produced five years ago. The story begins with a modern setting on the eve of the wedding of the young couple. The bride-to-be's mother shows the young couple an old family photograph album in which there is a family wedding group which dates back before the Crimean War. In a delightful way Philip Wade brings this wedding group to life and tells the story of the romance behind it.

Cabin No. 3

THE cruises of luxury liners have not provided such a spate of romance and crime stories as might have been expected, but Florence A. Kilpatrick has used the subject as the peg on which to hang an exciting play which is to be produced by Peter Creswell on June 13th. This is a story of a trip from Rio de Janeiro to Tilbury, and the main characters are a wealthy woman globe-trotter, her pretty young companion, and a stowaway who appears to be mixed up with a gang of emerald thieves who are after the globe-trotter's jewels. There is both crime and romance in the play, for the pretty young companion manages to save the designing stowaway from his worst self and the story has a happy ending.

BOOKS RECEIVED

DEFINITIONS AND FORMULÆ IN RADIO AND TELEVISION ENGINEERING. By A. T. Starr, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 50 pages. Price 6d.

THIS useful pocket handbook, intended for students of radio engineering, contains a large number of definitions, formulæ and circuits, covering many phases of radio, and based on standard practice. The book contains sufficient information for refreshing the memory as occasion requires.

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 "Quality" Equipment

SIR,—I enclose a photograph of my equipment which I have built with the aid of the knowledge obtained from your excellent paper.

The top of the rack contains an 8in. Epoch speaker (P.M.), which I use for DX work, though this was only put there to take the place of a low-power C.W. transmitter which I was going to put in the rack if transmitting had continued.

The middle rack contains the H.F. portion of the rig, and this consists of a VP215 R.F. amplifier which is tuned on all bands, which are fed into a triode detector. This part takes care of the DX, and it has a S.W. range of 12-60 metres, while the usual broadcast bands are also included.

A turntable is next, and this is fitted with a crystal pick-up for quality work with records. The bottom rack holds the most interesting part of the gear, which is the L.F. amplifier.

When on the radio the valve line-up is LP2 (transformer coupled to the detector), which is in turn transformer coupled to a 19 (Class B) valve, which has an output of over 2 watts. When over to the gramo. the line-up is HL2 pre-amplifier resistance coupled to an LP2, which is transformer-coupled to the output valve. The quality with this line-up is exceptionally good, and the output of the Class B valve is fed into a Celestion (P.M.) 10in. speaker. Switching for the L.F. amplifier is done by a multi-cut-out switch, while the two D.P.D.T. switches are for cutting out the Class B valve when working on 'phones, or the DX speaker. The speaker case may interest some quality "fans," as it consists of a strong box 2ft. 6in. square by 1ft. deep. The inside is lined with felt ¼in. thick and corrugated paper on the outside. The front is 5-ply wood, and perforated zinc was used over the speaker aperture. This greatly improves the quality, which was good before, but this extends the frequency range greatly in both directions. The whole rig is built primarily for quality work, though it is also good on DX. The aerial used is a 20 m. doublet, and the rig is entirely run from batteries with 180 H.T. Here's wishing your magazine all the best in the future.—C. HEYNE (Britton Ferry, Glam).

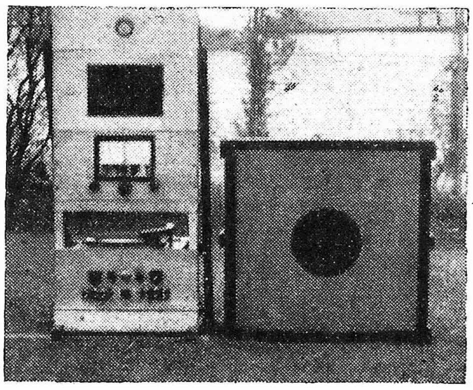
A Simple S.W. One-valver

SIR,—I enclose a short log of stations received with a simple single-valve short-wave set I have built, which may be of interest.

Aerial tuning condenser is .00001 mfd.

Coil: Grid winding 6 turns No. 16 standard gauge bare copper wire on 3in. ribbed former. Reaction winding 5 turns No. 20 D.C.C. wire. Grid condenser is .002 mfd.; grid leak, 2 mΩ. Ordinary broadcast valveholder. Tuning condenser and reaction condensers, .00015 mfd. These I made by removing half the plates and double spacing ordinary air-spaced .0003 condensers. An ordinary short-wave H.F. choke is used.

With this set and an aerial consisting of 10in. of No. 16 copper wire connected vertically to the grid terminal of the coil, I have logged the following stations: EA7BA, W2ECR, EK1EF, W1CRW, W1DLM, LY1J, ES1E, ES4G, I1JKV, K4END, W4XDK. With an aerial of



Mr. C. Heyne's equipment for quality work with records, and for DX work.

approx. 15ft. No. 20 enamel-covered wire hung round the room, the following commercial stations came in: W2XAD, 2RO6, DJD, GSQ, WIXAL.

Prize Problems

PROBLEM No. 404.

KENT had a three-valve battery receiver which gave splendid results on 'phones, but when he connected a loudspeaker he was disappointed with the results. He was assured that the speaker was in good condition and capable of good results, so he decided that perhaps results would be improved if he did not use a direct output feed. He accordingly decided to parallel feed the speaker, but as he had not got a suitable L.F. choke available he used a 50,000-ohm fixed resistance (bearing in mind that the effect is similar to resistance-capacity coupling). He fed the speaker from the anode through a .1-mfd. condenser, but the results were worse than ever. What was 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. 404 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, June 17th, 1940.

Solution to Problem No. 403.

When Matthews added his screen potentiometer he overlooked the fact that this was joined between H.T. positive and H.T. negative, and accordingly a switch should have been included to isolate this when the set was switched off. Failure to do this resulted in the battery discharging continuously with the results which he experienced.

The following three readers successfully solved Problem No. 402 and books have accordingly been forwarded to them:

M. Dullington, Yorktown Road, Sandhurst, Berks.
W. Brown, 46, Blantyre Street, S.W.10.
D. McLean, 49, Newark Drive, Glasgow, S.1.

I am a regular reader of your journal, and have always found it a great help to me.—W. G. MORRIS (London, S.E.).

"Radio Training Manual"

SIR,—May I take this opportunity of expressing my complete satisfaction with the "Radio Training Manual"?

I have studied this unique book from cover to cover, and have found that it fully explains a number of points which are extremely valuable, and yet are passed over lightly in most text-books.

In particular, I was highly interested in the chapters on the design of the detector stage and the principles of receiver design.

Many radio constructors, with a flair for the technical side of things as well as the constructive, would, I am sure, appreciate a series of articles in PRACTICAL WIRELESS incorporating such interesting subjects as high-frequency transformers, stability in high-frequency circuits, separating the three electrical current components; and oscillatory circuits.

To be brief, a series embracing the whole of the modern radio receiver, and dealing with it in detail, as you have done with the detector stage in the "Radio Training Manual." Most enthusiasts wish to know *why* this, that, and the other must be of such a value, instead of being told that it should be so.

PRACTICAL WIRELESS is certainly doing its bit 100 per cent. in keeping the wireless-minded public informed of all the latest developments in this ever-expanding field.

May it long continue to do so!—J. T. JACKSON (New Barnet).

Station CR7BE

SIR,—In a recent issue of PRACTICAL WIRELESS, R. Scotten, of Leyton, states that he picked up a Portugese East African station broadcasting on 30.8 metres. This station would be CR7BE Lourenço Marques, Mozambique, on 30.8 metres (9.71 mc/s). This station can be heard broadcasting in English from 20.00 to 21.00 B.S.T. every night.—C. MERRETT (Evesham).

Correspondent Wanted

H. TOBIAS, 56, Reginald Road, Crosby, Scunthorpe, Lincs, would like to get in touch with any reader who has built the "Midget S.W. Two."

RADIO CLUBS & SOCIETIES

EDGWARE SHORT-WAVE SOCIETY

Headquarters: Constitutional Club, Manor Park Gardens, Edgware, Middx.

Chairman: P. A. Thorogood, 35, Gibbs Green, Edgware.

ON Saturday, June 29th, from 4 to 10.30 p.m. there will be an exhibition of apparatus by well-known manufacturers; a demonstration of their new pick-up and loudspeakers by Messrs. Voigt Patents, Ltd.; an unusual junk sale; Morse speed competition; discussion by the secretary of R.S.G.B.; competitions, and in the evening a social and dance. Admission sixpence.

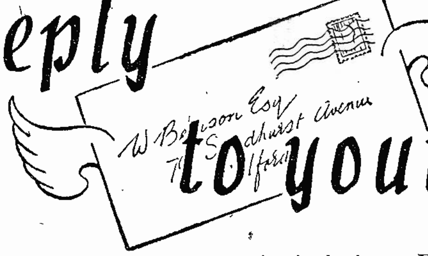
ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: H. G. Holt, 5, Butts Green Road, Hornchurch.

DURING April, and the early part of May, many members demonstrated apparatus they had made and queries were duly settled.

On May 28th we had a very enjoyable evening with Mr. Voigt, and his loudspeaker. Using his new experimental pick-up he gave a demonstration which far exceeded our expectations. Reproduction was the best we had ever heard, and everybody enjoyed it.

In reply to your letter



Tone Improvement

"I have a four-valve battery set which, whilst good so far as all normal requirements are concerned, could, I think, do with some improvement in the quality of its reproduction. This is particularly applicable to the gramophone side, and I append a circuit and would be glad if you would suggest a good tone-control device which would be guaranteed to give good results. I have tried several schemes without appreciable improvement."—K. M. (Wokingham).

YOUR circuit modifications may have been effective, but your speaker, the cabinet, or other acoustic details may have prevented the effects from being noticeable. Have you tried a "constant" tone-control device? This might give the desired improvement and it should be included across your volume control used with the pick-up. It consists of a 50 millihenry choke and a 15mmfd. condenser in series. The condenser is joined to the earth end of the pick-up volume control and the end of the choke is joined to the arm of a variable resistance having a value between 5,000 and 10,000 ohms. The resistance is connected to a tapping on the pick-up volume control, the best point being found by experiment. About one-fifth of the winding is generally satisfactory. The tapping is, of course, on the earth end. If you cannot tap the volume control you can obtain a similar effect by connecting a fixed resistance in series, but it is preferable to tap the control as this then enables the resonant circuit to be cut out at low settings and this gives the desired compensation.

Economy Amplifier

"I wish to build an economy amplifier, capable of giving a really good output for domestic purposes. I do not want dancing volume, but something a little above the ordinary for good music, and with good quality. What arrangement and circuit would you recommend?"—D. F. (Colchester).

THE $2\frac{1}{2}$-watt battery amplifier which we described some time ago would, we think, be the most suitable for your purpose. This consisted of a single L.F. stage with parallel-fed transformer feeding two pentodes in push-pull. The current consumption is fairly high, but by using a really good H.T. battery this should not be a difficulty. The amplifier is economical to operate and not expensive to build. Full details were reprinted in our issue dated December 23rd last.

S.W. H.F. Stage

"I have been using a detector-L.F. short-wave combination, but a friend has told me that I could improve my results by fitting an untuned H.F. stage in front of the detector. I do not see how an untuned stage can give any appreciable advantage and should like your advice on this before making any change."—J. E. T. (Cambridge).

ALTHOUGH an untuned stage may not give as much improvement as a tuned stage there are advantages to be gained by its inclusion. Firstly, the inclusion of the valve before the detector will result in a slight increase in amplification. Secondly, the inclusion of the stage between aerial and detector tuned-grid circuit will overcome erratic effects due to the damping of the aerial, and probably result in smoother reaction and consequent increase in the strength you may obtain on some distant stations. Another point is that on the lower wavelengths the gain obtained by using a tuned H.F. stage is not appreciable and thus there is no object in using the tuned circuit. The buffer stage, as the untuned arrangement is called, is, however, always worth while.

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.

Noisy Controls

"I am finding it difficult to adjust my volume control without a noisy background. I am afraid, however, that the control itself is not responsible for the noise, as I have examined it very carefully and the arm is making good contact all over the element. Is it possible to get noise with good contact? Failing this, is there any way in which I can find out the cause of my present trouble?"—A. E. (Isleworth).

IT is possible to get noise from a control which apparently has good contact. But this would only occur if H.F. was present, and then a poor H.F. resistance would be responsible. In some cases this could be overcome by shunting the control by a fixed condenser. If the control is on the L.F. side of the receiver there should be no H.F. present and faulty H.F. filtering would therefore be the thing to overcome. You may find, however, that the control itself is not responsible, but that when volume is turned up the increased vibration causes a poor contact to be jarred in some other part of the set and that this gives rise to the noise.

L.F. Transformer Design

"I have been looking into the question of improving my set and have come across a small problem which I should like you to solve. I have two transformers, at least five years old. They are substantially constructed, and I have always understood that this is one of the most important features of an L.F. transformer. It now seems that modern transformers are extremely small and I am not certain that by purchasing one of these I shall obtain any improvement from the quality point of view. I wonder if you could confirm this?"—H. E. R. (Colindale).

YOU have apparently overlooked the fact that modern transformers do not always employ the old form of core. In the early types of transformer ordinary Stalloy stampings were employed, but many modern transformers make use of special alloys, such as nickel-iron. This permits a high inductance to be obtained in a much smaller space, and therefore, it may be possible in certain circumstances to obtain better quality with a modern small transformer than with an old pattern large transformer of poor design. It is, of course, still possible to obtain high-quality transformers of substantial design, such as the Ferranti.

S.W. Oscillator Coil

"In reading about superhets I see that the oscillator section has to tune to 465 kc/s. From tables I find that this is equivalent to about 600 metres. Now I have a short-wave set tuning down to 9 metres, and on looking at the oscillator coil I find it only has a few turns of wire and is tuned by a very small variable, so I fail to see how it can go up to 600 metres. Perhaps you could explain this point to me."—S. L. (S.E.14).

THIS is a point where thinking in metres, rather than in kilocycles, has helped to confuse you. You have also overlooked the principle of the oscillator stage. It is true that the I.F. stages are tuned to 465 kc/s and that this frequency has to be developed in the frequency-changer stage. However, if you think in kilocycles you will see that the required frequency is obtainable, even down to 1 metre. Take, for example, a station working on a wavelength of 15 metres. This is a frequency of 20,000 kc/s. Now to obtain a beat of 465 kc/s you must tune the oscillator circuit to either 20,465 kc/s, or 20,000 minus 465 kc/s, or 19,535 kc/s. A frequency of 20,465 kc/s corresponds to a wavelength of about 14.65 metres and 19.535 kc/s corresponds to about 15.5 metres, and thus, you see that there is very little difference between the actual tuning circuit and the oscillator circuit, and you do not need a large coil to cover 600 metres. We trust the above explanation clears up your difficulty.

Midget Coil Connections

"I built up your small receiver some time ago, with a Bulgin midget coil in it. I dismantled the set and now wish to make up a similar one, but I have lost the code for the coloured leads of the coil. Is it possible to give me the wiring for this component?"—R. T. (Edinburgh).

THE coil in question had a fixing bracket on it and you should not have removed this in dismantling the set, as it is in contact with the lower end of the grid winding and must be earthed. The tuning condenser should be joined to the red lead and the on-off wavechange switch should be joined between earth and the blue lead. The grid condenser may be joined either to the green lead or to the red one which is already connected to the tuning condenser (the other side of which is, of course, earthed). The primary winding is between grey and yellow, the latter being the earthy end.

The coupon on page 288 must be attached to every query

Reducing Adjacent Channel Interference

Details of a New Type of I.F. Transformer

THE sensitivity of modern superheterodyne receivers is such that, when they are tuned to the frequency of any given broadcast channel, they respond to some extent to signals in an adjacent channel, and it is desirable to provide some means for reducing the adjacent channel interference. Such reduction is best effected in the intermediate frequency circuits because in these circuits the currents to be transmitted are of the same frequency for all signal channels and, as the broadcasting wavelengths are spaced apart by 10 kilocycles, the currents corresponding to adjacent channels to be attenuated are also of fixed frequency of 10 kilocycles above and 10 kilocycles below the intermediate frequency respectively.

The coupling arrangement about to be described provides an inexpensive means for the reduction of adjacent channel interference, and has the advantage that it requires a minimum of adjustment.

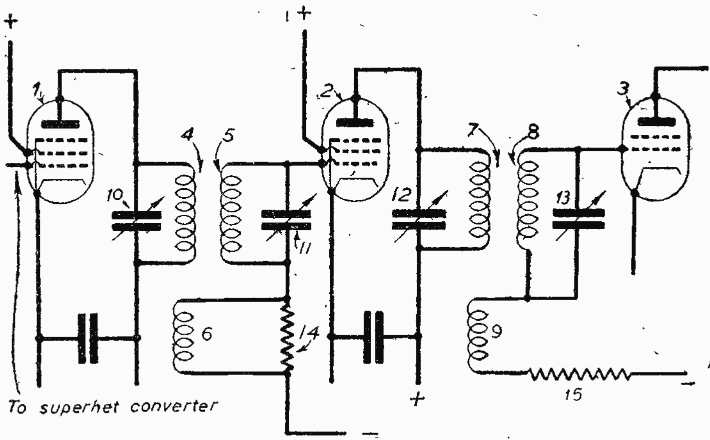


Fig. 1.—The early stages of a standard superhet.

Fig. 1 shows three cascade-connected valves, 1, 2 and 3, the first of which is a frequency changer, while the others are intermediate frequency amplifiers. The anode circuit of the valve 1 includes the primary winding 4 of a coupling transformer which has secondary windings 5 and 6, connected in series in the input circuit of valve 2. Similarly, the anode circuit of valve 2 includes the primary winding 7 of a coupling transformer which has secondary windings 8 and 9 connected in series in the input circuit of the valve 3.

The primary windings 4 and 7 and the secondary windings 5 and 8 are tuned to the intermediate frequency by condensers 10, 12, 11 and 13 respectively, these condensers being adjustable, in the manner of the usual trimmer condenser, for the purpose of initial adjustment. When so tuned, the voltage in the secondary of each transformer is displaced in phase with respect to the voltage of the primary winding by 90 degrees when the intermediate frequency is correct. When this frequency shifts, however, from the correct value, this phase relation changes and the secondary voltage becomes more nearly in phase with the primary voltage, or more nearly opposed to it, depending upon the direction of the shift in frequency and, of course, the magnitude of the phase displacement is dependent upon the magnitude of the frequency shift. The secondary winding 6 of the first transformer and the secondary winding 9 of the second are untuned, but these windings are coupled to their respective primary windings to have induced in them a voltage which is at a fixed phase relation with respect to the primary winding, and which therefore constitutes in the secondary circuit a replica of the primary voltage. Accordingly, this voltage may be made exactly to equal and oppose the voltage in the secondary winding 5, or 8, when the frequency has shifted from the intermediate frequency by the amount of 10 kilocycles. The voltage of the secondary winding 5 may be adjusted to be equal and opposite to the voltage of the winding 6 at a frequency of 10 kilocycles above the intermediate frequency, and similarly the voltage of the winding 8 may be made equal and opposite to the voltage of winding 9 at a frequency of 10 kilocycles below the intermediate frequency. Thus, at these two adjacent channel frequencies, infinite attenuation in the system is produced, the adjacent channel above the intermediate frequency being infinitely attenuated in the coupling device 4, 5, 6, and the opposite adjacent channel being infinitely attenuated in the coupling device 7, 8, 9.

Voltage Adjustment

The voltage adjustment producing infinite attenuation can best be obtained by the use of resistors as shown at 14 and 15, one of these resistors being in circuit with winding 6, and the other in circuit with winding 9. These resistors may be either in series with the respective windings or in shunt, and the diagram illustrates both methods of connection. Both resistors may, of course be connected in the same way, and their values are selected to assist the securing of the desired phase relations between the voltages in the secondary circuit.

Since the voltage on winding 5 is displaced in phase from the voltage on winding 6 by 90 degrees at the intermediate frequency, it will be observed that windings 4 and 5 may comprise the normal transformer

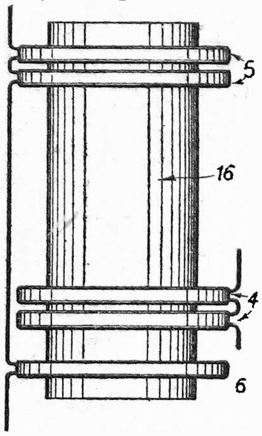


Fig. 2.—Method of winding the type of I.F. transformer described in this article.

coupling coils, since at the intermediate frequency the coupling is not appreciably affected by the winding 6. For this reason manufacturing variations in the coils 4 and 5 do not seriously affect the frequency at which infinite attenuation occurs, with the result that adjustment to take care of such manufacturing variations to secure the infinite attenuation of the adjacent channels is not necessary. In fact, it has been found that the adjustment of the coupling between coils 4 and 5, and similarly 7 and 8, to secure infinite attenuation at the adjacent channels is not more critical than the adjustment for critical coupling in the conventional intermediate frequency transformer.

Fig. 2 shows the structure of the transformer comprising the windings 4, 5, 6, in Fig. 1. While the arrangement of the windings and the structure of the transformer may vary widely, in the construction shown the secondary winding 5 comprises two coils mounted at one end of a coil support 16, and the primary winding 4 comprises two coils arranged near the opposite end. The winding 6 is arranged on the opposite side of winding 4 from the secondary winding 5 and is more closely coupled to winding 4 than is winding 5.

This system was developed in the laboratories of the G.E. Company of America.

NEW RECORDS

Dance Music

AMBROSE and his Orchestra have made two new records this month. They are "You Made Me Care" with a vocal by Vera Lynn and "In an Old Dutch Garden" on *Decca F* 7451, and "Indian Summer" and "My Capri Serenade" on *Decca F* 7452. Jack Payne and his Band also supply dance music with "Walkin' Thru' Mockin' Bird Lane" and "Me and the Moke and Liza" on *Decca F* 7454 and "Let the Curtain Come Down" and "Rainbow Valley" on *Decca F* 7453. Alex Moore presents Mantovani and his Music for Dancing on *Decca F* 7455-6. On the first record is a slow fox-trot "No Souvenirs" and a quick-step "Dancing is Another Name for Love" and on the other a quick-step "There's a Boy Coming Home on Leave" and "You Made Me Care," which is a waltz.

Rex

VOCAL recordings are supplied this month by that popular radio star Elsie Carlisle, with her version of "Walkin' Thru' Mockin' Bird Lane" and "A Little Rain Must Fall" on *Rex* 9775; Joe Peterson, who sings "I'm Praying To-night for the Old Folks at Home" and "You Made Me Care" on *Rex* 9771, and George Eldrick with "Arm in Arm" and "Light up Your Face with a Smile" on *Rex* 9773.

Dance music is supplied by Billy Cotton and his Band with "The Navy's Here" and "Let the Curtain Come Down" on *Rex* 9770, and "In an Old Dutch Garden" and "Rainbow Valley" on *Rex* 9766. Another popular dance band—Jay Wilbur and his Band—have also recorded this month. They play "Indian Summer" and "Dancing is Another Name for Love" on *Rex* 9767.

Notes from the Test Bench

Metal Panels

THE present shortage of metal has resulted in some difficulty in obtaining aluminium or copper for panels, chassis, etc. It may therefore be worth while remembering that a solid sheet of metal is not essential for the average receiver where screening is required. A very good substitute for a metal panel is an ebonite or wooden sheet, backed by ordinary perforated zinc. This is still available in fair quantities and as a screen is quite effective. Another alternative is to use fine mesh wire-netting. This is obtainable with ⅜in. mesh (used for bird aviaries) and on most apparatus, when earthed, offers a satisfactory H.F. screen. This material is, in fact, often employed in factories and test-rooms for screening off a section of the area for test purposes. A chassis could be made from perforated zinc, which solders nicely and offers only the difficulty that it is not rigid. Strengthening pieces may, however, be placed at corners or along edges, and ordinary plywood or angle strip from the popular constructional toy may be used for this purpose.

Test Apparatus

A DIFFICULTY which often besets the designer of an all-purpose type of test instrument is the selection of various voltage or other tappings. There is usually a range of outputs available at each type of test and it is often found that the most satisfactory plan is to use one or two flexible leads in conjunction with a number of sockets. Whilst this is a good plan there is the difficulty that should the plug be in a wrong socket the instrument may be damaged by connecting the test leads to, say, a high voltage for test purposes. Such a difficulty may be overcome by fitting a fuse, but this generally affects the range of the instrument or its accuracy. A better plan is to make use of a multi-contact selector switch, or a bank of such switches, so arranged that all that has to be done is to turn the indicator to the range desired and the internal switching is automatically carried out. This, of course, still leaves the human element, namely, that one must watch that the instrument is correctly indicated before making the test, but it simplifies this procedure as there will only be one indicator to attend to.

Classified Advertisements

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

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

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

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.

H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel: Pad. 5891.

LITERATURE

NEW Edition. American Amateur Relay League Handbook. 500 pages of up-to-the-minute technical information, 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.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make. 24-hour service, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

REPAIRS to moving coil speakers. 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.

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 CHASSIS

ARMSTRONG Co. recommending the following economically priced Radio Chassis for good quality reproduction.

ARMSTRONG Model AW38.—8-valve All-wave Radio-gram chassis, incorporating the latest circuit, including 6 watts push-pull output. Price £8/8/0 + 5% war increase.

Armstrong Co. have many other models of equal interest, please write for catalogue, 6d. Post Free. Armstrong Manufacturing Co., Warlters Rd., Holloway, London, N.5.

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.

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

FREE ADVICE BUREAU
COUPON
This coupon is available until June 22nd, 1940, and must accompany all Queries and Hints.
PRACTICAL WIRELESS, 15/6/1940.

PUBLIC APPOINTMENTS

MINISTRY OF AIRCRAFT PRODUCTION 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.

(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.

(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.

ACCEPTED candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three calendar months, and will be paid £3 15s. weekly during training. Subsistence allowance of £1 5s. weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £270 p.a. (payable monthly in arrear subject to a deduction of £12 p.a. for each year of age below that of 24. Examiners must be prepared to serve in any part of the United Kingdom.

NORMAL age limits 23 to 60.

CANDIDATES should indicate on their applications for which vacancy they wish to be considered—a, b or c.

APPLICATIONS must be made on form 786, copies of which can be obtained on application, by postcard only, to: The Inspector-in-Charge, A.I.D. Training School, (I.C.S. Rec. 53), Brandon Steep, Bristol, 1.

RADIO MAP AND GLOBE

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

READERS' BARGAINS

RADIOGRAM, good tone and working order, also all-wave table receiver. Must be good and reasonable price.—Roberts, Rural Structures, Amersham.

BTY. B.T.S. Trophy S.W. Three, £2 15s. Bty. straight S.W. Three, 26s.—8, Retford St., London, N.1.

FERRANTI m/c Meter, 500 m.a., 2½" dial, 15/-; Weston ditto, 200 m.a., 12/6; Eddystone 1v. battery pre-selector-converter, 25/-; S.H. "Mercra" Mercury vapour lamp, 150-watt, 10/-; 100 copies "Popular Wireless," August, 1935 to December, 1937, 10/-; 150 copies "PRACTICAL WIRELESS," August, 1935 to December, 1938, 15/-; 1lb. mercury, 10/-; parcel components (used), £1. All post free.—130, Hollycroft, Hinckley.

RECEIVERS AND COMPONENTS

LONDON CENTRAL RADIO. WE HAVE A FEW SPARTON 5-VALVE PRESS-BUTTON RECEIVERS LEFT, £4/5/- EACH. FOR FULLER DETAILS SEE "PRACTICAL WIRELESS," JUNE 1st ISSUE.

OLDHAMS.—Ex-Police, slightly used, unspillable 2v. 7 amp. Accumulators, suitable for Lamps, Portables, etc., 2/- each. Heavy Black Twin Flex, 20 yards, 2/6.—**London Central Radio, 23, Lisle Street, W.C.2.** Gerrard 2969.

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

COULPHONE Radio, Ormskirk. Collaro A.C. Motors, 12in. turntable, 27/6. Radiogram Units, 45/-. High quality crystal pickups, 25/-. Rola G.12 speakers, energised, 52/6. G12 P.M., 65/-. Guaranteed American valves, 4/6 ea. Octal, 5/6. 1d. stamp for lists.

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

RECEIVERS AND COMPONENTS

RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. TELEPHONE: HOLborn 4631.

LISSEN 2v. screen-grid valves, S.G.215 and S.G.2V, 3/6 each.

LISSEN 2v. battery pentode, 4-pin side terminal P.T.2A and P.T.225, **3/11** each.

LISSEN 4v. mains screen grid A.C./S.G., **4/11** each.

LISSEN 4v. mains output pentode A.C./P.T., **4/11** each.

LISSEN rectifier valve V650, **2/11** each.

ALL-WAVE super-het. chassis, 5 valve A.C. Latest Mullard valves T.H.4.B., V.P.4.B., T.D.D.4., Pen. A.4., L.W., 4/350v. Ranges: short wave 16-48 metres. Medium wave 200-560 metres. Long wave 800-2,200 metres. Size of chassis, 14½in. long, 7½in. deep, height overall 8½in. Controls, tuning at side. Volume on/off at side, wave-change, provision for pick-up. Complete with valves and knobs, **£4/17/6**. Special Speaker, 1,500 ohms field, **10/6** each.

ULTRA SHORT and short-wave choke. Lissen Hi-Q. Inductance, 100 microhenries. Boxed, list, 2/-. Our price, **1/-** each.

ULTRA SHORT and short wave double wound low-resistance choke. Lissen Hi-Q. resistance less than .05 ohms. Boxed, list, 2/6. Our price, **1/3** each.

LOW-LOSS Ceramic valve-holders. Lissen Hi-Q. Baseboard and chassis, 5- and 7-pin, **10d.** and **1/-** each.

MANSBRIDGE type condensers. Lissen Hi-Q. 250 D.C. working. Moulded case with feet .1 mfd. and 1 mfd., **6d.** each.

ROTARY COIL UNIT. Lissen Hi-Q. Four-band from 4.8-91 metres, can be selected by a turn of the knob. With circuit. Boxed. List, 15/6. Our price, **6/11** each.

LOW-LOSS short-wave variable condensers. Ceramic insulation. Brass vanes. Lissen Hi-Q. Minimum capacity 5 micro-micro farads. Two types. Boxed. With knobs. 160 mmfd. List, 7/6. Our price, **3/-** each. 20 mmfd. List, 5/6. Our price, **2/6** each.

CONE speaker unit. Lissen. Complete with reed and chuck. Boxed, **1/-** each.

PUSH-PULL switches. Lissen. 2-point, **4d.** each. 3-point, **6d.** each.

ROLA P.M. speakers. Latest type, 7½" cone with power and pentode transformer. Boxed. **15/-** each.

CLOCK-FACED dials. 5" x 3½". With printed 3-wave scale. Ox-copper escutcheon and glass, **3/6** each. Ditto, less escutcheon, **2/6** each.

FILAMENT transformers, input 200-250v., output 4v.4 amps., 4v.6 amps., **4/11** each.

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