WHY THE GRID LEAK? — See Page 190

A NEWNES PUBLICATION

Edited by F. J. CAMM

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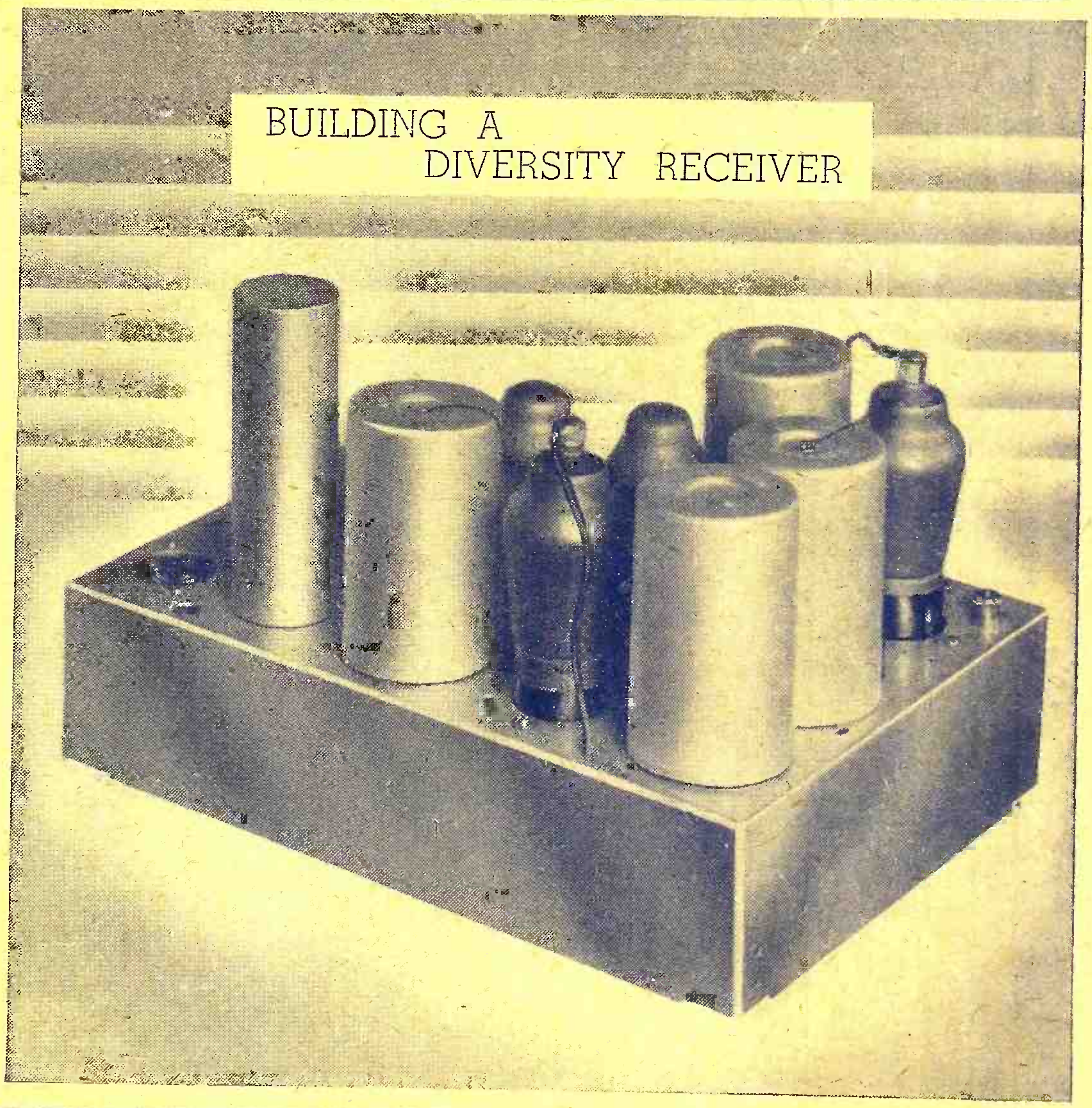
Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 18th, 1940.

Contents



NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 101

SYMBOLS

Admittance	Y
Amplification Factor	μ
Capacity	C
Current	I
Conductance	G
Dielectric Constant	ϵ
Efficiency	η
Electrostatic Flux Density	D
E.M.F. (voltage)	E
Energy	W
Frequency	f
Impedance	Z
Magnetic Field	H
Magnetic Flux	Φ
Magnetic Flux Density	B
Period Time	T
Permittivity	κ
Phase Angle	ϕ
Power	P
Quantity	Q
Reactance	X
Reluctance	S
Resistance	R
Resistivity	ρ
Self-inductance	L

UNITS

Ampere	A
Ampere-hour	Ah
B.O.T. Unit = 1,000 watt-hours, or 1 kilo-watt-hour	
Coulomb	C
Farad	F
Henry	H
Joule	J
Kilovolt-ampere	kVA
Ohm	Ω
Volt	V
Volt-ampere	VA
Watt	W
Watt-hour	Wh

PREFIXES

Kilo	k
Mega	M
Micro	μ
Milli	m

No. 102

L.T. METAL RECTIFIERS

Rectifier	With Tapped Transformer: Charging Rate Amps	No. of 2-volt cells	Resistance Ohms	A.C. Input Volts	With Tapped Resistance: Charging Rate Amps	No. of 2-volt cells	Resistance Ohms	A.C. Input Volts
L.T.4	1	1 2 3	1.75	7.5 9 11	1	1 2 3	5.25 3.25 1.75	11
L.T.5	1	3 5 6	1.75	15 18 22	1	3 5 6	7 3.5 1.75	22
L.T.7	—	—	—	—	0.5	1	2.5	4+4
L.T.8	—	—	—	—	0.5	1 2 3	4.5 3.5 2.5	8+8
L.T.9	—	—	—	—	0.5	3 6 6	11 7 5	16+16
L.T.10	2	3 5 6	1	14 17 20	2	3 5 6	4.5 2.5 1.0	20
L.T.11	4	1 2 3	0.25	6 8 11	4	1 2 3	1.5 1 0.25	11
A.4	2	1 2 3 4	0.5	5.5 7.5 9 14	2	1 2 3 4	3.5 3 2 1.5	14

Note.—The L.T.7, L.T.8 and L.T.9 are unsuitable for use with tapped transformer for control.

No. 103

H.T. METAL RECTIFIERS

Style	Rated Smoothed Output: Volts	mA	Max. Current mA	INPUT Open Circuit Voltage: Half Wave Volts	Half Wave mA	Voltage Dblr. Volts	Voltage Dblr. mA	Capacity of each Voltage Doubler Condenser	Working Voltage of each Condenser
H.T.14	130 120	15 20	30	135	30	80	60	4 6	200
H.T.15	200	30	40	250	80	140	120	4	200
H.T.16	300	60	60	400	90	240	200	4	400
H.T.17	200	100	150	250	150	150	300	8	250
H.T.17 used for Class B	150	25	—	150	40	—	—	Reservoir Condenser 8 mfd	350
Two H.T.17 used in Series	500	120	150	—	—	300	550	6	500

104

H.F. METAL RECTIFIERS

Model	Type	Length	Max. Safe Input Voltage	Max. Current Output	Colour of Label
W.4	Half-wave	1 15/16 in.	24-v. peak carrier	0.25 mA.	Yellow
W.6	Half-wave	1 15/16 in.	36-v. peak carrier	0.28 mA.	Blue
WX.6	Half-wave	1 15/16 in.	36-v. peak carrier	0.12 mA.	White-Blue
WM.24	Full-wave, centre tap	3 in.	24-v. each side of centre tap.	0.5 mA.	Yellow
WM.26	Full-wave, centre tap	3 in.	36-v. each side of centre tap.	0.5 mA.	Blue

Formulæ Relative to Circles

To find Circumference of a Circle:
Multiply diameter by 3.1416; or
Divide diameter by 0.3183.

To find Diameter of a Circle:
Multiply circumference by 0.3183; or
Divide circumference by 3.1416.

To find Radius of a Circle:
Multiply circumference by 0.15915; or
Divide circumference by 6.28318.

To find the Area of a Circle:
Multiply circumference by one-quarter of the diameter; or
Multiply the square of diameter by 0.7854; or
Multiply the square of circumference by 0.07958; or
Multiply the square of ½ diameter by 3.1416.

No. 105

COMPARATIVE RESISTANCE OF VARIOUS METALS AND ALLOYS

Material.	Resistivity in International Microhms at 0° Cent.: Centimetre Cube.	Inch Cube.	Relative Resistance.
Annealed Silver	1.48	0.583	1
Annealed Copper	1.55 to 1.61	0.610 to 0.633	1.04 to 1.09
Hard-drawn Silver	1.58	0.622	1.07
Hard-drawn Copper	1.59 to 1.64	0.626 to 0.646	1.07 to 1.11
Annealed Gold	2.05	0.807	1.38
Hard-drawn Gold	2.080	0.822	1.41
Annealed Aluminium	2.43	0.96	1.64
Silicium Bronze	2.5	0.98	1.69
Pressed Zinc	5.61	2.21	3.79
Tungsten	6.4	2.5	4.3
Annealed Nickel	6.94	2.73	4.69
Phosphor Bronze	7.80	3.07	5.27
Annealed Platinum	9.04	3.55	6.09
Annealed Iron	9.7	3.82	6.56
Gold-Silver alloy (2 oz. gold, 1 oz. Silver) hard or annealed	10.8	4.27	7.33
Pressed Tin	13.2	5.19	8.9

No. 106

COMPARATIVE RESISTANCE OF VARIOUS METALS AND ALLOYS (continued.)

Material.	Resistivity in International Microhms at 0° Cent.: Centimetre Cube.	Inch Cube.	Relative Resistance.
Pressed Lead	19.6	7.71	13.2
German Silver	19.0 to 42.2	7.48 to 11.8	12.8 to 20.2
Platinum-Iridium alloy (density 21.32)	22.2	8.73	15.0
Platinum-Silver alloy (1 oz. Pt., 2 oz. Silver) hard or annealed	24.3	9.58	16.4
Platinoid	34	13.4	23
Pressed Antimony	35.4	13.9	23.8
Manganin	42	16.7	28.7
Nickelin	43	17	29
Eureka	47	18.5	32
Ja Ja	51	20	34.5
Kruppin	85	33	57
Mercury	94.08	37.04	63
Pressed Bismuth	108	42.5	73
Carbon	4,000 to 10,000	1,600 to 4,000	2,700 to 6,700

(See also page 202)

Practical and Wireless
★ PRACTICAL TELEVISION ★

EVERY WEDNESDAY
Vol. XVI. No. 400. May 18th, 1940.

EDITED BY
F. J. CAMM

Staff:
W. J. DELANEY, FRANK PRESTO
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Why and Wherefore

THE majority of amateurs have studied the need for certain parts in a circuit, and the characteristics of valves; the use of transformer or resistance-capacity coupling, and similar details have been fully gone into. There are, however, certain items which are still just put into the circuit because they are accepted in that position, and their actual function or the reason why they are used is not known. For instance, the usual grid condenser and grid leak in a detector stage. If you ask the ordinary amateur why he uses them he will no doubt say that they are necessary in a grid-leak detector, and thus you cannot do without them. But their purpose, or why it is necessary to include them, may be unknown. Unfortunately, these items are not often discussed as they are accepted facts, and the latitude in values is not very great so that they do not lend themselves to discussion. However, for the benefit of those who are interested in every part of the circuit, we give in this issue some notes on the grid leak, and from time to time will deal with other accepted items which are in common use.

New Zealand Air Mail

THE Postmaster-General announces that air-mail correspondence for New Zealand, which has hitherto been forwarded by air as far as Sydney, Australia, and thence by surface route, will in future be conveyed by air throughout to New Zealand. There will be no alteration in the existing air postage rate of 1s. 3d. per half-ounce (postcards 7d.).

A Musical Journey Round Britain

AT this season with the near approach of summer and nature looking its loveliest, it is pleasant to turn one's thoughts for a brief space to the countryside of Britain. Listeners will be assisted in this way when "Round Britain," a musical journey, is broadcast in the Home Service on May 18th. H. V. Morton, whose colourful pictorial descriptions of sights and scenes in our own and other lands are so well known, will take listeners on this musical journey, and his words will be illustrated with music played by the B.B.C. Theatre Orchestra conducted by Stanford Robinson. Well-known artists from various parts of Britain will also be heard. The programme, which has been arranged by Gwen Williams and George Lestrange, will be one of the popular sessions given by the B.B.C. Theatre Orchestra under the title, "Saturday at 9.35."

"Itma"

FRANCIS WORSLEY, who was responsible for the radio version of "It's That Man Again," will be renewing pleasant associations when he goes to Manchester on May 18th to superintend the broadcast of the show from the Palace Theatre. "Itma," as many listeners will know, has been touring the country for some time past, and has proved itself to be one of the most successful road-shows of recent years. Listeners on May 18th will tune-in to music mysterioso and the sepulchral tones of "This is Funf speaking"—whereupon, after a vague conversation with Mrs. Tickle, a weird black figure quits a ghostly telephone-kiosk and vanishes into the pillar-box. This pillar-box thereafter causes most of the mischief. It should be pleasant to renew acquaintance with Tommy Handley, Maurice Denham, Jack Train, and all the other "Itma-ists."

"Dig for Victory" but don't miss Mr. Middleton! An Ekco portable radio keeps these allotment enthusiasts in touch with his latest hints and tips . . . and, anyway, music hath charms to ease the aching back.

"The Pig and Whistle"

SYD WALKER is to make his first appearance in Ernest Longstaffe's popular feature, "The Pig and Whistle," on May 15th. He will arrive at this now famous hostelry complete with his junk barrow. On this occasion, his merchandise will probably have to include hoes, pitchforks, and packets of garden seeds. The more permanent inhabitants—Charles Penrose, Charles Wreford, John Rorke and Miriam Ferris—will be there to give him a rousing welcome.

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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.

The Manchester Cup

ONE of the outstanding sporting broadcasts in the Home Service programme in the near future will be a commentary on the running of the Manchester Cup Races at Castle Irwell on May 17th. The commentary will be given by Richard North.

A Newark Band

RANSOME and Marles Works Band, from Newark, will have its second war-time broadcast on May 20th, in the programme for the Forces. This band, when in its first year, won the Butlin Cup in the Skegness contest in September, 1938. David Aspinall is the conductor.

"Star Chamber"

A NOEL COWARD comedy is to make its broadcast début on May 18th. This is "Star Chamber," an amusing study of actors and actresses. The producer will be John Cheatle.

WHY THE GRID LEAK?

A Simple Explanation of the Action of a Leaky-grid Detector Valve

By FRANK PRESTON

THE grid leak is such a simple component that the constructor seldom stops to consider what its function is, and how it changes an H.F. amplifier into a detector. I understand that several applicants for enrolment as radio mechanics in the Services have been asked to explain the action of the grid leak; unfortunately, a large number have failed to satisfy the examiner with their answer. It is to be hoped that examiners have not failed many applicants on this point alone, for the question is by no means an easy one to deal with, especially when suddenly asked in verbal form.

Different theories have been advanced concerning the precise behaviour of the leak, but there is one which is generally accepted and which certainly "fits in" with our understanding of valve operation and with simple tests by current measurement. It should be understood right away that a triode valve detector does not act as a "one-way valve." Nor does it convert alternating into pulsating direct current. It may be assumed that a crystal detector or even a diode acts in something like that manner, but a triode (or tetrode or pentode used as one) does not behave in that way.

Modulated Waves

Actually, the name "detector valve" is not a happy choice, but it is not easy to find a better one. Perhaps demodulator is more satisfactory, for the valve does—to a certain extent—separate the modulation from the carrier wave or signal current. It does not do this, however, by completely blocking one and permitting freedom of passage to the other. What it does is to modify the modulated signal current so

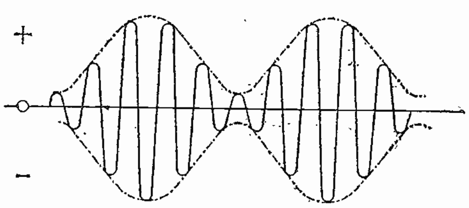

Fig. 3.—This diagram shows the form taken by a carrier wave modulated by a pure note.

that only the low-frequency component affects the variation in anode current.

To understand this matter more fully it is necessary to consider the form taken by an unmodulated and a modulated signal current. The former is shown in the usual graphical form in Fig. 1, where it will be seen that there is a constantly repeating wave or up-and-down curve. This is of such a high frequency that if it were applied to the grid of a valve it would not produce any audible note in a speaker suitably connected across a load in the anode circuit. So rapid is the change-over from positive to negative that, in effect, the successive half-cycles "cancel out."

The low-frequency or audio-frequency current—the modulation—is represented by a curve similar to that shown in Fig. 2, although this is drawn to show a pure note. In the case of most sounds the curve would be very much more uneven, although the general form would be similar. When the two waves are combined, which is the same as saying when the carrier wave is modulated, we have a curve of the form indicated in Fig. 3. This, it may be seen, is a series of waves divided into sets which gradually rise in voltage from zero to maximum; and then fall again.

Modifying the Curve

As we know, it is the purpose of the

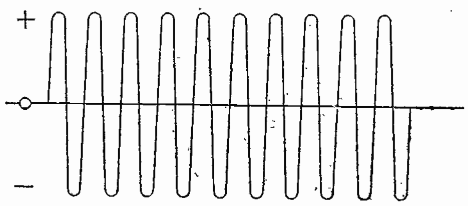

Fig. 1.—This diagram represents the carrier wave, which consists of H.F.

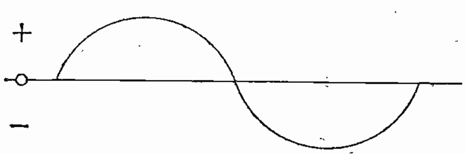

Fig. 2.—The L.F. or modulation curve.

detector valve to produce the equivalent of the L.F. oscillation represented by the curve in Fig. 2. It is clear that a series of waves such as those shown in Fig. 3 would be useless because, as in the case of the unmodulated wave, the successive half-cycles still cancel out, due to the symmetry of the curve about the centre, or zero-voltage line.

This brings us back a little nearer to our starting-point, the leaky-grid detector. The essential part of the grid-leak detector is shown in Fig. 4, and here it will be seen that the modulated signal is fed to the grid of the valve through a fixed grid condenser, and that the grid leak is joined between the grid of the valve and the filament.

Attraction of Electrons

When a modulated wave of the form represented by Fig. 3 is applied to the grid condenser, this component is charged and then the charge is passed on to the grid. There is a reversal of potential as the next half of the cycle comes into play, and the condenser is discharged. This continues, the grid being made positive and negative alternately. At each positive half-cycle some of the electrons (which comprise the anode current) passing from the filament to the anode are attracted to

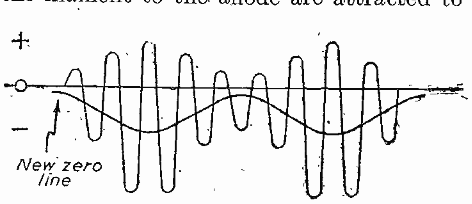

Fig. 5.—After detection by a leaky-grid "detector," the curve shown in Fig. 3 is modified to the form shown above. This the "mean" (corresponding to the modulation) is able to affect the anode circuit.

the grid. At each negative half-cycle the grid tends to repel the electrons.

As a result of this, there is a tendency for electrons (negative "particles" of electricity) to accumulate on the grid, making it increasingly negative. After a time the grid would become "choked" and the valve would cease to operate, since the high negative bias on the grid would seriously curtail the anode current.

Automatic Bias Effect

This is on the assumption that the grid leak was not connected. Since it is connected it allows the surplus electrons to escape to the filament, which is positive in respect to the grid. When this happens, we have the condition in which grid current is flowing. And when a current is passed through a resistor there is a voltage drop across the resistor, and a potential difference between its ends. In the case under consideration the resistor is the grid leak, and the potential between its ends is applied in the form of grid bias. The important difference between this bias and that supplied by means of a dry battery, or by the drop in voltage across a cathode-lead resistor, is that its value is dependent upon the strength of the applied signal. This is the same as saying that it is dependent upon the amplitude of the modulated wave.

Since the negative potential varies with the signal we get the effect shown diagrammatically in Fig. 5. It will be seen that the zero line has been curved to follow a mean of the waves comprising the modulated signal. In other words, the effect of the grid leak has been to produce a mean fluctuating grid potential of the form shown in Fig. 5—and which corresponds with that shown in Fig. 2. The result affects the anode current of the valve in almost the

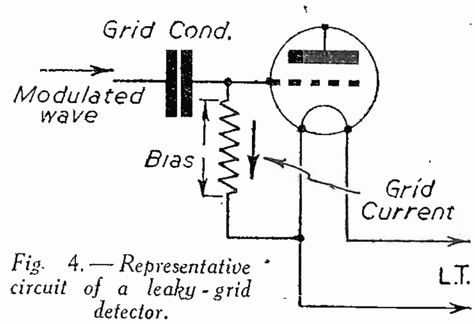

Fig. 4.—Representative circuit of a leaky-grid detector.

same way as if only the low-frequency portion of the modulated signal current was applied to the grid.

Component Values

It is possible to find by calculation optimum values for the grid condenser and leak, but the matter is one of complexity, and theoretical determination may not always agree with practical experimental results. In practice it is generally found that the values are by no means critical from the point of view of satisfactory demodulation (I prefer this word to detection and rectification, especially the latter), although selectivity may suffer if the capacity is increased and/or the resistance reduced. The customary values of

(Continued on page 201)

Getting the Best from the Pick-up

Connections, Tone Control and Scratch Filters are Dealt With in This Article By W. J. DELANEY

MANY constructors purchase a pick-up and connect it to their receivers with disappointing results. Others change from their present pick-up to what is purported to be a better one, and meet with similar disappointment. Actually, of course, a pick-up is quite a simple piece of apparatus, and its connection to the receiver is equally simple, but there are one or two points which, if not attended to, will result in failure to obtain the best from it. First of all, it must be emphasised that there are two main types of pick-up—the electro-magnetic and the piezo-crystal. The latter is often credited with providing the best results, but gives more trouble than the other type simply because it is wrongly used. There is no doubt that when properly connected and used the crystal type of pick-up does give the best overall performance, but there are one or two important items to watch with this type of instrument, and these will be discussed in their turn.

Connections

Under normal conditions the pick-up, no matter what type, has to be joined to the grid of an L.F. valve or a valve in the receiver which may be converted into an L.F. valve. This, therefore, includes the normal detector stage, as it is a simple matter to convert this into an L.F. amplifier. With battery valves, the necessary grid bias for correct L.F. working may be applied through the pick-up, and thus one pick-up lead is joined to the grid and the other lead to the grid-bias battery. To cut out the radio section of the receiver a change-over switch is the most suitable item. In the case of mains valves the valve may receive its bias automatically by means of a resistance in the cathode lead and thus the pick-up may be joined direct to the earth line. The essential arrangements for these two schemes are shown in Figs. 1 and 2, a change-over switch being indicated in both cases for the radio-gram switching.

In the case of the crystal pick-up, the connections which have been shown are not complete as the grid circuit must be completed, and there is no direct current connection through the crystal as in the case of the magnetic type of pick-up. Accordingly a volume control or similar

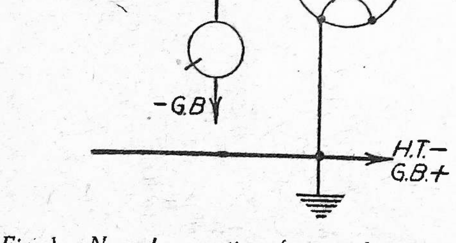

Fig. 1.—Normal connections for a pick-up with a battery-operated triode.

resistance must be joined in parallel with the pick-up as indicated in Fig. 3. Here it is essential to follow the makers' recommendations regarding values, as the whole response curve of the instrument may be upset by the use of a wrong value, whilst additions may be necessary to preserve or cut out certain frequencies.

Volume Control

This brings us to the general question of volume control, and although many pick-ups are fitted with a control on the carrier arm, this may be insufficient for the particular apparatus with which it is used, or alternatively may not be needed at all—owing

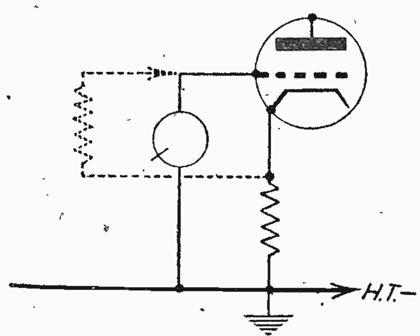

Fig. 2.—Normal connections for a pick-up in an indirectly-heated valve. If a detector, the grid leak is connected as shown by the broken lines.

to insufficient power in the amplifier. A good magnetic pick-up will deliver sufficient volume from a two-valve battery amplifier, or in the case of mains apparatus a three-stage amplifier could be used provided the output valve was capable of handling the signal. The average output for a good magnetic pick-up is about 1.5 volts, and from this it will be seen just what type of valve should be fed from it and how many additional stages may be used. If a simple type of pick-up is being used—that is, one without a volume control incorporated, and the amplifier or receiver has a volume control between the input valve and the next stage, it may be found that the input valve will be overloaded, with consequent distortion which cannot be cured by any adjustment of the volume control. Therefore, it should be the aim to fit the pick-up in such a position that the control may regulate the actual signal being fed to the first valve, on the assumption that this will be of a type which will handle the lowest power in the receiver. The value of the volume control should be between 250,000 ohms and 1 megohm. In the case of the crystal pick-up for average use a value of 500,000 ohms is suitable, but a reduction in the value will result in a reduction of the bass response. Down to 100,000 ohms may be used if desired. On the other hand, to preserve the higher frequencies the higher value of volume control should be used and a condenser should be included across the control as

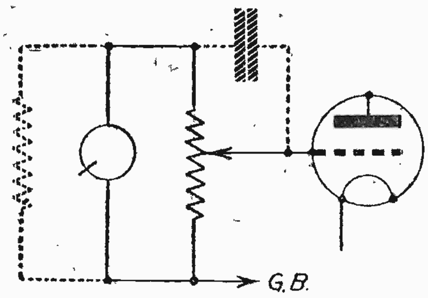

Fig. 3.—Connections for a piezo-crystal pick-up. The shunt and fixed condenser are referred to in the text.

shown in Fig. 3. Values from .005 to .01 mfd. may be tried. If the bass is overpowering due to poor amplifier design or speaker mounting a resistance may be shunted across the pick-up—a value of 1 megohm attenuating frequencies below 1,000 cycles per second.

Needles

A point which is often overlooked is the choice of suitable needles. Although most of those now on the market are designed for electrical pick-ups there are differences which may make a considerable difference to reproduction. For instance, a very thin (soft tone) needle may result in a weak, high-pitched reproduction, whereas a thick (loud tone) needle may result in lack of brilliancy. Generally speaking, the half-tone type of needle will be found best for all-round results, any necessary adjustments being made in the design of the amplifier or choice of volume control. Many listeners prefer the fibre type needle, and provided that there is not an undue weight on the record these are quite satisfactory. The crystal pick-up is light and they are therefore satisfactory with this type of instrument.

Scratch Filters

Under normal conditions the scratch should not be unduly prominent. Scratch filters merely attenuate frequencies above a certain level and thus in addition to the elimination of the scratch or surface noise the musical frequencies also will be lost. This will result in a loss of brilliancy, and it is up to the listener to decide whether the music is better fully balanced, but with slight background noise, or whether an unbalance with no background is preferable. If the records are well cared for, good needles are used, and the pick-up is a good model, there should be no need for any artificial tone devices or scratch filters. Although a condenser across the pick-up may cut out sufficient noise, a properly-designed filter is preferable as this will not be broad in its effect and will thus have a less marked effect on the general musical response. The makers of the pick-up may make some special recommendations regarding the use of this type of filter with their particular instrument, giving you data as to its resonant peaks (if any), and therefore their recommendations should be followed in this respect.

Comment, Chat and Criticism

Tschaikowsky's Last Works

A Review of the Great Composer's Symphonies, Ballets and Concertos, by Our Music Critic, MAURICE REEVE

ALTHOUGH only three years elapsed before the fourth symphony saw the light, it showed that Tschaikowsky had taken several giant's strides forward in his development. He passed in one bound from a composer of good, workmanlike compositions to a creator of masterpieces. The fiery passion, the haunting melancholy, several innovations, ravishing melodies and rhythms, dazzling orchestration, all these compel us to use the adjective great to this work and its companions.

It was dedicated to "my best friend," none other than Mme. von Meek. When Taniew asked whether it should be considered as programme music, he replied that "certainly it had a poetic basis. Moreover, I must confess to you that in my simplicity I had believed that the idea of this symphony was so clear of comprehension that its general meaning could be grasped by all without a programme."

In a long letter to the dedicatee he said, "The introduction is the germ of the entire symphony. That is fate, that tragic power which prevents the yearning for happiness from reaching its goal which jealously strives that happiness and peace shall not obtain the mastery, that the heavens shall not be free from clouds, a power which constantly hangs over us like the Sword of Damocles, and ceaselessly poisons the soul. This power is overwhelming and invincible. Nothing remains but to submit and lament in vain."

Its reception was overwhelming, and a repeat performance followed.

The Fifth Symphony

Eleven years elapsed before Tschaikowsky gave the fifth to the world. This glamorous and exotic work marks a further advance in the composer's mastery both of orchestral tones and architectural design. Although the writer prefers the sixth, the E minor would probably be voted into the seat of preference, especially by Promenade Concert fans.

Chief points of interest are the very original choice of key for the second subject of the first movement—D major—a flat seventh above the tonic; the large number of subsidiary subjects preceding it, each one of which seems important and charming enough to be the second subject itself; and the introductory theme which serves as a motto, and consequently recurs in each movement in various disguises.

The slow movement is a perfect poem, tender and impassioned in turn, but always charged with romance and perfume. The third is a most wistful waltz, taking the place of the customary scherzo: while the fourth is a huge, glittering conclusion: glamorous and exciting, but perhaps a bit garish, and the least interesting, musically, of the lot.

Sixth Symphony

Whether preferred or not Tschaikowsky's sixth symphony, written in the year of his death, is unquestionably his finest work, and a masterpiece of symphonic writing judged from any standpoint. It scales heights and plumbs depths which are at least a little loftier and a little deeper than he touched anywhere else. And between both he draws on the very well-springs of humanity itself.

It is a work painted in deep purples and rich browns, from its marvellous opening introduction on ghost-like double basses through which a bassoon foreshadows the chief theme, to its wraith-like close in equally deep valleys and shadows. The choice of a slow movement in first movement form with which to close the work was a master-stroke, and solved many problems which the symphonists had been trying to solve ever since Beethoven's death.

Many fierce and brilliant rays of sunshine pierce the dark clouds, notably the march-like scherzo, which is a flaw in its way, as it seems to be alien to the general temper of the remainder. The second movement, a kind of scherzo and trio, is that delightful number with five beats in a bar.

Perhaps the finest passage of orchestral writing Tschaikowsky ever put on paper is the recapitulation in the first movement where, after modulating from the astounding key of B flat minor, the theme is given out in slow fortissimo in dialogue between strings and wind.

Space compels me merely to record the fact that Tschaikowsky also wrote, in 1885, a programme symphony "Manfred," based on Byron's poem. Although possessing many claims to the title of a symphony, the work is not included in the set of symphonies, as it is not on pure orthodox lines. It is a splendid work, but one of the most difficult in the orchestral repertoire. As it also takes an hour and five minutes to perform there is no surprise in the fact that we do not hear it very often.

Three Ballets

Who is there who doesn't know Tschaikowsky's three famous Ballets, "The Swan Lake," "The Sleeping Beauty," and "The Nutcracker"? The latter, in its French title of Casse Noisette, might successfully compete for the honour of being the most widely and frequently performed work extant. They were completed in 1875, 1890, and 1892 respectively. The two latter, therefore, represent the master at his ripest and maturest. There is also the "Music for a Fairy Tale," "The Snow Maiden," or "Snegourotchka," written in 1875.

This latter work, consisting of an introduction and 18 numbers, so pleased the composer that he intended composing an opera upon the story, a fairy tale by Ostrowsky. But during delays caused, among other things, by a not too favourable reception upon its first production, Rimsky-Korsakow stepped in and wrote his famous opera upon the same story: one of the most delightful and accomplished of all Russian operas, as it also is one of the most popular.

Tschaikowsky was certainly a king of valse writers, and such masterpieces of seductive rhythm and melody as those from Casse Noisette, The Sleeping Beauty, and Eugene Onegin would, on their own, render that title proof against any successful challenge. They are magical in the sway they exercise and completely capture both our hearts and senses.

Concertos

Tschaikowsky's concertos next demand our attention. Two of them are masterpieces: that for violin, in D, and the first for piano, in B flat minor. There are also the second for piano in G and a third uncompleted, in E flat: together with the "Variations on a Rococo Theme" for 'cello. This is one of that instrument's finest works.

The story of the first piano concerto is rather remarkable and I am sure it will interest my readers, especially as the work itself is so widely known and so frequently performed. In a long letter to Mme. von Meek the composer explains that, not being a competent pianist, he decided to seek the advice of one on matters of technique and pianistic suitability, but not on the general lines of the work itself. Who else would he select for this purpose than Nicholas Rubinstein?

In picturesque phrases he tells how Nicholas Gregorievich listened to the concerto right through without a comment of any sort—a sinister omen. Then, after a pause, how he burst into torrents of abuse, saying how it was worthless as music, and quite impossible to play. Deeply mortified, Tschaikowsky ordained that not one note of it should be altered. Taking up the despised manuscript, he sought Hans von Bulow, who, already an admirer of his music, waxed enthusiastic over it and declared it to be quite the finest thing Tschaikowsky had at that time accomplished.

Consequently it bears von Bulow's name at its head as the dedicatee: but it is pleasant to record that Nicholas Gregorievich repented, about five years later, to the extent that he added it to his repertoire, and brilliantly performed it in most of the countries of Europe.

The opinion as to its being impossible to play makes a glaring shaft of light shine on modern methods of piano technique, because the numbers of pianists which play this famous work to-day are absolutely legion, and their ranks include many ladies. Moiseiwitsch is one of its most brilliant exponents, and few of my readers can have missed all of his multitudinous performances of it from the Promenade Concerts and elsewhere. Space compels me to wind up the review of Tschaikowsky and his music, so I can only record, catalogue-wise, his many other splendid works. Most notable are the Symphonic Poems "Romeo and Juliet," "Francesca da Rimini," "Hamlet," etc. The delightful Capriccio Italien, the piano trio and the chamber works, suites for strings, Mozartiana, hosts of songs, and last, but not least, the overture "The Year 1812."

ON YOUR WAVELENGTH

By Thermion

"A Bogy Laid"

MY paragraph under the above title in our issue dated May 4th has brought a reply from Mr. E. C. McKinnon, Chief Engineer to the Chloride Electrical Storage Co., Ltd. This is what he says: "You have apparently regarded my analysis of the solution to a problem appearing in PRACTICAL WIRELESS as savouring of a pill, and in return offer me a gilded pill as a mark of camaraderie. My views towards dopes of any description are already well known.

"I have before me three sets of battery instructions issued by makers of repute, and read therein:

1. Never add acid.
2. Putting acid or electrolyte into the cells can do no good, and may do great harm.
3. Never add acid except on expert advice.

"You claim that No. 3 lets you in and justifies your assertion that because a battery has been in service for some time, the acid in it is in need of replacement, even if this is in direct opposition to the battery makers' instructions.

"But you support your statement by the explanation: 'Conditions which exist at the average charging station result in continued dilution of the electrolyte. Consequently, after a long period of use the electrolyte becomes for the main part distilled water.'

"Do you seriously believe that this represents present-day average service station standards? I strongly doubt it. I am technical consultant for several hundred charging stations, and can only conclude that these must all be well above the average.

"My personal views towards the general standard of your paper on battery matters are sincerely expressed in the article referred to by you, wherein I stated: 'PRACTICAL WIRELESS deserves complimenting for the interesting practical hints which it publishes from time to time.'"

I am obliged to Mr. McKinnon for his letter. I do not, of course, question his judgment, for in his special position he must know far more about accumulator practice than most. I have not the least doubt that the Chloride Electrical Storage Company takes extreme care to see that its own charging stations are efficiently run. I was referring to the average charging station, and my remarks were not intended, as Mr. McKinnon facetiously supposes, as "dope." I was not, indeed, endeavouring to find a way out nor to be "let in." I am a trained engineer, and I suppose I have had rather more to do with garages and charging stations generally than the average reader. It is my experience that the average charging station—and there are many thousands who are not Exide Agents—is not too careful in its treatment of accumulators. By pure coincidence a letter arrived by the same post as Mr. McKinnon's letter. It came from Mr. G. E. Cockroft, and here it is:

"Your article in 'On Your Wavelength,' in the May 4th issue, 'A Bogy Laid,' reminded me of an experience I had, which might be of interest.

"I purchased a brand-new car accumulator, and had it filled with acid and charged at a wireless shop. Although the battery was perfectly satisfactory for the lighting and holding the charge, it simply refused to work the starter.

"The electrolyte was found to be the trouble; the acid was too weak. I often wonder if a good battery is thrown away sometimes."

Splitting the Programmes

AN inventor living abroad makes a suggestion that each item of the programmes should be radiated from a different station. Thus, there would be separate stations for talks, classical music, jazz, plays, religious services, educational talks, and so on. Each station would transmit its features for a certain number of hours a day. This, he thinks, would entirely get rid of the criticisms levelled at present programmes. It is impossible to plan a programme which in its entirety would appeal to every listener. Under his system listeners who have no time for anything but classical music would be able to listen in to the station which broadcasts nothing else, and the same would apply to the jazz and crooner fans, to those who like plays, and so on. It would enable the listener to switch on and listen to his favourite subject whenever he was disposed to do so, instead of as at present being tied to a particular hour. Seems to be something in the idea.

Trespass

A FINANCE company was recently fined £50 for trespass. The facts are that a man was unable to keep up the hire-purchase payment on a wireless set because his business had been wrecked by war conditions. He was thus protected by the Courts (Emergency Powers) Act. The finance company who were the owners of the set broke a pane of glass in the man's house, severed the wireless aerial and earth wire, and pinned a notice on a notice board stating that a van had collected the set owing to default in payment, and they had therefore forced an entry and taken the set away. Readers who are in similar circumstances to the plaintiff in this case should note the result.

Roamio

ANOTHER American word will shortly enrich our vocabulary. It is the word roamio, and it has been coined to describe the Crosley car radio sets, the indication being that the Roamio car radio set is ideal for your Juliet. Not a bad name.

The M.I.F.

I HAD a 'phone message the other day from an individual who had been commissioned by the M.I.F. to write for them an article on a particular subject. It was obvious that this individual knew nothing about that subject, and I want to know why the M.I.F. commissions those without knowledge of a subject to write about it. No one objects to a man endeavouring to earn his living, but what I object to is a man earning someone else's living, and there are plenty of experts on all subjects out of work at the present time. Is the incident I have quoted one of the reasons why so much bilge appears in the daily papers?

A War-time Broadcast

HOW is the B.B.C. arranging and transmitting its war-time music programmes? Scattered about the residential quarters of a well-known West Country town are B.B.C. studios and offices, many of them, installed since war broke out, in villas and disused parish halls. For recitals and the smaller ensembles the Regional studios and parish halls are large enough, but for a studio able to accommodate the Symphony Orchestra, or even a section of it, it was necessary to commandeer the conference room at the top of one of the largest merchant houses in the town, situated near a busy quayside. Here, on an average once a week, the B.B.C. Symphony Orchestra in exile assembles to remind the warring world that great music still exists.

Assume that you have been invited to be present in the studio at one of these important orchestral broadcasts. It is ten o'clock in the evening. Leaving the silent, moonlit street, you would enter a dark doorway leading to a spacious entrance hall whence you are whisked upwards in a lift to the top of the building, to find yourself in a large, well-lighted studio in the presence of the assembled orchestra. Their conductor, Sir Adrian Boult, elegant and genial in his shirt-sleeves, strolls about talking to friends, with one eye on the clock whose large hand is now ticking relentlessly towards zero hour. An assistant with earphones glued to his head is listening to the introductory announcement which is being read by an announcer in a studio somewhere at the other end of the town, and, as it nears its close, "silence" is signalled. Sir Adrian takes his stand on the rostrum and raises his baton; a red light flickers three times, goes out, and then returns to a steady glow, and at this signal the conductor launches his orchestra into the incisive opening phrase *fortissimo* of, say, Beethoven's Fifth Symphony. The B.B.C. Symphony Orchestra, "leader, Paul Beard, conductor, Sir Adrian Boult," is "on the air."

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

THIS week we are handing the page over to some of those members who have been kind enough to send us some details of their activities and experimental work, and it is hoped that the details quoted from the letters will be of general interest to all members. Space prevents us from giving each letter in detail.

Member 5110

SENDS in details of some very fine long-distance reception, and goes on to state, "The Rx here is the usual 1-v-2 operating off a home-made eliminator, and for listening on a 14 mc/s band I use B.T.S. 24-70 metre coils which, when tuned with a .0005 mfd. condenser having a low minimum capacity, cover most of the 20-metre band. When I learned to read C.W., however, I soon discovered that I could only tune from about 14,000 kc/s to 14,370 kc/s, and that I was missing the elusive DX stations at the extreme H.F. end of the band. After looking up some back numbers of PRACTICAL WIRELESS, I saw I could lower the inductance slightly by fixing a metal disc to a screwed rod so that the disc could be moved up and down inside the coil. This I found enabled the set to be tuned down to about 14,480 kc/s, and the first station I received after this modification was XU6CH in China on C.W.

"The aerial here is about 50ft. long, including the lead-in. The aerial proper is 20ft. long and 30ft. high, running north and south. The lead-in runs in the opposite direction, namely, east and west. I have tried a half-wave doublet for 20 metres, but I prefer the single wire aerial."

Member 6571

THIS member gives a very good outline of the most satisfactory procedure for all amateurs to adopt: "I have been constructing sets for the last seven years, working my way up from the crystal, one-valve, and two-valve stages, learning the merits of different circuits, etc. At the moment my Rx is an 0-v-2 with switches to cut out the last stage when using 'phones on a powerful station. I have come up against one or two slight snags, (1) I have no key to the abbreviations used by amateurs, and (2) I have no up-to-date list of the short-wave stations of the world. I wonder if it is possible for you to tell me where I could obtain them?"

All the abbreviations and codes used by amateurs will be found in Newnes Short-Wave Manual, but as regards an up-to-date list of short-wave stations, this is admittedly a snag at the moment, as we do not know of any publication which would satisfy all requirements.

Member 6567

THE letter from this member contains a plea for more active support from other short-wave enthusiasts in his district. To quote his remarks: "Short-wave enthusiasts don't seem to be very plentiful in this district, although I believe there are a lot in Salisbury but, unfortunately, the Salisbury S.W. Club has closed down. My present Rx is a home-constructed 0-v-2 with transformer coupling in both stages, and H.T. obtained from an eliminator."

He goes on to stress a point which we have always advised members to adopt. "And when I sit back and go over my log it gives added pleasure to my hobby, and I feel sure that if all members kept a complete log of their activities and stations, they would secure a considerable amount of pleasure, when conditions are unsatisfactory for listening, by reading about their past successes and experiments."

This brings us to Member 6506, who has been enthusiastic enough to send in two extensive detailed logs concerning his activities and reception. It would appear that this member takes the keenest interest in all details affecting reception conditions and the operation of his station and, if we may, we would like to make a little suggestion to him. If it is possible for you to make use of standard log sheets, or an ordinary book ruled in the manner of a log sheet, we think you would compile quite a lot of useful information which would prove very valuable and interesting to you during your activities, especially when you wish to refer to some peculiar condition or effect. If you send us your actual log, then you leave yourself without all the information you may require in the future, therefore, perhaps you would be good enough just to let us have general extracts. Many thanks, however, for your interest.

Member 6661

"I HAVE been doing the things which this club stands for, for the last six years, and my latest achievement is a five-valve all-wave receiver using a regenerative circuit and covering from 9 metres to 2,000 metres without breaks in the wavebands."

Very fine work. Perhaps we shall be hearing more about your activities in the near future.

Member 6519

THIS member sends in quite a useful log he has compiled since February 1st, all stations being received on a Crossley AW6, with aerial running due north and south. He says in his letter, "I think that a DX contest would be very interesting and I am sure it would be most popular among all members. In PRACTICAL WIRELESS I think it would be a good idea if you started giving simple S.W. circuits, beginning with a very simple one mainly for beginners, and then go on to something more ambitious as expressed by Mr. E. Andrews in his letter of April 6th."

Member 6561

THIS member evidently possesses the real enthusiasm of a genuine radio amateur, as he has been carrying on with the good work under rather trying conditions, but we hope that things will be much better in the near future. He describes the construction of a coil for one of his sets in the following manner. "To make the coil former I used some tracing paper, of which I had quite a quantity. This was rolled round a large dowel, glued, dried out and when set was impregnated with some copal varnish. The windings were eight turns of 28 D.C.C. close-wound, followed by a grid coil (⅜in. from previous winding) of 12 turns of 22 S.W.G. enamelled wire turns spaced the thickness of wire. Five-eighths-of-an-inch from the end of this coil the reaction coil was wound with eight turns, close-wound, of 28 D.C.C. The completed coil tuned the 21 to 45-metre band, and gave really excellent results on the 31-metre section. I had quite a little trouble with the grid circuit before I managed to get reaction satisfactory. However, looking through back issues of PRACTICAL WIRELESS I was struck by the fact that A. W. Mann always specifies a .0001 mfd. grid condenser and a 5 meg. grid leak in all his circuits. I decided to try these values and was amazed at the difference in ease of operation."

Here is a letter from a non-member and we are including it on this page as we think that his remarks will provide interesting reading to all interested in S.W. work.

"I was interested in your article in the issue of May 4th. I think there is one point that is worth stressing in the controversy of Buyers versus Builders of short-wave receivers. In all cases where logs are published the type of receiver should be stated and whether commercial or home-constructed. Readers could then form a pretty accurate idea of the operating skill involved.

"If you do run a DX contest run it in two sections, one for the build-it-at-home men, and one for the owners of commercial receivers. Apart from being fairer this should give interesting results and some illuminating comparisons. If you don't divide the contest, you, I think, are liable to fall into the same state as some of your American contemporaries. The winner of the contest will be the man who can afford to operate a dual diversity receiver and the keen amateur with a small set will be left in the cold.

"I have been a keen short-wave listener for years but (1) I don't listen on the amateur bands, (2) I haven't a great deal of use for them, (3) I never have collected a card, (4) I don't belong to a society and have no intention of joining one, (5) I like PRACTICAL WIRELESS but I don't like the designs for short-wavers with untuned H.F. stages, as they are not selective enough for present-day use, (6) Your recently published 'Short-wave Manual' is very well worth the money."—J. S. M. (Muswell Hill).

From the details already published about the proposed DX contest, members will have seen that we had not overlooked the points raised by the above reader as we fully realise that it would not be fair to consider results without taking into account the type of receiver used.

Pull-in Tuning Circuits

Interesting Details of Some New Superhet Circuit Arrangements

MANY kinds of pull-in tuning circuits are now known in which a reactance is effectively connected in parallel with the tuned circuit of the oscillator and controlled in magnitude by a bias developed by a discriminator. It can be shown that if the pull-in tuning is to be equally effective at all frequencies in a waveband, the reactance introduced into the oscillator circuit should not vary with frequency, but only with the magnitude of the control bias applied to it by the discriminator.

It is found that this condition is not satisfied either by a shunt capacity or by a shunt inductance, although the latter gives rise to less variation with frequency than the former, and the purpose of this article is to describe some ways in which the desired condition can be realised in practice.

The most usual method employed for introducing the shunt reactance into the oscillator circuit is to connect the anode/cathode path of valve provided with back-coupling in phase quadrature across the oscillator circuit. An example of this type of circuit is shown in Fig. 1, in which the valve F is provided with feedback via condenser Cp and resistance R and is connected in shunt with the oscillator circuit LC. The discriminator D applies a control bias to the grid G of the valve F via resistance RG and thus controls the slope of the valve F and therefore the reactance introduced into the circuit LC.

If no means are provided for additionally influencing the alternating voltage amplitude normally appearing at R and led thence to the grid, then with the anode A.C. amplitude constant, the grid A.C. amplitude would be greater at the upper than at the lower end of the tuning frequency range: and in fact the grid A.C. amplitude, and hence the amplitude of the anode A.C. current which is out of phase with the anode A.C. voltage, increase proportionally with the frequency. The regulating valve would then operate as a capacity. The frequency shift in this case would also be proportional to the frequency.

Constant Frequency Shift.

In order to obtain a constant frequency shift, assuming that the oscillator A.C. voltage has approximately constant amplitude, the grid A.C. voltage is limited to a fixed value, in fact, approximately to the value which it has at the lowest tuning frequency. This limitation is effected by means of the two rectifiers G1 and G2 (diodes or dry rectifiers), of which the one is connected to the cathode, and the other to the anode at the junction point of the resistance W and the coupling condenser CK. These are so biased that the two rectifiers limit respectively the two half-waves. The bias voltages are tapped from the divided cathode resistance of the frequency regulating valve in such a way that the lower end of the potential divider resistance R is connected with the centre tap, the anode of the rectifier G1 with the earthed lower end of the cathode resistance, and the cathode of the rectifier G2 with the upper (cathode) end of the cathode resistance. In this case the frequency regulating valve operates as a reactance whose magnitude is practically independent of frequency.

The regulation of the valve F is carried out by means of the frequency regulating voltage led to the grid G via the leak resistance RG, which voltage is derived in the usual way from the regulating voltage generator D, connected to the output of the I.F. amplifier Z. The L.F. amplifier N and loudspeaker L are also of the usual type.

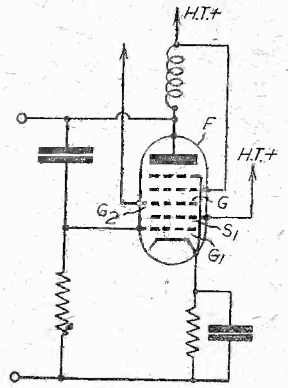

Fig. 2.—A five-grid valve for the special arrangement described here.

In place of the potential divider Cp, R, it is also possible to use a type which would itself cause the regulating valve to operate as an inductance, e.g., if Cp were replaced by a high resistance and R by a condenser. The amplitude of the grid A.C. voltage is then smallest at the high frequencies, and must be held at this value by means of the limiting device, in order to obtain a reactance of constant absolute magnitude.

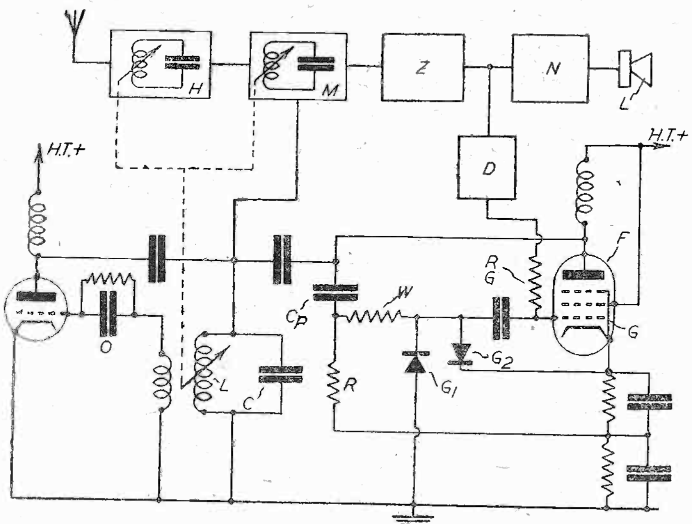

Fig. 1. (Left).—A usual arrangement of the pull-in tuning circuit.

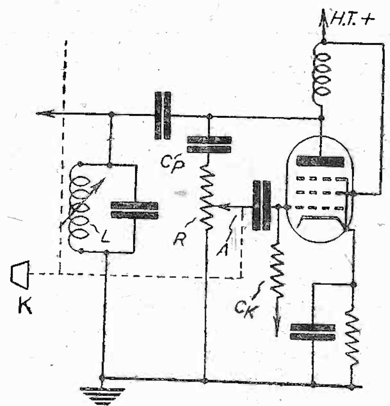

Fig. 3. (Right).—Manual control is provided by knob K.

Modulating Range

The limitation of the grid A.C. voltage may in some cases also be brought about by the characteristic of the control grid G1 itself. In this case it is desirable (see Fig. 2) to make the positive bias on the screen grid S1, following the grid G1 fairly small, so that the modulating range, defined at the upper limit by the onset of

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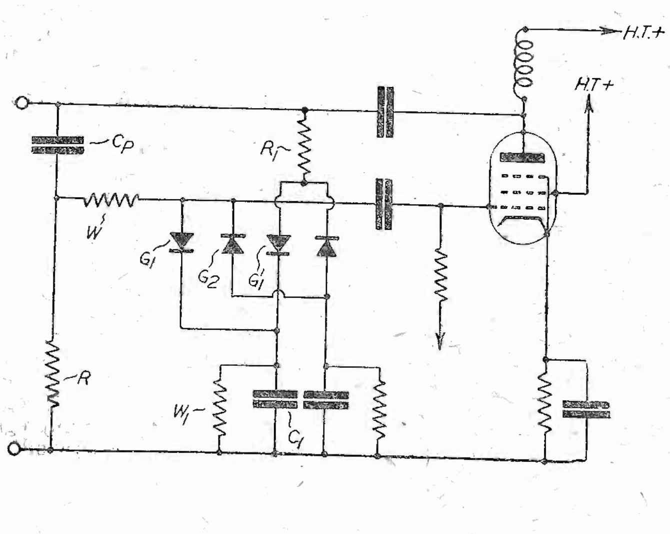


Fig. 4.—Another scheme which produces the same result as Fig. 1.

PULL-IN TUNING CIRCUITS

(Continued from previous page)

grid current and at the lower limit by the zero value of anode current, is sufficiently small. The regulation must in this case be done by an auxiliary control grid G2.

In the case where the oscillator-voltage amplitude varies over the tuning range, the general condition for the regulating valve to operate as frequency-independent-reactance takes the form that an always-constant fraction of the anode A.C. voltage must be fed back out of phase to the control grid. As shown in Fig. 3, this may, for example, be done by mechanically coupling to the adjusting knob K, which varies the self-inductance L, a sliding contact A on the potential divider resistance R. This contact is connected with the control-grid via the block condenser CK. If at the upper end of the frequency-tuning range the contact A is displaced in the direction of the earthed lower end, in an appropriate manner, then a constant degree of feedback, and hence a constant-frequency shift may be achieved.

In certain cases the resistance R may be of the temperature-dependent type, in particular it may be an indirectly heated resistance whose heating current is varied appropriately by the adjusting knob K.

If Cp and R are changed over and made of suitable magnitude, as mentioned above, then it is desirable to make the condenser of the rotating type, and to rotate it in the same sense as the variometers by means of the adjusting knob K.

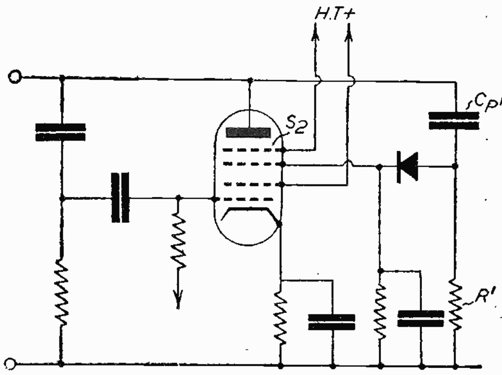


Fig. 5.—Rectified voltage is applied here to the 4th grid.

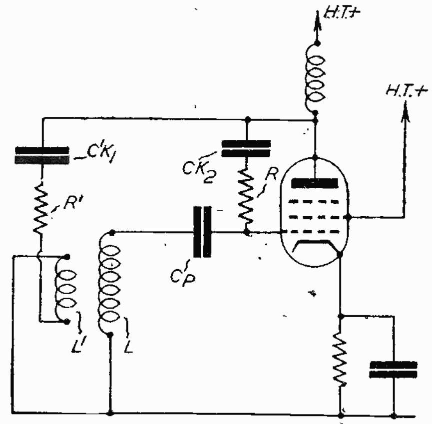


Fig. 6.—Another scheme which is ideal for the medium-waveband.

Varying Bias Voltage

With a circuit as in Fig. 1, in order to maintain the degree of feedback even with respect to fluctuation of amplitude of the A.C. voltage lying between anode and cathode of the regulating valve F, the bias voltage of the limiting rectifiers G1 and G2 may be allowed to vary automatically in dependence of the anode A.C. voltage amplitude, these bias voltages being generated, say, by rectification of the anode A.C. voltage. This may be achieved, as for example in Fig. 4, by connecting between the anode and the lower end of the cathode resistance a series circuit consisting of resistance R1, rectifier G1, and condenser C1 in parallel with leak resistance W1. The cathode of the rectifier G1 is connected with the upper plate of the condenser C1, which charges up negatively. G1 is thereby biased by a steady voltage whose magnitude is a constant fraction of the anode A.C. voltage amplitude, and limits the amplitude of the positive half-wave of the grid A.C. voltage to this value. It is assumed here that the potential divider R1, G'1, W1 is of relatively low ohmic value in comparison with the potential divider Cp, R, which produces the phase displacement; or that the resistance W is sufficiently high. In a corresponding way the rectifier G2 is also biased. The regulating valve F, whose amplification can be controlled by variation of grid bias voltage, and which here takes the form of a triode, thus operates over a wide range of frequencies and amplitudes as a reactance of constant magnitude. Such a circuit has application for other purposes also. If no means are provided for maintaining at a constant fraction the fed-back out-of-phase voltage throughout the tuning range, then it is possible to achieve constancy of the reactance represented by the valve with regard to frequency variations by additionally varying the amplification of the valve corresponding to the variation of oscillator frequency. This can be done, say, by arranging that with a valve which is actually connected up as a capacity the contact of a D.C. potential divider is shifted with the tuning, thus varying the potential of an auxiliary control grid in such a way that at the upper end of the tuning frequency range the amplification is less than at the lower end. It is also possible to rectify the oscillator A.C. voltage via a frequency dependent member, and to use the D.C. voltage generated for amplitude regulation. Such an arrangement is shown in Fig. 5. Here an additional potential divider Cp'; R', is in parallel with the valve. The A.C. voltage at R' whose amplitude may increase with frequency, is rectified. The resulting negative D.C. voltage regulates the amplification at the grid S2. The regulation may also be undertaken at the screen grid, the modulating range for the regulating voltage being different.

Frequency-dependent Regulation

It is, of course, also possible to connect up the valve itself as an inductance, and to regulate the amplification or modulating range in the opposite sense to the above, in dependence of the frequency, so that the amplification or modulating range increases roughly proportionally with the frequency.

This frequency-dependent regulation of amplification may in all cases be done by means of the screen grid instead of a second control grid. Moreover, instead of this type of frequency-dependent regulation of amplification, use may be made of a frequency-dependent regulation of the limitation of the re-tuning control voltage. In the last mentioned case, in which the valve itself is connected as an inductance, the effective re-tune regulating voltage would have to be limited to a smaller value at the lower end of the tuning frequency range than at the upper end (e.g., by rectifiers with frequency dependent bias voltage). Fig. 6 shows a further circuit by means of which it can be achieved quite simply that within a frequency range, which may, for example, be the broadcast range of 200 to 600 m., the frequency shift fluctuates by 20 per cent. at the most. In series with the potential divider condenser Cp is a coil L which is coupled to the coil L' of a second potential divider R'L' in such a way that the voltage transmitted is in phase with the voltage at Cp and is greater than the opposed phase voltage arising at L due to the current of the potential divider R, Cp, L. Values must be so adjusted that the difference in voltage arising at L is roughly equal to the co-phasal voltage at Cp at the geometric mean value of the frequency range. CK1 and CK2 are blocking condensers.

In place of the potential divider Cp, R, which effects the phase displacement, it is, of course, possible to substitute a more complicated network.

PROGRAMME NOTES

Empire Day Programme: May 24th

THIS year Empire Day will, no doubt, have a special significance for millions of listeners. Since the outbreak of war, members of the British Commonwealth all over the world have crossed the seas to Britain, and this rallying will be reflected in the Empire Day broadcast from London. Every man and woman taking part in the programme will have been born and brought up outside the British Isles, though all will come from lands marked red on the map.

The programme will be devised and produced by John Gough, himself a native of Tasmania, who will gather together some twenty or thirty people, of different ages, walks of life and colour, all united by the firm though impalpable bond of their loyalty.

Studio Variety

THREE Midland artists are to take part in a studio variety broadcast for the Forces on May 20th. They are: Jimmy Donovan, saxophonist, with Jack Wilson and his Versatile Five, and in the last war an Acting Drum Major; Barney Johnson, who tells Black Country stories; and Jack Hill, the Birmingham pianist and composer.

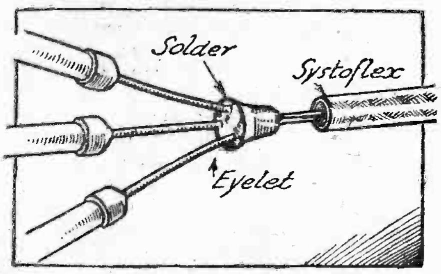
Recital by Famous Blind Organist

DR. ALFRED HOLLINS, who was born blind but who showed such musical talent that he played Beethoven's famous "Emperor" Concerto at the Crystal Palace when he was quite a boy, and was led to a piano in Windsor Castle at the age of sixteen to play to Queen Victoria, will give a recital on May 17th on the organ of St. George's (West) Church, Edinburgh. Dr. Hollins is not merely one of the most noted organists in Scotland, but has appeared in Berlin, Brussels, the United States, Australia, and South Africa. His programme on May 17th will include two of his own compositions, "Siciliana" and "Bourrée." He will end his programme with his own arrangement of Gounod's "Marche Militaire."

Practical Hints

Making Multiple Connections

WHEN a number of connections have to be taken to the same point, as, for example, when wiring up several fixed condensers or resistances of the wire-end type, an excellent method is that illustrated in the accompanying drawing. It will be seen that the various wire ends are pushed into one end of a small metal eyelet, a single



An effective method of making multiple connections.

connecting wire being slipped into the other end.

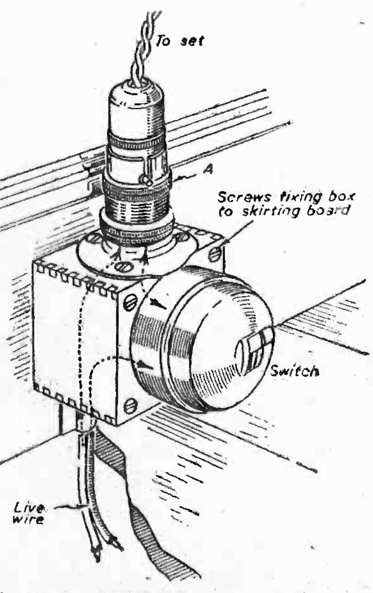
It is then only necessary to apply a spot of solder to the eyelet to make a perfect and neat connection between all the various leads. Suitable eyelets can be obtained from any boot repairer, or from sixpenny stores, for about twopence a dozen; they should, of course, be of the non-enamelled type to ensure ease of soldering.—S. HOLMES (Swindon).

A Safety Mains-plug

BEING rather scared of my two young children pulling out an ordinary skirting plug and pushing a steel knitting-needle or similar article in the sockets, thus getting a bad shock, I assembled the switch and plug shown in the accompanying sketch. The materials required are:

One box as used for flush mounting light switches; one ordinary two-point 5-amp. switch; one batten mounting lamp holder; and one bayonet plug. The method of mounting is clearly shown in the illustration. There is one point which might need mentioning: the switch should break the live lead, as this leaves the holder dead when the switch is in the off position. The box can be cleaned up with glass-paper and stained to match the skirting board.

When the plug is inserted, the lamp-shade ring marked A is screwed up tight to the plug sprigs so that it cannot be removed except by an adult.—J. G. PICOT (Chatham).



A safety mains-plug switch attached to a skirting board.

THAT DODGE OF YOURS!

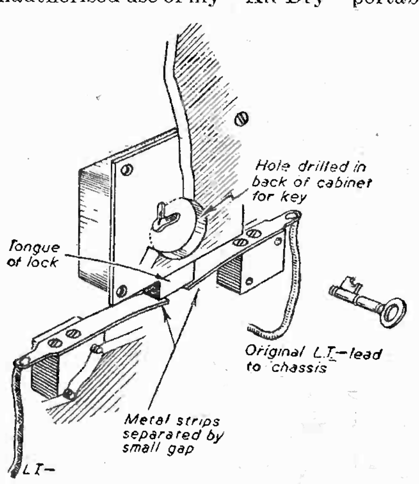
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending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

SPECIAL NOTICE

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

A Simple Lock Switch

BEING on Active Service, I required some means of preventing the unauthorised use of my "All-Dry" portable

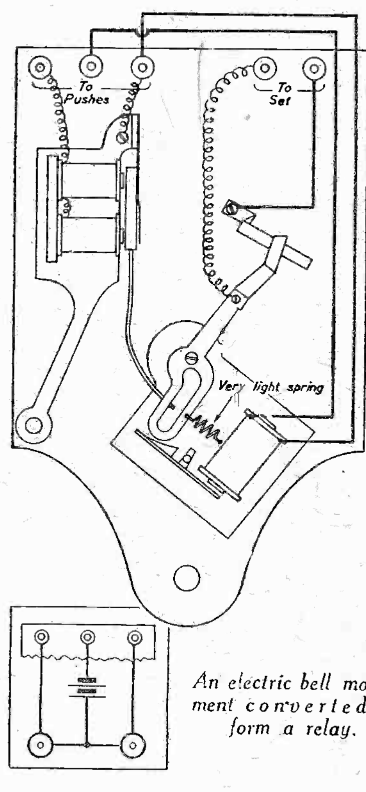


A novel lock switch

receiver. I finally evolved a lock switch, so that the set must be switched on and off with a key. The L.T. negative lead to the battery was broken and connected to two metal strips which were screwed down inside the back of the set. The lock, which cost twopence, was then mounted inside the back panel, so that turning the key brings the tongue of the lock on to the metal strips, so completing the circuit, as shown in the accompanying sketch.—A. G. HOBSON (Doncaster).

A Remote Control Relay

THE accompanying sketch shows a remote control relay which I have had working for several months. It comprises an old electric bell and a unit from an indicator board. The hammer is removed from the bell and the arm bent up about an inch so as to engage the other unit. The two parts have to be arranged so that when one is "on" the other is "off." The set contacts are made of strip copper and are bent in such a way as to be self-cleaning. Two bell pushes are required, and these are connected in the usual way with three wires.



An electric bell movement converted to form a relay.

With this relay an ordinary 4½-volt torch battery will last for months as the current is only used momentarily.—F. J. FIELDER (Epsom).

A DIVERSIT

Constructional Details Unusual Type of Rec

IF the receiver is to be used remote from the transmitter, it may be desirable to include H.F. chokes so as to make use of reaction in order to bring up the volume; but the experimental receiver is working quite well in Wiltshire (about 100 miles from the transmitter) and neither reaction nor chokes have been found necessary.

A reaction winding is included on the C7 coils, and a 0.0003 mfd. preset condenser (C18 or C19) should be joined between terminal 4 of the coils and the detector anodes, if such is necessary.

This completes the design of section A of the receiver. Section B is on exactly the same lines, but when completed is to be tuned to a different wavelength.

Constructional Details

The unit may be built up on a wooden or metal chassis, whichever is most easily procurable. We prefer the metal chassis with sub-chassis wiring for efficiency and neatness and the experimental receiver was constructed on these lines. Owing to the difficulty in obtaining aluminium for the construction of a special chassis, a drilled steel chassis was purchased from Radio Clearance of High Holborn (see the advertisement pages at the end of this week's issue) for the modest sum of 10d. (or 1s. 6d., including postage and packing.). This meant that as the steel was extremely difficult to work without proper tools, use had to be made of the holes for coils and valveholders already drilled in the chassis. This did not result in an altogether pleasing layout (see Fig. 2), but did not upset the efficiency and stability of the receiver in any way. Two additional holes had to be cut in the chassis, and this was done by first marking them out and then drilling ⅛in. holes right round the circle, punching out the middle, and filing down the rough edges. It was rather laborious work, but has resulted in an efficient and cheap chassis.

For those who wish to build a new chassis a suggested layout is shown in Fig. 3. This gives a very compact and pleasing layout and should be quite efficient.

Having procured or built a chassis, mount the valveholders, preset and electrolytic condensers, and the coils in position. Note that if reaction is used the preset reaction condensers must have their spindles insulated from the chassis.

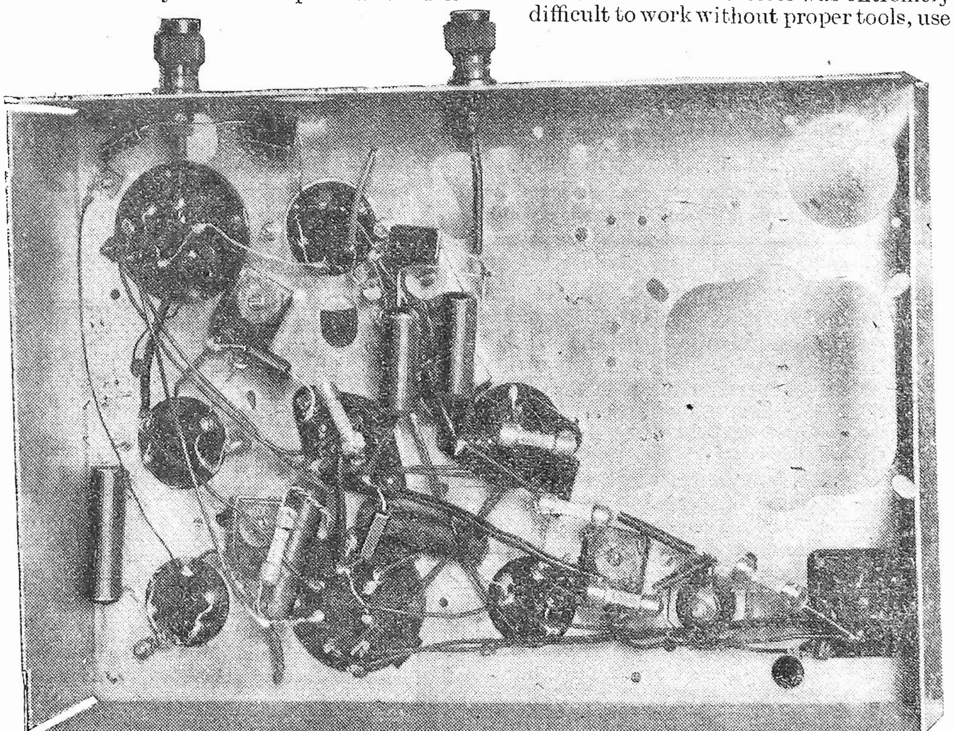


Fig. 6.—Underside view of the chassis showing components and wiring.

COMPONENTS REQUIRED

	£	s.	d.
Two aerial coils, Bulgin C.6		10	0
Two H.F. transformers, Bulgin C.7		10	0
Two 7-pin valveholders, Bulgin VH.49		1	6
Three 5-pin valveholders, Bulgin VH.48		1	6
Four 0.0006 mfd. preset condensers, Bulgin C.P.4, C3, 4, 7 and 8		7	0
Seven 0.0001 mfd. condensers, C1, 2, 9, 10, 11, 12 and 16. Dubilier type 635		3	6
Three 0.01 mfd. condensers, C5, 6 and 17. Dubilier 4603/S.		3	6
Two 0.02 mfd. condensers, C14 and 15. Dubilier 4601/S		1	6
One 8 mfd. surge-proof electrolytic condenser C13 Dubilier 0281 surge-proof		4	0
One 500 ohm ½-watt resistance, R1. Dubilier F½			3
Two 250,000 ohm ½-watt resistances R2 and 3. Dubilier F½			6
Two 50,000 ohms ½-watt resistances, R4 and 5. Dubilier F½			6
One 10,000 ohm ½-watt resistance, R6. Dubilier F½			3
Three terminals, Bulgin type T.L.			10½
	£2	4	10½
RECOMMENDED VALVES:			
2 SP4B H.F. pentodes, Tungsram	1	1	0
2 HL4 + triodes, Tungsram		15	0
	£4	0	10½

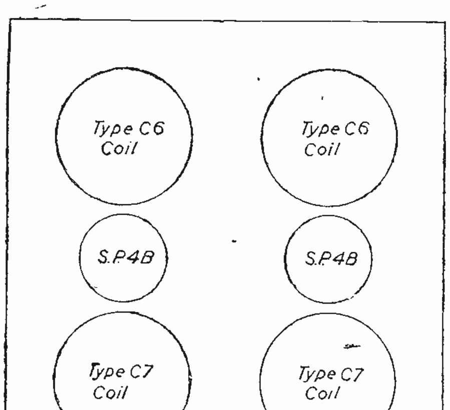


Fig. 3.—Suggested chassis layout for those who wish to use a new chassis.

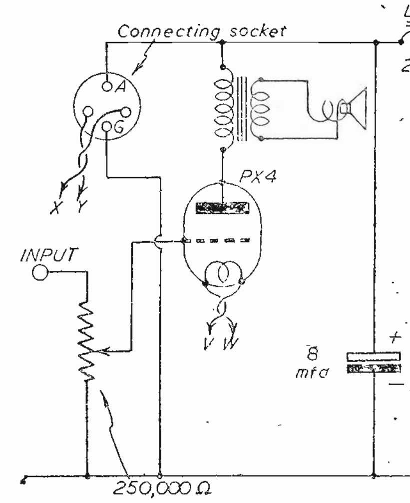


Fig. 5.—Alternative amplifier

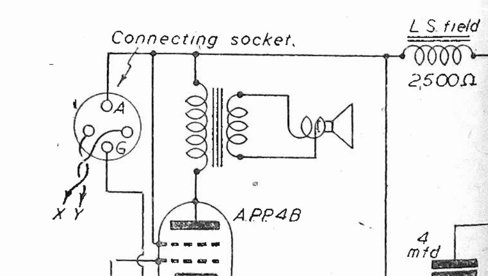


Fig. 4.—Mains section and Power Amplifier for Receiver.

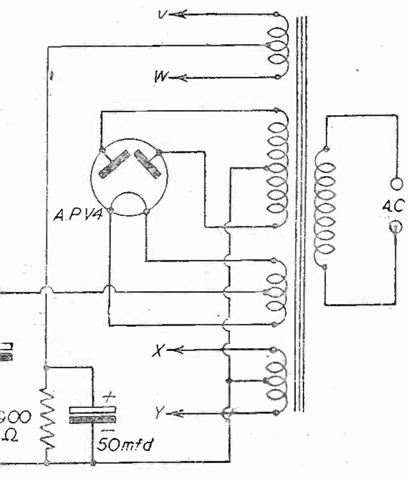
Y RECEIVER

Operating Notes of this

By W. A. FLINT

Wiring

First complete the heater wiring to all valveholders, and then proceed with the rest of the wiring. It is advisable to complete say section A first, and then proceed with the wiring of section B.



section using a valve rectifier.

The output of both portions is taken to a common terminal for connection to the amplifier, and provision is made for connecting heater, H.T. and "earth" supplies to the amplifier by means of a 4-pin plug and socket and 4-core cable. Two lengths of twin flex may be used for the latter. The 4-pin plug may be an ordinary valveholder and is mounted on the unit chassis and wired up as shown. The anode pin is used for H.T., "grid" for earth, and the filament pins for the heater supply.

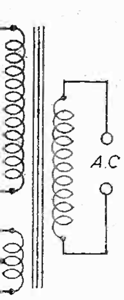
It should be noted that as the SP4B valves have their control grids brought out to the top cap, it is necessary to bring the leads from terminal 1 of the C.6 coils up through the chassis. Similarly, the top red leads of the C.7 coils have to be taken down through the chassis for connection to the SP4B anodes. Do not take any of these leads down or up through the coils or instability will result. Keep them both outside the coil cans, and well away from one another.

Tuning

Tuning is quite a simple matter. If reaction is to be used, unscrew the reaction condensers to minimum capacity. To deal with section A first, which is to be tuned to 449 metres, take out the detector valve of the other section and screw down the preset condensers controlling the H.F. and detector tuning of section A for maximum capacity. Then unscrew each a little at a time until the first Home Service programme is heard. Adjust the condensers on this wavelength for maximum volume and seal with wax. Adjust the reaction condenser for volume and seal.

To tune section B replace the detector valve and remove the detector from section A. Here the procedure is reversed, i.e., the tuning condensers are unscrewed to minimum capacity and then screwed up a little at a time until the programme on 391 metres is heard. Adjust the condensers for maximum volume on this wavelength and seal them.

If it is found that one station is much stronger than the other, adjustment can be made by use of the reaction controls, or by using separate bias resistances for each H.F. valve and adjusting them until the volume is at the same level for both stations.



the Diversity

Amplifier Details

This completes the unit, and it is now ready for connection to the amplifier, which may be either a single high slope pentode for efficiency or a triode for quality. For the former a Tungsram valve type APP4B connected in circuit as shown in Fig. 4 has been found extremely effective, while an Osram PX4 valve makes a good triode output stage (Fig. 5). If the latter is used, note that a Post Office permit must be obtained before the valve may be purchased. In either case, the H.T. supply may be obtained from a Westinghouse metal rectifier (type H.T.16) or an APV4 rectifying valve. Fig. 4 shows the use of the metal rectifier, Fig. 5 that of a valve, and in each case provision is made for the use of a mains energised speaker.

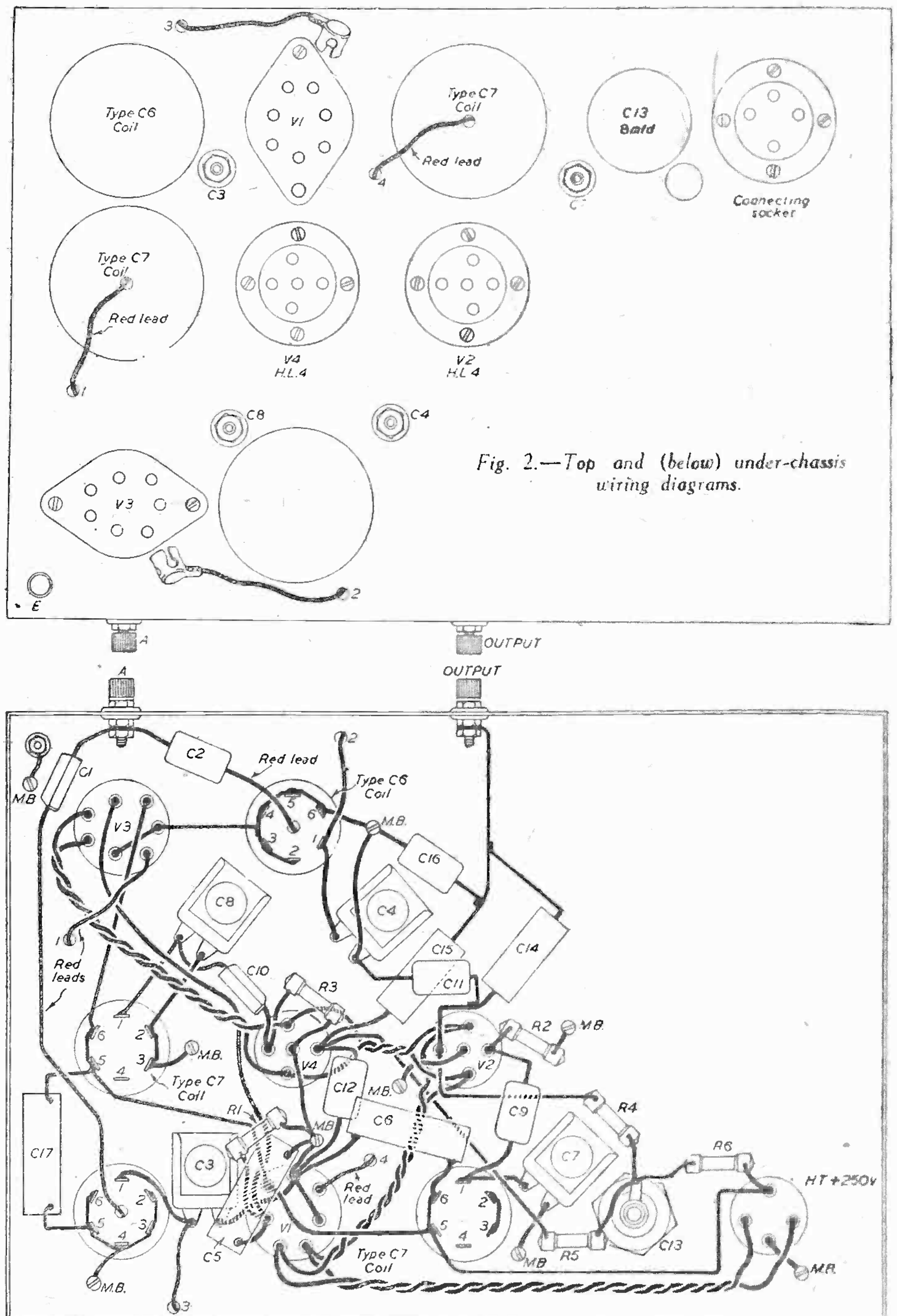


Fig. 2.—Top and (below) under-chassis wiring diagrams.

L.F. AMPLIFIER TROUBLES—2

The Importance of Grid-decoupling, Lay-out and Wiring are Discussed by L. O. SPARKS

(Continued from page 178, May 11th issue.)

As mentioned in the issue of last week, the resistance used in the anode circuit for decoupling purposes introduces a voltage drop proportional to the current flowing and the value of the resistance. In certain circuits this can be put to good effect: for example, the H.T. positive line might be of a higher voltage than that required for the valve, so the resistance can then be made to serve the dual purpose of decoupler and voltage regulator. Unfortunately, the reverse is so often the case with battery-operated apparatus and one is often forced to reduce the value of R in consideration of the valves' requirements. In such instances it is usually advisable to increase the value of the decoupling condenser or make use of a good L.F. choke. There is, however, another method, not widely used by amateurs but often incorporated in commercial products, especially high-gain amplifiers.

It is permissible to replace the decoupling resistance with two resistances, the values of which should be approximately half of the single resistor. There is no fixed rule, but if the maximum decoupling is required then they should be made as high as the operating conditions of the valve permit. The idea is shown in Fig. 4, where it will be seen that R and C1 of Fig. 3 have now been replaced by R1, C1 and R2, C2. The correct term given to this arrangement is double-decoupling, and it is often essential in high-gain L.F. stages such as those used for the input of amplifiers associated with microphone work, especially if the apparatus is of the A.C. mains operated type, where hum is likely to be introduced in the stages giving the highest amplification, i.e., the input valve.

Grid Decoupling

In spite of the precautions already mentioned, it is often necessary to provide some further means of stopping the slightest trace of H.F. currents from getting on to the grids of the L.F. valves. Although this might seem hardly vital to some, the amateur will do well to make note of the simple method which, if adopted, will usually prove its worth by helping to maintain the amplifier in a perfectly stable condition. The simplest form of H.F. grid-stopper is shown in Fig. 5, the effective component being the additional resistance R3.

With a transformer-coupled stage, one cannot go wrong with the connections, but many amateurs do make a slip when the stopper has to be introduced in a resistance-capacity coupled amplifier. It should be noted that R3 is connected to the *grid terminal* of the valve*holder* and that the usual grid-leak is joined to its *opposite* end. The diagram (Fig. 6) will make the reason for this more clear; if the grid-leak is also connected to the grid terminal on the valveholder, a potentiometer is virtually formed (diagram on left of Fig. 6) and a moment's consideration will reveal that it is equivalent in effect to an ordinary variable potentiometer being connected across the grid circuit, after the manner of a volume control, and that the grid or input to the valve is tapped *down* the potentiometer. The correct method of connection gives the network shown on the right of Fig. 6.

The value of such H.F. stoppers is not supercritical, but excessively high values are not recommended, otherwise there will be a risk of effecting the response of the

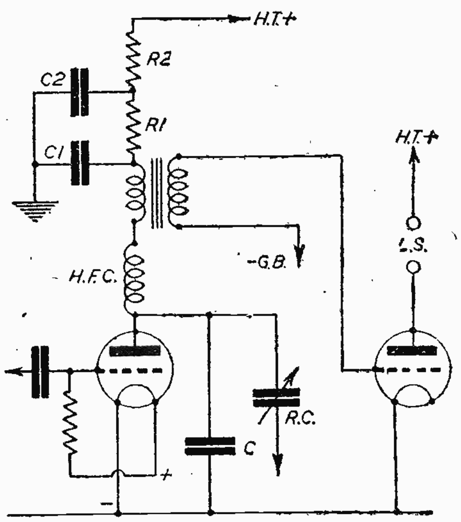


Fig. 4.—Double-decoupling added to the anode circuit of the original detector stage.

higher frequencies. Common values range between 10,000 ohms and 50,000 ohms.

Circumstances do arise, chiefly with mains-operated apparatus, when it becomes advisable to apply decoupling to the actual grid-leak or grid return, but this necessity does not occur so frequently as the need for the other forms of decoupling mentioned above. As with double-decoupling, it is most likely to be called for in high-gain circuits, where every precaution against any form of instability or background noise has to be considered. When it becomes desirable to introduce this additional refinement, it is only necessary to insert a resistance between the *low-potential* end of the normal grid-leak and earth, the resistance being by-passed by a fixed condenser of, say, 0.1 mfd. A satisfactory value for the resistor will be between 50,000 ohms and 100,000 ohms.

Lay-out

Too many constructors are so anxious to start the actual constructional work, once they have collected the required components, that they give far too little time to the all-important question of lay-out. With L.F. apparatus, a very fine circuit can be completely ruined by the inconsiderate assembly of the components and haphazard wiring. If a blueprint is not being used, it is really essential for a rough plan of the baseboard or chassis to be drawn, preferably full size, on which the components can be arranged to enable the constructor to see the best location for the various items consistent with their associated wiring.

It is always very nice to arrange a lay-out so that it looks neat and tidy and symmetrical, but, unfortunately, it does not follow that the arrangement which will satisfy those requirements is the best from the point of view of wiring and efficiency. It is simply up to the would-be designer to play about with all the parts on the plan drawing, until he can secure the lay-out which will satisfy as many of the items as possible, but if it is a question of sacrificing anything, then appearances must go rather than efficiency. To quote but one apparently small matter to prove this, it is not absolutely necessary for all valveholders to be fixed so that, say, the filament or heater pins are all pointing in the same direction. If, when these components are being placed, *careful consideration is given* to the associated wiring and components, it is possible to obtain a very much neater and more efficient lay-out and, of course, wiring, by fixing the valveholders in the manner which is going to simplify all connections.

All transformers and chokes should be so located that there is no possibility of their fields interacting with each other; decoupling condensers and resistances should be as close to the points they are decoupling

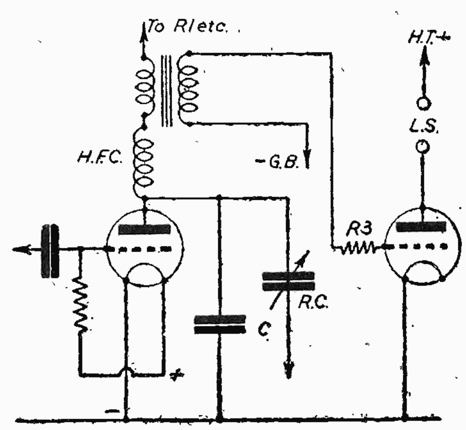


Fig. 5.—Showing the position of the grid H.F. stopper resistance R3 in a transformer-coupled stage.

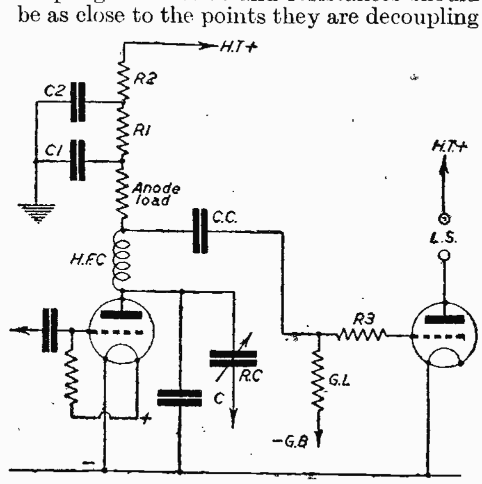


Fig. 6.—With resistance-capacity coupling, care must be taken to see that R3 is wired in the correct position relative to the G.L.

L.F. AMPLIFIER TROUBLES—2

(Continued from previous page)

as possible, and volume controls and switches must be placed in the positions which allow the shortest possible wiring.

Wiring

At the risk of harping on an old theme, the writer cannot emphasise too strongly the necessity for perfect connections. Terminals are quite good when they are *really tight*, but for a first-class job soldering

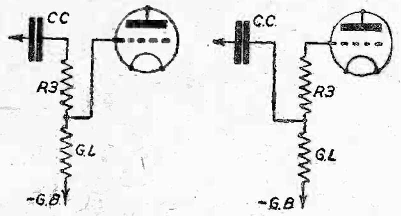


Fig. 7.—Shows the actual network formed by R3 and G.L. The method shown on right is correct.

is undoubtedly far superior and the constructor is advised to make full use of a decent soldering outfit. Like everything else, bad soldering is far worse than no soldering at all, so if you are not already an expert with the iron, get down to it and overcome the little snags which beginners sometimes experience. It is not difficult.

Keep all grid, anode and cathode wiring as short as possible and arrange matters so that such wiring does not run parallel with either of the circuits mentioned. It is usually advisable to run grid connecting wires, if they are of any length, in screened sleeving, making sure that the metallised sleeving is connected to the nearest earthing point. See that the metallising does *not touch* the conducting wire. With volume controls wired across a grid circuit, it is often necessary, especially in mains equipment, to earth the metal casing which houses the element, to reduce the possibility of the introduction of hum. This applies in particular when the volume control incorporates the on-off switch for the mains.

The wiring for the heater circuits should always be carried out with wire of a reasonable gauge for the current flowing. 20 S.W.G. or 18 S.W.G. is quite satisfactory, and after making sure that its insulation is perfect, twist the two wires together between connecting points, in the same manner as ordinary twin flex, as this tends to reduce the field which would normally be created by the A.C. flowing in the circuit.

WHY THE GRID LEAK?

(Continued from page 190.)

approximately .0002 mfd. and 2 megohm cannot normally be bettered, although for short-wave work it is sometimes found better to use a .0001-mfd. grid condenser with a leak having a resistance up to about 5 megohms.

In the earlier days of valve receivers it was not unusual to fit a variable grid leak, so that the most suitable value could be found by trial. With present-day valves and circuits there is little point in using a variable leak. In general, the only case in which it is worth while to use variable components is when there are "dead spots" in the tuning range of a short-wave set, which cannot be removed by paying full attention to reaction-circuit constants and anode voltage.

A Gramophone Improvement

It is well known that in most gramophone motors slight mechanical vibrations occur which are imparted to the record through the turntable, and introduce distortion in reproduction known as "rumble."

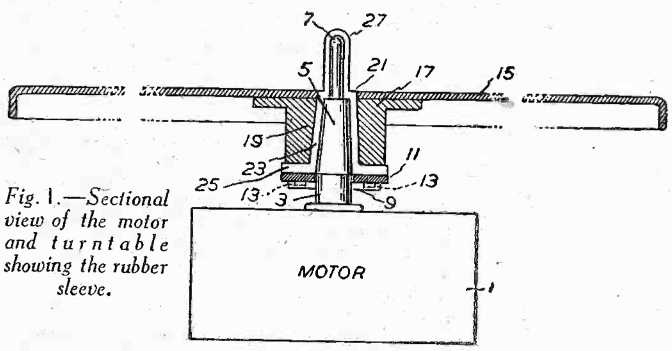
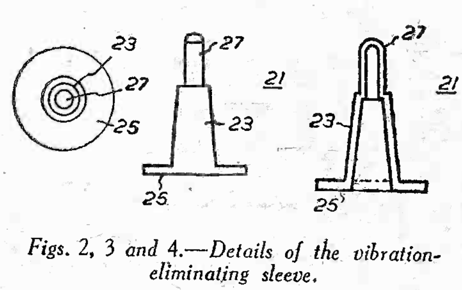


Fig. 1.—Sectional view of the motor and turntable showing the rubber sleeve.

These parasitic vibrations can be prevented largely from reaching the turntable by interposing a vibration absorbing member between the turntable and its driving spindle. A soft-rubber sleeve may, for example, be fitted over the turntable spindle, and the turntable mounted on this sleeve. A suitable form of sleeve is shown in plan, in elevation and in vertical cross-section in Figs. 2, 3 and 4, and a gramophone motor unit complete with sleeve is shown in Fig. 1.

The motor 1 is provided with a spindle formed with a cylindrical portion 3, a conical portion 5 and an upper cylindrical portion 7. A washer 11 rests on a cross pin 9 and is provided with pairs of lugs 13 which embrace the cross pin to form a driving connection. The rubber sleeve 21 is formed with a cylindrical upper portion 27 and a conical portion 23, and terminates in a flange 25. The sleeve fits snugly over the spindle, and the flange rests on the washer 11. The hub 17 of the turntable 15 fits on to the conical portion 23 of the sleeve 21, and the bottom of the hub rests on the flange 25.

Other arrangements can readily be devised; for example, the hub of the turntable might be formed of soft rubber and the portions 23 and 25 of the sleeve dispensed with so that only the record-receiving portion 7 of the spindle is encased in a rubber sleeve.



Figs. 2, 3 and 4.—Details of the vibration-eliminating sleeve.

NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 107

MENSURATION

A and a = area; b = base; C and c = circumference; D and d = diameter; h = height; n° = number of degrees; p = perpendicular; R and r = radius; s = span or chord; v = versed sine.

Square: $a = \text{side}^2$; $\text{side} = \sqrt{a}$; diagonal = side $\times \sqrt{2}$.

Rectangle or parallelogram: $a = bp$.

Trapezoid (two sides parallel): a = mean length parallel sides × distance between them.

Triangle: $a = \frac{1}{2}bp$.

Irregular figure: a = weight of template ÷ weight of square inch of similar material.

Side of square multiplied by 1.4142 equals diameter of its circumscribing circle.

A side multiplied by 4.443 equals circumference of its circumscribing circle.

A side multiplied by 1.128 equals diameter of a circle of equal area.

Square inches multiplied by 1.273 equals square inches of an equal circle.

No. 108

MENSURATION *(continued)*

Circle: $a = \pi r^2 = d^2\frac{\pi}{4} = 0.7854d^2 = 0.5$ cr.; $c = 2\pi r = d\pi = 3.1416d = 3.54\sqrt{a} =$ (approximately) $\frac{22}{7}d$. Side of equal square = 0.8862d; side of inscribed square = 0.7071d; d = .3183c. A circle has the maximum area for a given perimeter.

Annulus of circle: $a = (D+d)(D-d)\frac{\pi}{4} = (D^2-d^2)\frac{\pi}{4}$.

Segment of Circle: a = area of sector — area of triangle $= \frac{4v}{3}\sqrt{(0.625v)^2+(\frac{1}{2}S)^2}$.

Length of Arc = 0.0174533n°r; length of arc $= \frac{1}{3}\left(8\sqrt{\frac{S^2}{4}+v^2} - s\right)$; approximate length of arc = $\frac{1}{3}$ (8 times chord of $\frac{1}{2}$ arc − chord of whole arc).

$d = \frac{(\frac{1}{2}\text{ chord})}{v} + v$; radius of curve $= \frac{S^2}{8V} + \frac{V}{2}$.

Sector of circle: a = 0.5r × length arc; = n° × area circle ÷ 360.

No. 109

MENSURATION *(continued)*

Ellipse: $a = \frac{\pi}{4}Dd = Rr$; c (approx.) $= \sqrt{\frac{D^2+d^2}{2}} \times \pi$; c (approx.) $= \pi\frac{Da}{2}$.

Parabola: $a = \frac{2}{3}bh$.

Cone or pyramid: surface $= \frac{\text{circ. of base} \times \text{slant length}}{2} + \text{base}$; contents = area of base × $\frac{1}{3}$ vertical height.

Frustum of cone: surface = (C + c) × $\frac{1}{2}$ slant height + ends; contents $= 0.2618h\,(D^2 + d^2 + Dd)$; $= \frac{1}{3}h\,(A + a + \sqrt{A \times a})$.

Wedge: contents = $\frac{1}{6}$ (length of edge + 2 length of back) bh.

Prism: contents = area base × height.

Sphere: surface $= d^2\pi = 4\pi r^2$; contents $= d^3\frac{\pi}{6} = \frac{4}{3}\pi r^3$.

Segment of sphere: r = rad. of base; contents $= \frac{\pi}{6}h\,(3r^2+h^2)$; r = rad. of sphere; contents $= \frac{\pi}{3}h^2\,(3r-h)$.

Spherical zone: contents $= \frac{\pi}{2}h\,(\frac{1}{3}h^2 + R^2 + r^2)$; surface of convex part of segment or zone of sphere = πd (of sph.) $h = 2\pi rh$.

No. 110

MENSURATION *(continued)*

Mid. sph. zone: contents $= (r + \frac{2}{3}h^2)\frac{\pi}{4}$.

Spheroid: contents = revolving axis² × fixed axis $\times \frac{\pi}{6}$.

Cube or rectangular solid: contents = length × breadth × thickness.

Prismoidal formula, contents $= \frac{\text{end areas} + 4 \text{ times mid. area} \times \text{length}}{6}$

Solid of revolution: contents = a of generating plane × c described by centroid of this plane during revolution. Areas of similar plane figures are as the squares of like sides. Contents of similar solids are as the cubes of like sides.

Rules relative to the circle, square, cylinder, etc.:

To find circumference of a circle:
Multiply diameter by 3.1416; or divide diameter by 0.3183.

To find diameter of a circle:
Multiply circumference by 0.3183; or divide circumference by 3.1416.

To find radius of a circle:
Multiply circumference by 0.15915; or divide circumference by 6.28318.

To find side of an inscribed square:
Multiply diameter by 0.7071; or multiply circumference by 0.2251; or divide circumference by 4.4428.

No. 111

MENSURATION *(continued)*

To find side of an equal square:
Multiply diameter by 0.8862; or divide diameter by 1.1284; or multiply circumference by 0.2821; or divide circumference by 3.545.

To find area of a circle:
Multiply circumference by $\frac{1}{4}$ of the diameter; or multiply the square of diameter by 0.7854; or multiply the square of circumference by 0.07958; or multiply the square of $\frac{1}{2}$ diameter by 3.1416.

To find the surface of a sphere or globe:
Multiply the diameter by the circumference; or multiply the square of diameter by 3.1416; or multiply 4 times the square of radius by 3.1416.

Cylinder.
To find the area of surface:
Multiply the diameter by $3\frac{1}{7}$ × length.
Capacity = $3\frac{1}{7}$ × radius² × height.

Values and Powers of:
$\pi = 3.1415926536$, or 3.1416, or $\frac{22}{7}$ or $3\frac{1}{7}$;
$\pi^2 = 9.86965$; $\sqrt{\pi} = 1.772453$;
$\frac{1}{\pi} = 0.31831$; $\frac{\pi}{2} = 1.570796$;
$\frac{\pi}{3} = 1.047197$.

No. 112

UNITS AND EQUIVALENTS

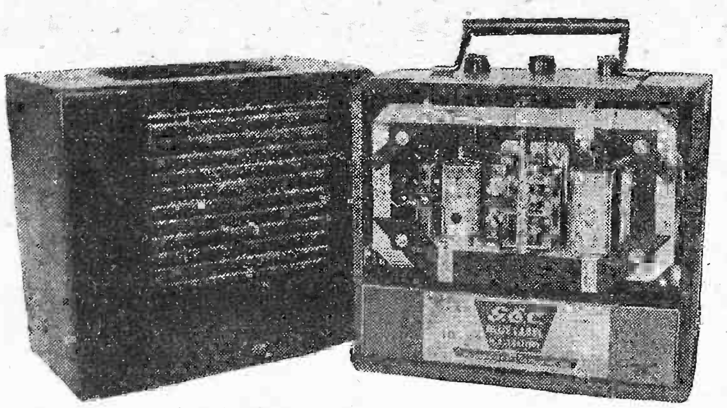
One ft. lb.	1 lb. raised 1 foot high.
One BTU	1,055 joules.
One BTU	778.8 ft. lbs.
1 watt	10 ergs per second.
1 watt	23.731 foot poundals per second.
1 watt	0.7376 ft. lb. per second.
1 watt	0.001341 h.p.
One HP hour	0.746 kW. hour.
One HP hour	1,980,000 ft. lbs.
One HP hour	2.545 BTU's.
One kwH. (kilowatt hour)	2,654,200 ft. lbs.
One kwH.	1,000 watt hours.
One kwH.	1.34 HP hours.
One kwH.	3,412 BTU's.
One kwH.	3,600,000 joules.
One kwH.	859,975 calories.
One HP	746 watts.
One HP	0.746 kW.
One HP	33,000 ft. lbs. per minute
One HP	550 ft. lbs. per second.
One HP	2,545 BTU's per hour.
One HP	42.4 BTU's per minute.
One HP	0.707 BTU's per second.
One HP	178,122 calories per second.

G.E.C. BATTERY PORTABLE

Details and Test Report on a G.E.C. One-battery Receiver

IN our issue dated February 24th last we mentioned that the G.E.C. were shortly producing a new battery portable. We have now had an opportunity of testing a sample of this receiver, which is a superhet, and gives real superhet performance, which means that it will give good reception of a number of stations when used in any part of the country. Another important item is the provision of a single dry battery which serves for both high- and low-tension; there is no accumulator to need charging or to add seriously to the weight of the receiver.

The battery (type BB395) supplies H.T. at 90 volts and L.T. at 1.5 volts. The latter is to feed the filaments of the 1.4 volt battery valves which are used. These valves are used in the following order: X.14 frequency changer, Z.14 intermediate-frequency amplifier, HD.14 second detector, A.V.C. and first L.F. amplifier; and N.14 output. All of these valves are of the comparatively new dry-battery type with octal base.



This illustration shows how the novel cabinet design is carried out, and the chassis lay-out.

Sound Design

In constructional details the new G.E.C. portable is extremely interesting. This is because the receiver itself, along with battery platform, is made as a rigid framework and is fitted with a really substantial carrying handle. The outer case, which carries the speaker grille, is made from shaped plywood attractively covered in imitation grained leather. This cover is entirely free from sharp corners and can be removed for replacing the battery (not more often than about once in three months) simply by taking out two screws and lifting it. A valuable feature is that the outer shell does not have to support any weight and can therefore be made very light.

It will be seen from the accompanying illustration that the three controls and tuning scale are on top of the receiver chassis and are accessible due to the rectangular hole in top of the shell. Of the three knobs, that on the right is for on-off switching and for changing from medium to long waves, the centre knob is for tuning and that on the left is for volume control.

Built-in Aerials

The receiver itself is a model of compactness, despite the fact that the permanent magnet speaker unit is 6½ins. in diameter and the L.F. transformer is not a midget. There are two built-in frame aerials, for long and medium-wave use respectively. In addition, however, there is provision for connecting external aerial and earth leads when it is wished to increase the range of reception.

It should be mentioned in passing that the dry battery has a valve-holder type connector socket into which a corresponding plug is inserted when the battery is installed. Incorrect connection is therefore impossible, however carelessly the job may be done. As the complete battery is listed at 10s., it will be seen that running costs are very modest for a receiver of this type.

Excellent Reception

We have been very well pleased with the results obtained on actual test. Tuning is childishly easy, and the fact that the station and wavelength marked scale is accurately calibrated is of great assistance.

Our first tests were made in a steel-framed building in Central London. In daylight it was possible to receive many stations on the medium waves, and Radio-Paris on long waves, at good strength. The Home and Forces stations were received at such strength that it was necessary to turn the volume control well down to avoid overloading the speaker, whilst Radio-Paris could be listened in to in comfort with the control below maximum. This reception was obtained, it should be noted, in conditions which are very unfavourable, and in which many portable receivers are able to give only mediocre results.

As is always the case when using a frame aerial, there was a useful directional effect, but this was not sufficiently critical to make the tuning-in of even weak stations difficult. It was, however, useful in minimising interference from electrical equipment in the building.

Out-of-doors, or in the home (where the shielding effect of steel girders is not experienced), reception was still better. In fact, when using only the frame aerials, the range was comparable with that of many older type battery receivers when connected to a good aerial-earth system. By connecting aerial and earth leads the range was, as expected, considerably extended and was as good as that with the average good "home" receiver with a similar circuit.

Dimensions

For the type of receiver, the quality of reproduction was fully satisfactory, on both speech and music. Even the critical listener would find little to complain of in this direction. The makers introduced the set for use in any conditions, and they have succeeded, for it weighs only 19 lbs., and the overall dimensions are 11½ins. by 12½ins. by 7⅜ins. In addition, the finish is such that it should withstand the rough usage which it might receive in an air-raid shelter, or when carried by train or car. An important feature in this respect is the flexible mounting of the metal chassis, frame aerials and controls within the interior wooden framework.

The price is £8 18s. 6d. complete.

ELECTRONICS

Various Applications of Photo-electric Cells

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

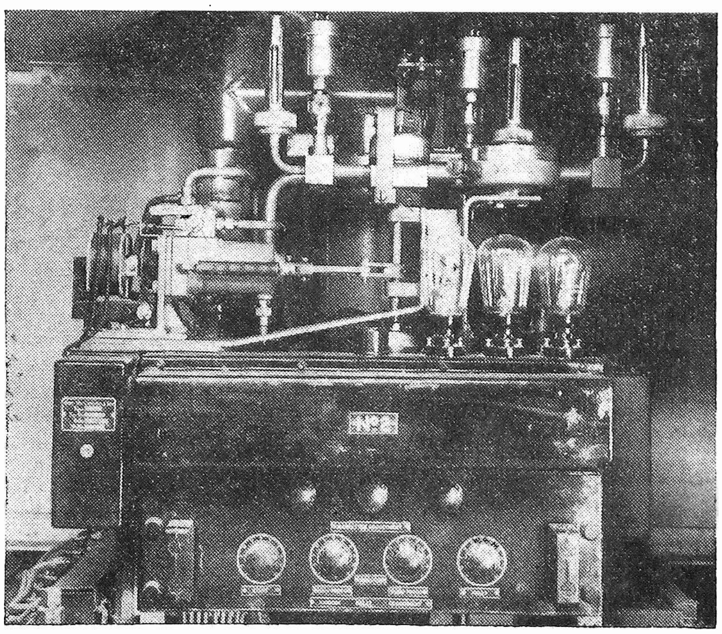
IN an endeavour to provide a satisfactory form of remote control which can be usefully applied, for example, to the remote tuning of a radio receiver, many schemes have been tried, and one of the latest to be disclosed makes use of the fundamental operating characteristics of a photo-electric cell which can be of the simplest type. The control box itself houses an endless band, along one side of which are marked the stations, wavelengths or frequencies which are to be covered by the set. Along the other side are a number of perforations corresponding to these markings, and as the band is moved so that the station marking is brought to coincide with a fixed pointer, these slots move across an opening. A beam of light from a small projection lamp is focused on the opening, and behind this is placed the photo-electric cell. Each perforation will allow the beam of light to reach the cell cathode surface while the beam is cut off between the perforations. The cell therefore generates a number of current pulses corresponding to the total number of perforations chopping the light beam. These are amplified and fed to an electro-magnetic relay operating a ratchet armature connected to the tuning condenser drive. This moves the condenser through an arc corresponding to the perforations, and the set is therefore tuned so as to be in step with the scale markings on the remote unit.

Automatic Feeding

The diversity of applications of photo-electric cells increases as industry finds that automatic control is in many cases more reliable than manual. One of the latest confirmations of this point is to be found in arc-lamp working where, as readers know, the positive carbon has to be fed towards the negative counterpart in order to allow for burning away by the light crater formed in the positive carbon. In addition to accurate feeding it is essential to ensure that the light crater is maintained in its correct position relative to the optical system focusing this light source on to its particular objective. A scheme has therefore been put forward whereby a portion of the light between the carbon electrodes is reflected back by a pair of mirrors positioned on opposite sides, so that the double beam reaches the opposite edges of a photo-electric cell cathode. Normally, the feeding of the positive carbon is undertaken by means of a series wound motor, but if there is any undue increase or decrease of light in the lamp crater, then the change of light beam on the cell is made to operate a relay so that resistances in series with the motor's field winding can be cut in or out as the case may be. This will accelerate or decelerate the motor speed as required.

Pumping and Electrons

The continued progress which is being made in America in the use of demountable valves for high-power working on the ultra-short waves, has led to the development of special auxiliary equipment to ensure that the service provided by these valves is as efficient as possible. As readers have been told before in these columns, the valves, when properly designed, give a degree of stability which is difficult to achieve by other means. Furthermore, should a cathode fail it is not a difficult matter to re-filament the valve and put it back into service in a relatively short space of time. The valves are water cooled by a circulating system which extracts the heat from the anodes and any cooled circuits in the complete transmitter, and in a modern installation flow meters are inserted at intervals together with control thermometers. Then, in the event of a restriction or a stoppage of supply or an excessive temperature rise in any branch of the circuit, relays are brought into action which close the station down automatically and isolate the essential power supplies. In addition to this, however, it is necessary to arrange for the valves to be continuously evacuated, and the accompanying illustration shows one of these intricate pumps designed specially for the purpose. It is a case once more of electronic engineering being allied to other engineering practices, for a special barretter adjustment is provided, the controls for this being visible at the bottom of the pump. A high degree of vacuum is furnished by this apparatus, and the valves doing duty on the right-hand side of the main body ensure that relays will be activated immediately there is any failure in the pumping plant.



A modern example of an efficient pumping outfit employed in conjunction with continuously evacuated water-cooled high-power tetrode valves.

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 Suggestion for the Trade

SIR,—With reference to the paragraph "A suggestion for the trade" by an Irish reader which appeared under the heading "On Your Wavelength" in a recent issue. I have been a reader of your PRACTICAL WIRELESS since its inception, and have made radio my hobby for years, always willing to attend local classes. I have had a correspondence course, and am always reading over the lessons, T. & C.R.C. and also old issues of PRACTICAL WIRELESS and many other publications. I have also a shed in my garden as a "fan's" den. Thinking I might be able to help some trader, I have answered some of their advertisements for Servicemen, etc., and have written to others not advertised, but only one has taken the trouble to answer my letters. Their assistants have told me they can't get any Servicemen.

I support "Irish Reader's" view on the suggestion that manufacturers should get in touch with some of us amateurs; a little instruction on their sets and modern meters, and it would not be like training the raw recruit.

Perhaps some of us would not like to give our positions up, but we have many spare hours we could usefully employ, and not always for financial gain.—A. E. MARTIN (Lostock, Bolton).

A Woman Reader's Log

SIR,—My husband has just become a regular reader of P.W., and being interested in S.W. listening myself I have read several copies. The readers' logs in these issues interested me very much, as from January, 1938, to the spring of 1939 I logged "hams" myself. Listening infrequently, and for short periods, I have logged close on 3,000 stations. As I had not been on the bands since war began I decided to spend one hour nightly to test the bands. Here is my log from 8.4.40 to 12.4.40:

W1: CVC, DAY, KIU, IED, MHD, CBV, MFL, ISC, BXE, FH, FDL, AEP, EVJ, OR, RHJ, LMB, and LTC.

W2: IHX, ONM, INM.

W3: GTL, FRP, FRS, GKM, FJL.

W4: BMR, DSY, CYU, EWY, ENT, YCG, FCG, GLQ, BNL.

W8: RHC, CZV, RHP, OH, OPB, EBF, POQ, CRA, GYJ, QVR, MKY, HUD, AU, AOW.

W9: WMI, QI, PEU.

CE3CE, CO2DR, CO8, JKBC, EA9AI, K4ENT, PY1BE, PY2IT, TG9BA, YV4AE, YV5ABE.

These were received on an 0-v-2 S.W. set with indoor dipole aerial, set designed by E. Orchard, of Weymouth, who won first prize DX Contest, 1937.—Mrs. T. POWNCEBY (Wallasey).

The "Rapid Two"

SIR,—Recently I reconstructed, for stand-by purposes, "The Rapid Two," which was described in P.W. some months ago.

I used a slightly different coil (standard 6-pin medium- and long-wave bands), from that specified. I fitted a series condenser and wavetrap to the aerial, a fairly long one. For detection I used an old screen-grid valve without the extra grid. I was agreeably surprised to be able to tune-in to six different stations perfectly, all on the medium waveband: Home Service, Forces, Athlone, Overseas Service, and two French stations. I also heard traces of reception on the long-wave band with head-phones. A speaker works very well on the other six, but I was unable to identify the long-wave stations. In my opinion a wave-trap is essential, and I think that this performance is excellent for a two-valver, especially "under the shadow of the transmitter" as I am.

This set is very cheap and thoroughly satisfactory, and I would advise any beginner who is considering such a set to build this one.—ALAN MCGUGAN (Dromore, Co. Down).

Correspondents Wanted

F. WRIGHT, 41, Parkgate Street, Dublin, is anxious to get in touch with any reader who has a Formo Twin-Coil unit, type A/HG (with switch), or type AH (without switch), for disposal.

A. C. Cuff, Gush's Restaurant, The Square, Wimborne, Dorset, is desirous of getting in touch with any local wireless enthusiast about 17 years of age.

L. W. Brooks, 38, Farm Road, Edgware, Middlesex, who is a newcomer to radio, wishes to get in touch with an old hand at S.W. reception, who would be willing to co-operate and offer friendly advice.

Prize Problems

PROBLEM No. 400.

MELVILLE had an S.G. Det. Power battery receiver of standard design which had given good results for some time. A simple triode was used in the detector stage, transformer-coupled to the output valve, and he decided that he could improve results by using an S.G. valve in the detector stage. He therefore obtained a valve of this type and fitted it to the receiver, providing a flexible lead for the screen so that a suitable H.T. voltage could be applied to it. In spite of considerable variation in the H.T. on the screen he was, however, unable to obtain any improvement on the results originally obtained with his lower magnification triode detector. Why was this? Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 400, and must be posted to reach this office not later than the first post on Monday, May 20th, 1940.

Solution to Problem No. 399.

Melvin needed a larger by-pass capacity, and should therefore have connected extra condensers in parallel with his existing one, not in series.

The following three readers successfully solved Problem No. 398 and books have accordingly been forwarded to them:

A. Kay, 27, Ridge Road, Sutton, Surrey.
A. Keating, 58, Orchard Avenue, Lancing, Sussex.
A. Avery, High Street, Linninglen, Nr. Doncaster, Yorks.

Practical Wireless BLUEPRINT SERVICE

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

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

The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.
Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

PRACTICAL WIRELESS

CRYSTAL SETS

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

STRAIGHT SETS. Battery Operated.

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

Mains Operated

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

SUPERHETS.

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

SHORT-WAVE SETS. Battery Operated.

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

PORTABLES.

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

MISCELLANEOUS.

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

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

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

STRAIGHT SETS. Battery Operated.

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

Mains Operated.

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

SUPERHETS.

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

PORTABLES.

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

SHORT-WAVE SETS. Battery Operated.

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

Mains Operated.

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

MISCELLANEOUS.

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

In reply to your letter

W Benson Esq
7 Sandhurst Avenue
Ilford

Eliminator Condenser

"I have a small mains unit with metal rectifier, and some time ago this gave trouble. I had it seen to by a local man and he said a condenser had gone, and he replaced it and gave me the old one back. I am uncertain, however, regarding one small point. That is, the condenser he took out was 4 mfd. and he has put an 8 mfd. in it. A friend tells me this is wrong and may damage the rectifier. Is this so?"—H. W. (Heysham).

IT is not possible to state definitely whether the change will be detrimental, but the output of a rectifier of the type mentioned is definitely dependent upon the reservoir capacity. There are two condensers in the ordinary rectifier circuit, one a smoothing condenser on the receiver side of the rectifier, and the other a reservoir condenser. A larger capacity than the makers recommend for the latter should not be used, and there is a possibility in your case that the rectifier has been damaged and is giving a low output, and this has been forced up to a higher level by the use of the large condenser. We suggest you have the rectifier tested.

Condensers in Series

"I wish to use a by-pass capacity of .00015 mfd. (found by trial with a variable), and I have not got this exact value by me. I have several condensers, the highest being .001 mfd. Can you tell me how to get at the value necessary to obtain the desired capacity? I cannot do it with parallel arrangements as these are additive and I have worked them all out. I am not sure of the series arrangement, however, and it is in this connection that I am seeking your advice."—S. R. (Kilburn).

THE capacity of condensers in series is equal to the $\frac{1}{C}=\frac{1}{C1}+\frac{1}{C2}+\frac{1}{C3}+\frac{1}{C4}$ etc. As you know the capacity you finally require it is not a difficult matter to work out the effects of combinations of two condensers by taking the capacity you need as C2, and then putting down the values of any pair of condensers as C1 and C. The formula then becomes $\frac{1}{C2}=\frac{1}{C1}+\frac{1}{C}$. You may eventually find that with the particular values which you have available, it may be necessary to connect two or more in parallel to obtain one of the values in your final series circuit.

Quench Coil

"I wish to try out a super-regen. circuit but should like to make up the quench coil unit. Could you give me some rough idea as to windings so that I could have a basis for experiment? I do not expect complete winding data, but so long as I have something which will be near right I can soon experiment and find the exact values for the valves and circuit I intend to use."—N. E. I. (Barrow).

A GOOD plan is to take a 1in. diameter paxolin former and place four rings of cardboard over it to leave two narrow winding spaces. Into these wind about 2,000 turns of 30 S.W.G. enamel wire. .006 mfd. parallel capacity may be used for tuning and should give a quenching frequency of about 20 kc/s. Separate the two windings by about ⅛in.

S.W. Converter

"I have been studying the details in your article on frequency-changers in the issue dated Feb. 24th. The circuits of Fig. 2 and 3 certainly seem to me to be capable of conversion to a small unit which could be added to a standard set in the same way as a short-wave converter. As I should like to try these out, perhaps you could inform me whether or not I am right in my assumption, and if so, what results I might expect."—S. M. (Bridlington).

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.

YOU could certainly use either of the arrangements as a converter, and the only point is that in each one an I.F. transformer is shown in the anode circuit. This means that if built exactly as shown the secondary of the I.F. transformer (marked I.F. on the diagrams) would have to be joined between grid and earth in the circuit of the first valve in your receiver. Any components already in that circuit would have to be disconnected. It would therefore be preferable to cut out the I.F. transformer, fit a suitable choke and condenser and connect the latter to the aerial terminal of your present receiver, tuning this to the long-wave band and thus providing the necessary intermediate-frequency.

Morse Practice

"What is the best method of getting good practice in Morse? I have a friend who is also interested and we should like to get some good speed before starting to listen to commercial broadcasts for the purpose. Have you given any articles on the subject?"—C. R. (Bedford).

YOU can obtain gramophone records of recorded morse with a printed copy of the text; you can obtain a correspondence course on the subject; you can make use of a mechanical code sender or recorder, or you can make up a small test set for use with a key. The latter will enable you both to practice sending to each other, although it will not ensure correct sending if you get into bad habits. For mastering the code it is no doubt the most useful arrangement, and you can use a battery and buzzer, a neon oscillator, or a valve oscillator for the purpose. We published an interesting article on the subject in our issue dated November 25th last.

Split Stator Condenser

"I was looking through a catalogue recently and saw a split-stator condenser advertised. I should be glad if you could tell me just what this is and what it is used for."—L. R. S. (Exeter).

THE term was applied to certain condensers of the variable type designed primarily for transmitters. They are in effect merely two-gang condensers, the split stator being the two separated fixed sections, the rotor or moving section being mounted on a common spindle in the usual way. For ideal results, however, the two sections should be well separated, well insulated, and the rotor should have the connection taken to the centre of the spindle, that is, between the two moving sections.

REPLIES IN BRIEF

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

D. D. L. (Bangor). The slope should be towards the lead-in end.

G. T. (S.E.). The set was described in a contemporary which is not now on the market. We have no details.

H. W. (Swansea). The coil costs 5s. 6d., but you need not worry about the screen in this particular case. Use exactly according to the makers' directions.

W. D. (Burslem). The component is not now on the market, as the arrangement has been superseded. You would have to use two separate components for the purpose.

D. M. J. (Brynmawr). Write direct to the makers for details of the circuit.

R. G. S. (Taunton). Write direct to Messrs. Peto Scott, 77, City Road, London, E.C.1.

E. I. (Silverdale). You must use a battery for the purpose. The only other way out would be to use a potential divider with separate volt and ammeters in circuit continuously so that compensations could be made to keep things constant. This would be expensive and difficult.

G. L. (Kelso). We regret that we cannot supply a blueprint or wiring diagram for the set in question. It is not one of our designs.

H. W. P. (Gillingham). The arrangement is unusual and thus we are unable to advise concerning the modification. Could you let us have any further details?

E. C. (Swansea). Varley Class B input, type DP.40 and Class B output, DP.42; Hivac B.230 and D.210 (or L.210); no resistance in anode circuit of output valve; volume control 50,000 ohms.

J. R. (Brighton). Wind both coils identical. On no account reverse the secondary. The idea is good.

K. R. S. (Gillingham). The battery may be under the set, but good ventilation is desirable and therefore we do not approve of the idea.

B. T. (N.21). Eight watts is more than ample. The sets in question will, of course, only deliver that output when fully loaded and this will probably only occur on the local stations.

G. B. (Isleworth). Do not use tin—which is merely tinned iron. It would be preferable to use ordinary wood and obtain coil and valve screens for the individual parts.

N. H. A. (Liverpool). The two speakers may not be in phase, or alternatively the resonance points may coincide. A balanced pair is generally employed.

G. M. (Lancaster). Although fine emery or sandpaper would be used we do not recommend it owing to the risk of metallic dust getting into moving parts and giving rise to trouble. A chemical cleaner would be preferable.

M. T. (Faversham). Brass would definitely be preferable, as it is not only easier to work and a sound soldered joint is thus possible, but it would have better conductivity than the other material.

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

Notes from the Test Bench

H.F. Pentode

MANY constructors are unaware that an ordinary H.F. pentode may be used for low-frequency amplification, with quite good results. The main details are that a high impedance must be used in the anode circuit and that the voltage on the grid must also be critically chosen. A good all-round suggestion is to use a .5 megohm anode load, and for the screen voltage it is desirable to use a flexible lead with an H.T. battery in series with a grid-bias battery, so that changes of 1.5 volts may be made in the H.T. It will no doubt be found that even these steps may be too great with some valves, but for normal work the modification of 1.5 volts will be found sufficient, although it may take some time to find the most suitable voltage for the valve in use. A stage gain of 200 or more is theoretically possible.

H.F. By-pass Condensers

A SMALL point, but one which may assume considerable importance in some receivers, is the method of using H.F. by-pass condensers. It is customary to use the small tubular type for this purpose, but as these are wrapped (non-inductively, of course) there is still an inside and an outside end to the condenser. In some H.F. circuits the connection of one end or the other to earth may make a considerable difference to results. For this reason, most of these condensers are now marked with the letters O.F. or a ring to indicate the outside foil, and this should be the end which is joined to earth. It is, of course, assumed that every constructor knows that a non-inductive type of condenser must be used for H.F. by-passing.

Brace Screwdriver

CONSTRUCTIONAL work may be speeded up if you possess one of the special speed screwdrivers used by manufacturers. These only need a push to produce a high speed of rotation, but they are expensive and a ready substitute is not difficult to make. Simply obtain a long-handled screwdriver of the standard type, and saw off the blade to a length of about 4ins. The end may either be filed to a square section, or roughened by a file. It may then be gripped in the chuck of an ordinary twist brace and then screws and bolts may be quickly driven home or unscrewed. With care a box spanner may be made up on similar lines so that nuts may be run home in a similar manner.

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.

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COULPHONE RADIO, Grimshaw Lane, Ormskirk. Collaro A.C. Gramophone Motors, 12in. turntable, 27/6. With pickup, 45/-. Crystal pick-ups, 22/6. Rola G.12 Speakers with transformers, 1,250 ohms, 52/6. P.M., 65/-. Guaranteed American valves, 4/6, Octal, 5/6. 33⅓ per cent. discount on Record British Types. Latest Double Decca, 9 gns. 2½d. stamp or Lists.

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

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

TRANSFORMERS for L.T. Rectifiers for charging and safety, 12v. lighting, from 12/6.—Thompsons, 176, Greenwich High Road, S.E.10.

LONDON CENTRAL RADIO, 23, LISLE STREET, W.C.2. GERRARD 2969. SEE PREVIOUS ISSUES FOR OUR BARGAINS.

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