THE PICK-UP AND A.V.C.—See page 155.

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Edited by F. J. CAMM

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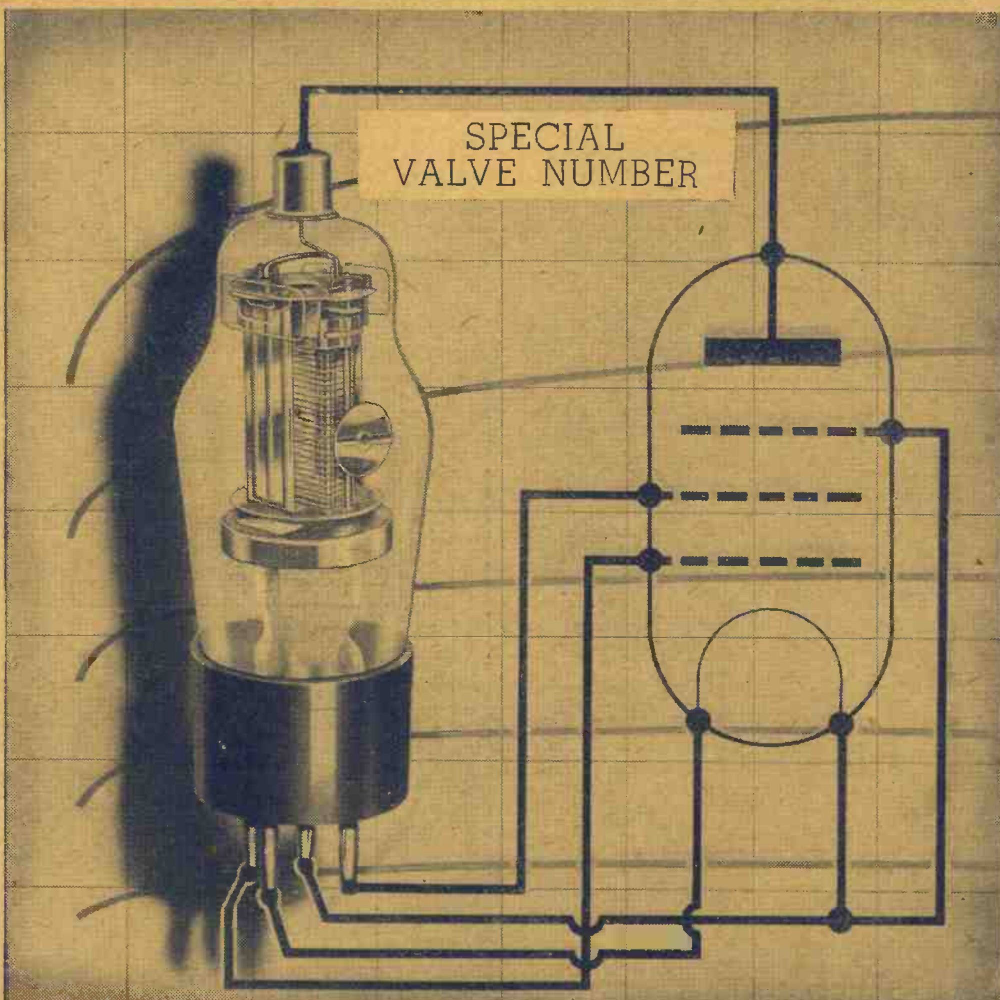
Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 4th, 1940.

Contents



NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 83

METALLIC ELEMENTS AND THEIR PROPERTIES

Number of Symbol.	Colour.	Date.	Atomic Weight	Specific Gravity or Density.	Specific Heat.	Melting-point (°Centigrade.)	Coefficient of Linear Expansion.
Aluminium ... Al	Tin-white	1827	27.1	2.67	.2140	657	.0000231
Antimony ... Sb	Bluish-white	—	120.2	6.71-6.86	.0508	630	.0000105
Arsenic ... As	Steel-grey	—	7.5	5.72	.081	450	.0000055
Barium ... Ba	Pinkish-grey	1808	137.4	3.8	.068	850	—
Beryllium (see *Glucinum*)							
Bismuth ... Bi	Pinkish-white	—	208.0	9.823	.0305	268	.000014
Bromine ... Br	—	—	79.6	—	—	—	—
Cadmum ... Cd	Tin-white	1817	112.4	8.546-8.667	.0548	322	.000027
Cæsium ... Cs	Silver-white	1850	132.8	1.9	.048	27	—
Calcium ... Ca	Yellow	1807	40.1	1.578	.1700	800	.0000269
Cerium ... Ce	Grey	1819	140.2	7.64	.0448	623	—
Chromium ... Cr	Grey	1797	52.0	6.81-7.3	.1200	1,700	—
Cobalt ... Co	Greyish-white	1742	59.0	8.5-8.7	.1070	90	.0000123
Columbium (see *Niobium*)							
Copper ... Cu	Red	—	63.6	8.92-8.95	.0952	1,100	.0000167
Erbium ... E	—	1843	166.0	—	—	—	—
Gadolinum ... Gd	—	—	156.0	—	—	—	—
Gallium ... Ga	Bluish-white	1875	69.9	5.9	.079	30	—
Germanium ... Ge	Bluish-white	1875	72.5	5.5	.074	900	.0000167
Glucinum ... Gl	Silver-white	1828	9.1	1.9	.5820	—	—
Gold ... ... Au	Yellow	—	197.2	19.265	.0324	1,065	.0000136
Indium ... In	White	1863	114.8	7.42	.0570	176	.0000417

No. 84

METALLIC ELEMENTS AND THEIR PROPERTIES (continued)

Number of Symbol.	Colour.	Date.	Atomic Weight	Specific Gravity or Density.	Specific Heat.	Melting-point (°Centigrade.)	Coefficient of Linear Expansion.
Iridium ... Ir	Steel-white	1803	193.1	22.38	.0326	2,250	.0000068
Iron ... ... Fe	Silver-white	—	55.9	7.84	.1140	1,550	.0000116
Lanthanum ... La	Grey	1839	139.0	6.163	.0449	750	—
Lead ... ... Pb	Bluish-white	—	207.1	11.254-11.388	.0314	328	.000027
Lithium ... Li	Silver-white	1855	7.02	.589-.598	.9410	180	—
Magnesium ... Mg	Silver-white	1808	24.3	1.75	.2500	750	.0000269
Manganese ... Mn	Reddish-grey	—	55.0	8.0	.1220	1,245	—
Mercury ... Hg	Bluish-white	300 B.C.	200.0	13.594	.0319	-40	.0000610
Molybdenum Mo	Silver-white	1782	96.0	8.6	.0722	1,600	—
Neodymium Ne	—	—	143.6	7.0	—	840	—
Nickel ... Ni	—	1754	58.7	8.9	.1080	1,450	.0000127
Niobium ... Nb	Steel-grey	1846	93.5	12.1	.071	1,950	—
Osmium ... Os	Bluish-white	—	190.9	22.5	.0311	2,500	.0000065
Palladium ... Pd	Tin-white	1804	106.7	11.4	.0593	1,400	.0000117
Platinum ... Pt	—	1558	195.2	21.5	.0324	1,760	.0000089
Potassium ... K	Silver-white	1807	39.10	.875	.1660	60	.0000841
Praseodymium Pr	—	—	140.5	6.5	—	940	—
Radium ... Ra	—	1901	225.0	—	—	—	—
Rhodium ... Rh	Tin-white	1804	102.9	12.1	.0580	2,000	.0000085
Rubidium ... Rb	Silver-white	1861	85.5	1.52	.077	38.5	—
Ruthenium ... Ru	—	1828	101.7	12.261	.0611	Over 20,000	.0000096
Samarium ... Sm	—	—	150.3	—	—	—	—

No. 85

METALLIC ELEMENTS AND THEIR PROPERTIES (continued)

Number of Symbol.	Colour.	Date.	Atomic Weight	Specific Gravity or Density.	Specific Heat.	Melting point (°Centigrade.)	Coefficient of Linear Expansion.
Scandium ... Sc	—	—	44.1	—	—	—	—
Silver ... Ag	White	—	107.9	10.4-10.57	.0560	962	.0000192
Sodium ... Na	Silver-white	1807	23.0	.98	.293	96	.000071
Strontium ... Sr	Yellow	1808	87.6	2.5	—	800	—
Tantalum ... Ta	Black	1802	181.6	16.8	.0365	2,910	.0000079
Tellurium ... Te	—	—	127.5	6.25	.049	452	.0000167
Terbium ... Tb	—	1843	160	—	—	—	—
Thallium ... Tl	Bluish-white	1861	204.0	11.8	.0335	303	.0000302
Thorium ... Th	Grey	1826	232.4	11.2	.0276	1,690	—
Thulium ... Tm	—	—	171	—	—	—	—
Tin ... ... Sn	White	—	119.0	7.293	.0559	232	.0000203
Titanium ... Ti	Dark grey	1789	48.1	3.6	.13	1,800	—
Tungsten ... W	Light grey	1783	184.0	19.129	.0334	1,700	—
Uranium ... U	Greyish-white	1789	238.5	18.33	.0277	1,600	—
Vanadium ... V	Whitish-grey	1801	51.1	5.9	.125	1,680	—
Ytterbium ... Yb	—	—	173.0	—	—	—	—
Yttrium ... Yt	Grey	1797	89.0	3.80	—	—	—
Zinc ... ... Zn	Bluish-white	—	65.4	7.1	.0935	419	.0000274
Zirconium ... Zr	Grey	1789	90.6	4.15	.0662	Over 1,300	—

No. 86

MAINS TRANSFORMER DATA

By means of a Constant obtained from the table below the turns of wire for a primary of a transformer may easily be ascertained. For example, the constant of a transformer for a supply of 220 volts 50 cycles is 1,760. Therefore, with a core of 1 sq.in. cross sectional area you use 1,760 turns of wire for primary. For a core of 2 sq. in. you use $\frac{1760}{2}$=880 turns and so on. The secondary is directionally proportional to the voltage ratio.

Reactive Voltage	Frequency cycles per second								
	20	30	40	50	60	70	80	90	100
50	525	485	444	400	362	325	287	250	206
100	1050	975	888	800	725	650	575	500	412
110	1155	1073	976	880	797	715	632	550	453
150	1575	1455	1332	1200	1096	975	861	750	618
200	2100	1950	1775	1600	1450	1300	1150	1000	825
210	2205	2048	1864	1680	1533	1365	1207	1050	866
220	2310	2146	1952	1760	1594	1430	1264	1100	906
230	2415	2243	2041	1840	1666	1495	1321	1150	947
240	2520	2341	2130	1920	1739	1560	1378	1200	988
250	2625	2425	2220	2000	1810	1625	1435	1250	1030

CRYSTAL DATA

Crystals and their Symbols

Bornite	$3Cu_2S_3Fe_2S_3$
Carborundum	SiC
Cassiterite (tinstone)	SnO_2
Copper pyrites	$Cu_2S_2FeS_2$
Galena	PbS
Graphite	C
Hertzite	PbS
Iron Pyrites	FeS_2
Malachite	$CuCO_2CuH_2O$
Molybdenite	MoS_2
Silicon	Si
Tellurium	Te
Zincite	ZnO

Crystal Combinations

Carborundum with Steel	Tellurium with Zincite
Iron pyrites with Silicon	Carborundum with Silicon
Galena with Tellurium	Copper Pyrites with Tellurium

No. 87

CHORDS OF CIRCLES

No. of Spaces.	Length of Chord.	No. of Spaces	Length of Chord.	No. of Spaces	Length of Chord.	No. of Spaces	Length of Chord.	No. of Spaces	Length of Chord.
3	.8660	23	.1362	43	.0730	63	.0499	83	.0378
4	.7071	24	.1305	44	.0713	64	.0491	84	.0374
5	.5878	25	.1253	45	.0698	65	.0483	85	.0370
6	.5000	26	.1205	46	.0682	66	.0476	86	.0365
7	.4339	27	.1161	47	.0668	67	.0469	87	.0361
8	.3827	28	.1120	48	.0654	68	.0462	88	.0357
9	.3420	29	.1081	49	.0641	69	.0455	89	.0353
10	.3090	30	.1045	50	.0628	70	.0449	90	.0349
11	.2817	31	.1012	51	.0616	71	.0442	91	.0345
12	.2588	32	.0980	52	.0604	72	.0436	92	.0341
13	.2393	33	.0951	53	.0592	73	.0430	93	.0338
14	.2225	34	.0923	54	.0581	74	.0424	94	.0334
15	.2079	35	.0896	55	.0571	75	.0419	95	.0331
16	.1951	36	.0872	56	.0561	76	.0418	96	.0327
17	.1838	37	.0848	57	.0551	77	.0408	97	.0324
18	.1736	38	.0826	58	.0541	78	.0403	98	.0321
19	.1646	39	.0805	59	.0532	79	.0398	99	.0317
20	.1564	40	.0785	60	.0523	80	.0393	100	.0314
21	.1490	41	.0765	61	.0515	81	.0388		
22	.1423	42	.0747	62	.0507	82	.0383		

No. 88

SHORT-WAVE COIL DATA

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
½″	18	10½	½″	5¼	5	9	11	16
”	”	”	¾″	7⅞	6½	11½	14½	22
”	”	”	1″	10½	7½	13½	17	26
”	”	”	1¼″	13⅛	8½	15½	19	30
”	”	”	1½″	15¾	9¾	18	21½	33
¾″	18	10½	½″	5¼	6¾	12½	15½	24½
”	”	”	¾″	7⅞	9¼	17	20½	32
”	”	”	1″	10½	11	20	24½	37
”	”	”	1¼″	13⅛	12¾	23	28	43
”	”	”	1½″	15¾	14¼	26	31½	48
⅞″	18	10½	½″	5¼	8	14½	17½	26½
”	”	”	¾″	7⅞	10½	19¼	23½	36
”	”	”	1″	10½	12½	23	28	43
”	”	”	1¼″	13⅛	14½	26½	32	50

(See also page 160)

Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
Vol. XVI. No. 398. May 4th, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Understand Your Valves

MANY constructors spend a considerable amount of time and money on the component parts of a receiver and in many cases are disappointed in the results which they obtain from experimental equipment. In some cases it may be found that the failure of a proposed circuit to function properly is due to the use of a wrong type of valve, and the valve is often taken for granted. Any type is considered good enough to use for test purposes, whereas it may be possible that the circuit would act quite differently if another valve was used. In order that readers may have a better understanding of the differences in valves and the features associated with them, the majority of the articles in this issue are devoted to valve data and associated subjects, and it is hoped that these details will enable improved results to be obtained by using more suitable valves or circuits for the valves on hand. It should also be remembered that a valve does not last indefinitely, and although it may continue to function for years the emission may have suffered from continued use, and the mere replacement of the valve by one of exactly similar type may give greatly improved results.

Sponsored Programmes

IT has been suggested in certain quarters that the B.B.C. is considering, or preparing to consider, the introduction of sponsored programmes. We understand from the B.B.C. that there is no foundation whatever for this suggestion.

Mr. R. d'A. Marriott

THE B.B.C. announces that it has appointed Mr. R. d'A. Marriott to be its war-time representative in Paris. Mr. Marriott's task will be to facilitate the closest possible co-operation between the British and French broadcasting authorities and to co-ordinate the B.B.C.'s growing activities in France in non-technical fields. Mr. Marriott joined the B.B.C. in 1933. For some years before the present war he was the B.B.C.'s liaison officer with foreign broadcasting organisations. Since the war he has taken an important part in the organisation of the Monitoring Service. He will take up his new duties on May 6th next.

"British and Proud of It"

ERNEST LONGSTAFFE produced recently his first version of "British and Proud of It," with four compères, one for each of the four countries. On May 3rd he intends to have four commères. Somehow, it is not difficult to imagine that at one time or another there may have been four compères to one programme; but four commères is a very different matter and probably unique in the annals of broadcasting. At the time of writing, their names are not yet known, but a thorough bid is being made in England, Scotland, Wales and Ireland to find the woman who is really representative of her country. In the last programme, the great wealth of song and story which is the heritage of each country was well represented.

Our Special Book Offer

RADIO TRAINING MANUAL for the Services and the Trade.

Readers who have been collecting Tokens from No. 1 in connection with our special offer now have the four Tokens required, and should claim their Book to-day.

The Voucher on which the Tokens must be affixed, together with postal order, should be posted at once, and your copy of the RADIO TRAINING MANUAL will be dispatched within 14 days.

If you have mislaid any of your four Tokens you may complete your Voucher by sending up Token No. 5. No. 5 will be given in next week's PRACTICAL WIRELESS.

Readers who have just begun to collect Tokens must wait until they have four numbered consecutively before sending them in.

Special arrangements have been made for those who overlooked the original offer. They should apply for a Voucher to PRACTICAL WIRELESS Presentation Dept., Holford Square, London, W.C.1 (Pref.), enclosing a penny stamped addressed envelope marked "Printed Matter." The Voucher gives full particulars of the offer.

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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.

Mr. Amery to Broadcast

AN appeal on behalf of the British Social Hygiene Council will be given in the Home Service programme on May 5th by Mr. L. S. Amery, M.P. It is an unfortunate fact that the vast majority of young people are still without proper information or guidance on sex behaviour, and this ignorance may lead to individual tragedies as well as serious results for the health of the community and of future generations. Fortunately, up to date the incidence of preventable diseases is far less than during the last war. For the last twenty years the British Social Hygiene Council, recognised by the Ministry of Health and local authorities, has been working actively to eradicate such diseases. Already, one disease has fallen by over 50 per cent. To prevent the ground already won being lost and the damage of the last war repeated, the Council's educational work both for Service and civilian men and women is essential and urgent. This work is essentially directed towards the protection of family life.

Children's Hour Fable

"THE SINGING ASS" is the title of the Æsop fable which occupies ten minutes of the Children's Hour on May 4th. It will be retold with words and music by Henry Reed, who has already done much work with fairy-tale and fable adaptations. Also on the same afternoon will be a variety programme which will include Edith and Vi on two pianos, the Three Semis, Francis Walker with his harmonica and accordion, and Wilfred Pickles.

"Meet the Family"

ON May 3rd Martyn Webster will revive a farce with music by the Melluish Brothers, called "Meet the Family," which was last produced from Birmingham in January, 1934. The Melluish Brothers are renowned for their burlesques—an excellent example of their work, "Only a Mill-girl," has already been broadcast, but it is not often that they attempt actual farce. Since its radio performance "Meet the Family" has become a great favourite with amateur actors.

For the Beginner

VALVE TYPES EXPLAINED—3

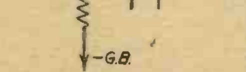
The Third Article of This Series Deals with the Screen-grid and Pentode Types of Valve. By L. O. SPARKS

SO far we have dealt with diodes and triodes, and have seen that the latter are produced in several types, but for the purpose of classification it can be assumed that the three groups given below cover all general requirements. The first of these would embrace those triodes suitable for high-frequency amplification and those which form efficient detectors. It will be remembered that such valves have a high magnification factor and an impedance between 15,000 and 30,000 ohms. The second group would cover those triodes specifically designed for low-frequency amplification, and, as already explained, in consequence of the work they have to undertake, they usually have a lower amplification factor and impedance. Values between 8,000 and 15,000 ohms are normal for valves coming within this section. The last group is solely concerned with those types which come under the heading of *power* valves, and they are intended for the output stage of a receiver or amplifier. Owing to the fact that they have to handle a much larger signal than the valves which precede them, they have the lowest impedance of all; in fact, the value might be anything between 1,500 ohms and 5,000 ohms. The amplification-factor is, of course, reduced accordingly.

Screen-grid Valves

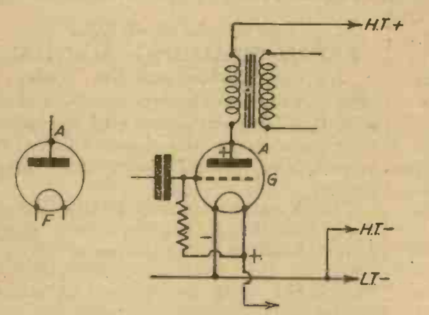
The next valve type in order of popularity is, undoubtedly, the pentode, but before any consideration can be given to it, the screen-grid valve must be explained, as this will then keep them in their proper sequence as regards the number of electrodes employed in their construction.

The screen-grid valve, or to give it its correct technical name, the tetrode (tetra meaning five), consists of nothing more than an additional grid added to a triode assembly. This, then, now gives us the filament or heater, the anode, the *control* grid and the additional grid which is known as the screening grid. The fifth electrode has a grid or mesh construction similar to the control grid, but its gauge, i.e., mesh, is very much finer, and it is located between the *grid* and the *anode*. It is rather difficult to understand its purpose without going into technical matters and characteristic curves, but as we are avoiding such items in these articles, it is hoped that the following description will make matters quite clear.



The order of location of the three grids in a pentode valve.

When it was desired to increase (amplify) the signal before it reached the detector, in the early days of the thermionic valve, use had to be made of the triode, owing to the very good reason that nothing better was then available. Owing to the characteristics of those valves, plus other items, it was not possible to obtain a very high degree of pre-detector (H.F.) amplification without introducing that very undesirable item known as *instability*, or, in other words, lots of whistles and shrieks and very little amplification. One of the main factors which contributed to this very unsatisfactory state was the fact that the triode allowed a certain amount of energy to be passed from the *anode back to the grid*, and this, especially when the two circuits were tuned to the same wavelength, caused the valve to act as an oscillator. This passing back of energy from one electrode to another (*feed-back*) was chiefly due to the two electrodes forming a very minute *condenser* which provided the valve with what is described in valve-makers' leaflets as *inter-electrode capacity*. Valve designers, realising that until the value of this minute condenser or its effects could be rendered so small as to be negligible, no worth-while amplification would be possible, set about the problem seriously. The result is the screen-grid valve; it was found that by introducing the second grid between the first and the anode, the inter-electrode capacity could be enormously reduced, and the characteristic of the valve so affected that it was possible to obtain an exceptionally high degree of amplification together with perfect stability, provided that, of course, certain common precautions were taken with the lay-out of the components and the operating voltages.



The electrode arrangements for the diode (left) and the triode (right) are shown here.

To enable the screening-grid to carry out its functions to the full, it has to be maintained as a positive voltage with respect to the filament or cathode, in a similar manner to that of the anode. The chief difference between the voltages applied to the anode and the screening-grid is not one of polarity (they both have to be *positive*) but of value. The voltage on the screen is usually in the neighbourhood of half that applied to the anode. The valve-makers always quote the most satisfactory voltage values for both electrodes.

The impedance of these valves is of a very high order, when compared with other types, the figure being in the region of 300,000 ohms and more, while the amplification-factor also rises to the amazing figure of 330, to quote but an average value.

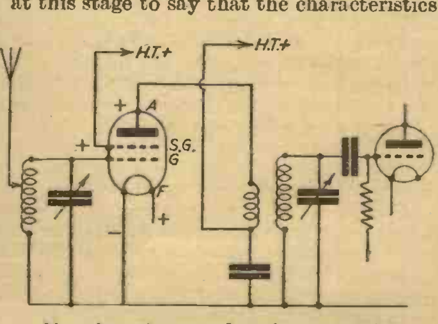
Variable-mu S.G.'s

The term variable-mu is applied to valves of the S.G. and pentode types which are used for H.F. amplification purposes to denote that it is possible to vary their amplification factor. The expression "mu" is another term for amplification factor.

Valves of this type are similar in construction, but their characteristics are different from that of the ordinary S.G. or pentode valve, inasmuch that their operation can be affected by varying the bias applied to the grid. With an ordinary or straight type of S.G. valve, its grid coil is normally returned to the negative earth line, but with one of the variable-mu type it is taken to a source of negative grid-bias which can be varied according to the will of the operator. As this variation increases or decreases the amplification factor according to the value of the negative bias supplied, it forms a very efficient type of pre-detector volume-control and also introduces other certain desirable features.

To sum-up the screen-grid valve, we can say that it is primarily designed for use as an H.F. amplifier, but in addition to its original purpose, it is now quite widely used as a detector and in certain instances as the first valve in an L.F. amplifier when exceptionally high amplification is required.

In spite of the numerous advantages a screen-grid valve offers over the triode it has, however, certain defects which the technicians in their quest for super-efficiency decided could be removed with advantage. For a more complete technical description of the problems involved, the reader must wait until he is more fully conversant with the items mentioned in the previous articles, therefore, it must suffice at this stage to say that the characteristics of the S.G. valve were considerably improved by the simple process of adding yet another grid.



Note how the second grid is inserted in the S.G. valve.

This third grid has a much coarser mesh and is inserted between the screening grid and the anode. It is actually situated nearer the anode than to the screening grid; in fact, its position with relation to these two electrodes is rather critical. To differentiate between the three grids now in use, the last one to be added is known as the suppressor grid, and it is either connected internally to the filament or cathode or, in the case of multi-pin bases, it is brought out to a separate pin.

Valve Installation

Important Points Regarding H.T., L.T. and G.B. Supplies for Battery and Mains Valves. By W. J. DELANEY

ELSEWHERE in this issue the important points regarding the selection of valves, and the various types, are explained, but it is also important to know how to install the valves in a receiver—that is, the various methods of obtaining L.T. and H.T. supplies for different types of valve and different types of receiver. First and foremost, the heater or filament supply must not exceed that recommended by the makers or the life of the valve will be impaired. With indirectly-heated valves, that is, those which have a cathode which is heated to obtain the necessary electron stream, it is also essential to see that the valve is not under-run. A low temperature may cause unsatisfactory performance, and also will reduce the valve life. Operating at too high a temperature will also shorten the life of the valve. Therefore, the voltage applied to heaters or cathodes should always be measured across the valveholder terminals with a good meter. A.C. types of valve may be operated direct from a transformer, whilst D.C. valves may be operated from dry batteries or through a mains dropping resistance from D.C. mains.

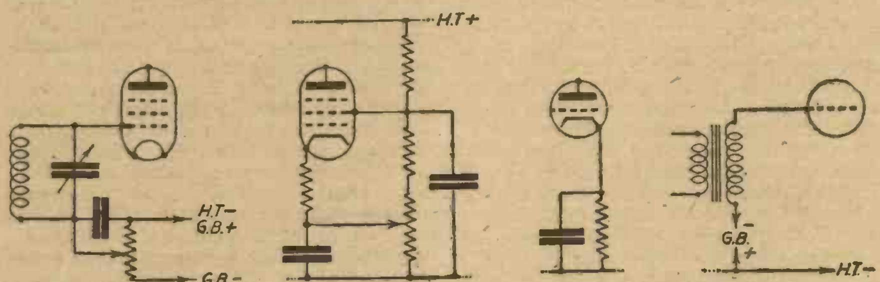


Fig. 2.—Alternative methods of biasing mains and battery H.F. and L.F. valves.

Filaments or heaters (they are both regarded in the same light although in the case of the former type the emissive element is on the filament and in the latter case the heater is merely used to make the cathode hot, and it is this which has the emissive coating) may be joined in series or parallel.

Filament Circuits

With battery valves the usual procedure is to connect the filaments in parallel. With A.C. valves the heaters are usually connected in parallel. With D.C. valves the arrangement may consist of series or series-parallel connections. The current in the case of D.C. valve circuits must be the same for each valve, although the voltage rating may be different. A series resistor is then also included between the chain of heaters and the mains to provide the correct voltage drop, and at the same time regulate the current. In the case of the transformer the winding must be capable of delivering sufficient current for all the valves in circuit, that is, the sum of the individual currents.

With A.C. indirectly-heated valves the cathodes should be joined to the centre tap on the heater winding, or the centre-tap on a resistance across the winding. If the modern 6.3 volt types of valve are used, and operated from an accumulator, then the cathodes should be joined to the negative terminal on the cell. These remarks apply, of course, to those valves which are not to be biased as described later.

H.T. Supplies

H.T. may be obtained from dry batteries, from banks of accumulators, from D.C. mains through a smoothing choke, or from A.C. mains through a transformer and rectifier. The latter may be a valve or metal unit, but the output from either is of the pulsating D.C. type, and must therefore be smoothed in the same way as that from D.C. mains. In all cases the smoothing consists of a high inductance iron-cored choke having a large capacity fixed condenser connected on each side of it joined to the negative line. The maximum rating given by the makers should not be exceeded or the valve life will be shortened.

Screen Voltages

Valves having a screening grid—H.F. pentodes, L.F. pentodes, S.G. valves or output tetrodes — must have a positive potential applied to the screen, and this may be obtained by means of a resistance in series with the grid and the H.T. positive line, or by means of a potentiometer connected across the H.T. supply. The latter arrangement is generally preferable for H.F. valves, as it enables the current to be raised to such a level that the voltage on the screen remains sensibly constant in spite of variation in the grid voltage. This is important for H.F. valves of the variable-mu type. Output valves, or simple S.G. H.F. valves, may be fed through a single resistance. As a reduced screen voltage lowers the gain or amplification of the valve it is important to obtain the correct voltage, unless the potential is varied by means of an adjustable potentiometer in order to provide a volume-control effect. High voltage on the screens will cause instability and shortening of the valve life.

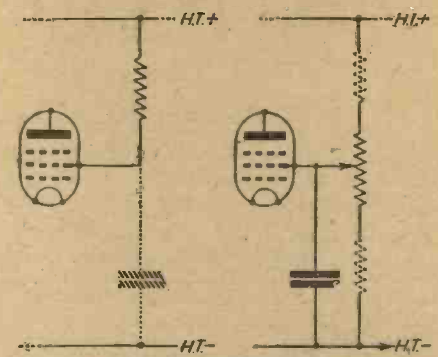


Fig. 1.—Alternative methods of feeding the screen-grid of a pentode valve.

Grid Voltage

Not all valves work with zero grid voltage, and therefore some method of applying a voltage—negative—is necessary in most cases. A detector will work with positive grid volts, obtained by connecting the grid leak to the positive filament terminal or to a resistance across the filaments. H.F. valves generally require a lower voltage than L.F. or output valves. With battery types the bias is generally applied by means of a battery. Variation in the bias causes erratic performance or hum, and therefore a constant or smooth bias supply is essential. The grid is joined to the negative side of the battery at the voltage desired, in the case of L.F. valves through the transformer secondary or through the grid leak of an R.C. coupling. In the case of H.F. valves the lower end of the tuning coil is joined to the battery or to the arm of a potentiometer joined across the battery. This may have a total value of 9 or 16 volts, the former being necessary for "short grid base" valves, and the latter for "long base" valves. In the case of mains valves the bias is generally obtained by including a resistance in the cathode lead. To smooth out the effect and prevent hum a high-capacity fixed condenser must be joined across the resistance. On the H.F. side a maximum of 1 mfd. is suitable, but on the L.F. side up to 50 mfd. may be used. The value of the biasing resistor may be calculated from the following formula:

$$\text{Resistance (ohms)} = \frac{\text{Desired bias voltage} \times 1{,}000}{\text{Anode current in mA.}}$$

The anode current is sometimes referred to as the cathode current, as the cathode and anode are in series, and thus the anode current also flows through the cathode.

(Continued on page 166)

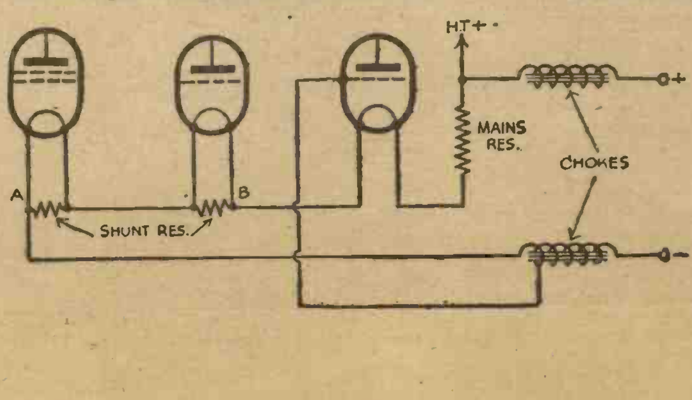


Fig. 3.—How D.C. heater circuits are wired.

Comment, Chat and Criticism

Tschaikowsky—2

Further Notes on the Life and Work of the Great Russian Composer, by Our Music Critic, MAURICE REEVE

AT the time of which we are writing, Russian music was divided into two clearly defined schools: the nationalists in St. Petersburg, comprising the Kutchka under Balakirew's leadership, and the "eclectics" of Moscow, of whom Tschaikowsky was to become the bright particular star. Although Tschaikowsky occasionally used folk-songs, he more frequently crossed the national frontiers for his inspiration than his St. Petersburg rivals, who dug ever deeper and deeper into the well-springs of Russian lore. But he had great admiration for much of their work, particularly Balakirew's. The group, for their part, also recognised Tschaikowsky's genius, and made many attempts to convert him to their ways. Each played the other's work, and thus showed a commendably liberal-minded spirit.

The success of Nicholas Rubinstein's school naturally led to a valuable increase in Tschaikowsky's material prosperity, but he was fortunately dissuaded from leaving it to set up on his own. His life was rather uneventful, consisting mainly of the usual round of pupils plus his own studies, and great bursts of creative effort in the recesses, and such other times as were practicable.

But the development of his own genius, and doubtless, also, its recognition by the public, led to further attempts at gaining independence from anyone who might prove a restraining influence, and he finally managed to do so in 1877. The affair over the piano concerto will be referred to when that work is discussed.

Antipathy to Wagner's Music

After 1870 he travelled much, and had to leave Paris hastily during the Franco-Prussian war. He developed a great antipathy to Wagner's music, and more especially to Brahms'. The latter is more understandable than the former, as we have a cold, logical reasoning opposed to the rule of feeling and passion. He actually expressed a preference for Delibes' Sylvia Ballet music to "Götterdämmerung": even genius nods sometimes.

The year 1877 was a memorable one. Perhaps the more important, as it certainly was the more remarkable, event was the amazing friendship which sprang up between the 37-years-old composer and the 46-years-old widow of a railway engineer. Mme. von Meek first heard of Tschaikowsky from one of his pupils at the Conservatoire, who never tired of singing his praises, and whom she used to engage to play the violin at her house. She became very enthusiastic over Tschaikowsky's music, and ordered an arrangement for piano of two or three of his orchestral pieces for her use. This led to a protracted correspondence over technical and other details, the whole of which is quoted in his brother Modeste's exhaustive biography. It is an historic series of letters, and most of what we know of the composer's own opinions of his works, as well as on music in general, comes from them.

Whole Time to Composition

Later, Mme. von Meek engaged him at a regular salary of 6,000 roubles a year, ostensibly to make piano arrangements of his works for her, but *de facto* to render him independent of all further material worries, and free to devote the whole of his time to composition. One of the conditions, however, was that the two should never meet. This was faithfully kept, even to the extent of avoiding each other's recognition when they met at Tschaikowsky's concerts; she in the audience, and he on the platform.

This condition was chiefly insisted upon so that she could preserve intact the impressions of him which she derived from hearing his music. There is certainly nothing known about him that was likely to disagreeably dispel her illusion had she come into personal relationship with him. She was doubtless also solicitous of avoiding him any pain of feeling under personal obligation to her that a meeting might have engendered within him. Art has always had its wealthy patrons, but few more tasteful and delicate examples are to be found than the present instance.

The second event was his unfortunate marriage. Whilst engaged on the Fourth Symphony he began looking round for the subject of a new opera. A professor at the Conservatoire suggested Pushkin's "Eugene Onegin." On reading it he was completely fascinated. Without waiting for Shilowsky's libretto, he got to work on Tatiana's Letter scene, which exercised an immediate appeal to him. At the same time he received a long letter, containing a passionate declaration of love, from Mlle. Milyukow, who said that her love for him began when she was his pupil some years before at the Conservatoire. Being very busy, he put the matter out of his mind, but another letter arrived. He was wholly wrapped up in Tatiana whilst he considered Onegin one of the worst of scoundrels. Miss Milyukow pleaded eloquently and in the same terms as he, in his imagination, was addressing to Onegin. She threatened suicide if he did not reply. This similarity affected him so profoundly that he called upon her.

His Unhappy Marriage

With typical Russian fatalism, and still immersed in the hallucination that he and the lady were Onegin and Tatiana, he expressed his willingness to marry her, declaring, at the same time, that it would be a loveless union. He also painted his health and his poor prospects in the darkest colours.

It is not surprising that such a marriage turned out disastrously and late in the year he fled to St. Petersburg where, on arrival, he was prostrate for forty-eight hours. Followed a week of fever, and the doctors ordered him out of Russia for a complete rest. A separation was effected.

Nicholas Rubinstein died in 1881, and Tschaikowsky refused an offer of the succession. In Leipzig he met a remarkable number of musicians, the most famous of whom were Brahms, Grieg, Delius, Brodsky and the young Busoni.

Once free, he left Moscow much more frequently than hitherto, and rarely did a year pass by without his making a trip abroad. He found himself a suitable country house near Klin, and led the life which he preferred above all others, that of a hermit, only emerging from it for those triumphal tours which the spread of his fame rendered unavoidable and inescapable. He rose between seven and eight and had tea. He then read books of a philosophic character occasionally varied with the biography of one of the master musicians. During the last years of his life he took up the serious study of English, and it was at this time of the day that he devoted himself to it. Then he would go for a short walk, and it was curious how he would reveal his intentions for the day. If he breakfasted in silence and started out alone, it was practically certain he would commence work on his return. On the other hand, if he was jovial or shared his walk with a friend, it meant that little beyond some proof reading would be accomplished. His servant Sovranof, on whom he was solely dependent for every comfort, always acted on these indications. He dined at one and invariably went for another walk, returning at five for tea. He would then work again until about eight. We have noted how his nervous disability compelled relaxation after that hour.

European Tour

In 1887 he undertook an arduous three months' tour of Europe, partly because, most unexpectedly, he very successfully conducted one of his own operas and then a symphony concert. But a diary, quoted in Rosa Newmarch's biography, shows how little enjoyment he obtained from it. Although highly successful, the concerts he gave in London hardly foreshadowed the enormous popularity his work achieved here after his death. In 1892 he gave six concerts in America, and he could not cavil at the magnitude of his triumph there.

Towards the end of his life he was much distressed by the cooling off of Mme. von Meek's friendship. She was supposed to have suffered considerable financial losses through the extravagances of her son. Also her own health was rapidly declining, and was probably more to blame than her son's follies for the ceasing of the correspondence which had been carried on for fourteen years. Before this, however, Tschaikowsky had voluntarily cancelled the financial arrangements subsisting between them upon his hearing of her straitened circumstances. She died only two months after Tschaikowsky himself.

ON YOUR WAVELENGTH

By Thermion

A Bogy Laid

I WAS glancing through Number 83 of that interesting and well-produced house organ, *The Chloride Chronicle and Exide News.* In it I found a most interesting article by the Company's chief engineer, Mr. E. C. McKinnon, who has a friendly word in that article for PRACTICAL WIRELESS. He compliments us for the interesting practical hint which we published in our issue dated November 11th, 1939, relating to a charge indicator. He points out that this is a revival of the Hicks Patent Hydrometer which was in fairly common use 40 years ago. He thinks that our reader's idea would be less satisfactory than Hicks', owing to the slowness of diffusion, for there can be no assurance that the electrolyte inside the glass tube has the same specific gravity as that of the surrounding electrolyte. In the Hicks hydrometer, he tells us, attempts were made to overcome this objection by making a series of holes in the walls of the glass tube. He states that from experience this was not effective, and it was necessary before taking a reading to lift and lower the tube a few times in order to be assured of reasonable approximation to accuracy.

Which is, of course, all very pleasant and friendly. Having, however, gilded the pill, Mr. McKinnon proceeds to the pill itself. This is what he says: "A problem propounded to the readers of the same paper was one in which the owner of a battery set found that after some years satisfactory service, the quality was not so good and the accumulator did not last very long between charges. After re-charging the accumulator and making a few tests on the receiver, which failed to reveal any trouble, the accumulator was disconnected and its voltage measured with a good meter, giving a reading of 2 volts, which was assumed by the owner to indicate that it was in order.

"The correct answer to the problem, as given subsequently in the paper, was that the voltage should have been measured with the valves in circuit. The published answer amplified this by stating that as the accumulator had been in constant use for a considerable period, the acid was in need of replacement. This sweeping statement does not carry any endorsement in the battery-makers' instructions, unless the accumulator is contained in a celluloid box, in which case exchange of the acid would not be tied up with falling away in capacity.

"It would appear to be another indication of the widespread erroneous impression that sulphuric acid loses virtue when employed for any time as electrolyte in an accumulator." I fear that Mr. McKinnon in this case has jumped to the wrong conclusions. He has, in fact, created a bogy which does not exist, and then proceeds to slay it. The inference in the solution to our problem which he quotes was not that acid loses its effectiveness after use through any actual change in the acid due to the cell material, but that 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. I invite Mr. McKinnon to refute the accuracy of my comment.

Mr. McKinnon will observe my little pleasantry of adopting his formula, namely, first the gilding, then the pill!

The Radio Engineer's Pocket Book

THE very convenient series under the above heading, which has been running for several weeks now, has been much appreciated by readers. The information has been set in small pages so that readers can stick them into a small pocketbook. It has been suggested, however, that we should publish these sheets in book form. I have duly passed along the suggestion to the powers that be. In these days of paper shortage I should imagine that there would be a difficulty on that score.

H.P. Re-possession

A CASE of great interest to all those who purchase wireless sets on hire-purchase arrangements was recently tried at Norwich County Court. The facts briefly are: that a man who had paid £11 out of £31 due on the set fell into arrears. The suppliers removed the set from the man's home without his consent. A representative of the firm entered the home and, against the wishes of the wife, took the wireless set away. No notice had been given by the suppliers of intention to re-possess. The hire-purchaser went to see the manager of the depot and protested, but the manager stated that he had the right to take the set away. Thereupon, the manager was given a couple of hours to return the receiver, but this was not done. The judge stated that no action could lie against the defendants under the Hire Purchase Act, or the Courts Emergency Powers Act, but he considered an action did lie against them for trespass. He was not satisfied that the firm was acting as authorised agents for the real owners. He found for the plaintiff and awarded him £10 damages with costs.

Radio Service Engineering

THE National Association of Radio Retailers has been considering the problem which affects all radio dealers. The Army has called up a large number of them, and there is now a great shortage of service engineers. They are pressing for a modification in the reserved occupation age limit, and are also adopting schemes for the rapid training of service engineers. They have prepared a 20-lesson course, and those taking it will be sent one lesson at a time. Each course includes a number of questions which must be answered by the student and returned for correction and comment. My objection to this arrangement is that a dishonest person anxious to obtain a post as a radio service engineer, and not possessing any degree of conscientiousness which is vitally necessary for home study without a personal tutor, could easily get someone else to answer the questions, and thus without the slightest technical knowledge obtain a post. It is true that he might not hold the job long, but if he is engaged by a dealer who himself knows nothing of radio it might take a long time. The only satisfactory method in my opinion is to hold annual examinations so that those wishing to pass would all attend an examination, and be given a list of questions to answer both orally and in writing.

I see that it is suggested that the student should be able to complete one lesson in a week. At this rate the N.A.R.R. proposes to turn out a fully trained service engineer in twenty weeks. Impossible!

Those who wish to take the course can obtain further details from the N.A.R.R., Africa House, Kingsway, W.C.2.

An Anxious Moment

PROMPT action by an anti-aircraft gunner a few days ago probably saved the crew of an R.A.F. Blenheim from being killed or seriously injured. Flying at about 2,000 feet over an anti-aircraft gun site some miles from an R.A.F. station in the South of England, a gunner noticed that one of the Blenheim's wheels was hanging down.

He at once telephoned to the station, from where a wireless message was flashed to the Blenheim's pilot, a sergeant, warning him of his danger.

The station fire engine and an ambulance were rushed on to the landing ground in readiness for an accident. After a while the Blenheim appeared over the aerodrome. An officer on the ground gave instructions by wireless-telephone to the pilot. "Dive at high speed and pull out quickly," he advised the sergeant.

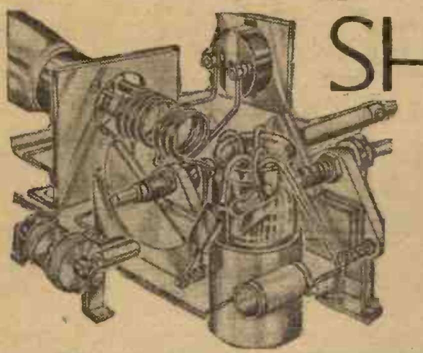
It was hoped that this manœuvre would release the whole under-carriage. Four or five times the Blenheim swooped over the station, and then the ground staff, with a sigh of relief, saw that the under-carriage had come down. A few minutes later the sergeant made a safe landing.

"GADGETS"

THERE'S always lots of gadgets
Which the sucker's asked to buy
By the boosting of their "Wonders"
Which are mainly "all my eye";
Relying on the well-known fact
That suckers have no sense,
And it's not too hard a matter
To annex their hard-earned pence.

So I offer words of caution,
Which is surely not a fault:
When you read these "gadget adverts"
Don't forget a pinch of salt.
And remember what the Yankee said,
That still to-day is true,
"There's a sucker born each minute,"
And look out it isn't you.

"TORCH."



SHORT-WAVE SECTION

Suggestions for U.S.W. Working

Hints for the Experimenter, and Details of a Simple Dipole Aerial

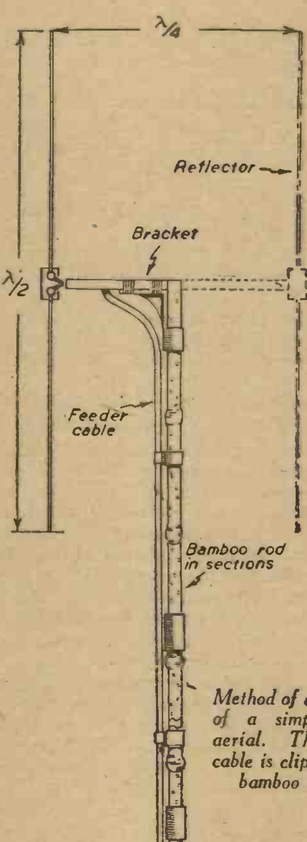
TO meet the special needs of the service and commercial interests as a result of war developments, it is a well-known fact that most of the available frequency spectrum has been sorted out. Wireless communication is vital, and the result of this is that no matter whether listening is undertaken on the long, medium, short, and ultra-short wavebands a veritable mixture of broadcasts will be heard. Coded messages, broadcast entertainment, high-speed communication, etc., all vie with one another in their adjacent channels and it says much for the efficiency and careful control of the radio transmitters themselves that intelligent results are obtained. There is no doubt that crystal control of the transmitters has had much to do with maintaining the different messages within the carrier band allotted, while in other uses the design of the master oscillator has been improved to such a degree that the quite usual tolerance of 0.1 per cent. has been improved upon very materially.

It is both interesting and instructive to carry out an ether search within the tuning range of the particular set which functions for home listening requirements, but the keen amateur is always anxious to go a stage farther, and so keep his operating and practical skill at their maximum efficiency. It is for this reason that so many have turned their attention to the ultra-short waves, and although spells of listening may prove a trifle tedious at times, if attempts at ambitious contacts outside what is regarded as the normal service range are made, this should only add zest to the work, and in no way discourage the amateur.

Adaptations

In many cases there is available a perfectly good television receiver which has had but little use lately, and there is no reason why some of the experimental work undertaken should not be with the sound chassis of this set. Insofar as the commercial models are concerned the circuit arrangements differ very materially but three basic designs are employed, namely superheterodyne, tuned radio frequency and super-regenerative. Nominally these sets are required to function on one ultra-short wavelength, namely 7.23 metres corresponding to the 41.5 megacycle carrier-wave which used to be radiated from the Alexandra Palace. An examination of the instruction booklet will often show whether the set is capable of being tuned over a certain band, or, alternatively, the local dealer can furnish the information by a reference to the service manual.

In the earlier days of the B.B.C. high-definition television service many sets were marketed with some form of tuning control over a known band, because at that time it was not known whether more than one television programme service would be provided, and, in consequence, the manufacturer deliberately incorporated sound tuning over a specific band. Indeed, in some sets, the instructions were to tune to the position for the best sound, and this would automatically provide the best picture.



Method of construction of a simple dipole aerial. The feeder cable is clipped to the bamboo support.

A Special Aerial

In any case it is possible to find out the operational possibilities of the sound chassis and make use of this in searching for transmissions. It is advisable to employ a separate and distinct aerial when engaged on this work, for it must be borne in mind that the response of a simple dipole aerial is dependent upon its orientation with respect to the plane of polarisation of the station's carrier-wave. For the television transmissions this was vertical, but there are other stations which resort to horizontal polarisation for their particular service.

With the usual form of efficient dipole construction it is found that it is possible to get about 12 megacycles off resonance and only have a 6 decibel drop in signal strength as compared with that secured at the frequency for which the length of the aerial is designed. That is to say, that if this drop in signal strength to about one half can be tolerated at each end of the band and assuming the aerial is designed originally for 45 megacycles (6.67 metres), then one aerial will be suitable for 33 to 57 megacycles (9 metres to 5.3 metres approximately).

Light Construction

For simple experimental work it is best to make up a light aerial which can be moved to convenient places and orientated as desired to suit the form of polarisation of the transmissions being tuned in. This can be done with the aid of light bamboo rods made with brass end bushes which fit snugly into one another. The number of rods used will depend upon the height at which it is proposed to locate the aerial for it must be remembered that the best results are achieved when the dipole aerial is mounted free from all obstruction because of the fairly limited service range of the broadcasts. At the summit of the top bamboo rod a small bracket should be attached so that the dipole is held away from the rod by a distance of at least 1ft. This will enable the feeder cable to be clipped in place along the rods and then make its connection at right angles to the centre of the dipole elements.

This is shown in the accompanying sketch. Good quality coaxial cable provides a convenient form of feeder, that known as AS42C having a characteristic impedance of the order of 70 to 80 ohms. This cable will normally be coiled up when not in use and then when the bamboo rods are joined together small clips can be made to hold it in position down the rods when positioning the aerial. The aerial itself can be made from any suitable metal up to about 0.1in. in diameter, and the separate sections of the dipole should be cut to the desired resonant length with a correction factor allowance. That is to say, if the dipole is to resonate at 7 metres the theoretical length for the whole dipole would be almost 11ft. 6in. This must be multiplied by a conversion factor 0.9 giving a length for each dipole element of 5ft. 2in. One or more dipoles of differing lengths can be made up as desired and these should be fixed to a cross bar attached to the arm as shown on the left.

Using a Reflector

The cross bar must be capable of turning through a right angle so that it can be set horizontally or vertically as required and the outer metal braiding, and inner core of the coaxial feeder cable, should be joined to the two ends of the dipole as shown. When made up in this way the light bamboo construction imparts to the aerial a high degree of portability, and allows it to be set up in position in convenient places. If increased gain in signal strength should be desired it is a relatively simple matter to extend the top bracket or cross bar in the opposite direction as shown dotted in the sketch, and mount a reflector one quarter of a wavelength away. This will increase the signal strength by about 5 decibels, and also improve the signal-to-noise ratio by destroying the omni-directional characteristics of the aerial by cutting down signal pick up from the rear of the combination. To discriminate correctly, and give full advantage to this form of construction the bamboo rod with aerial array should be turned until maximum signal strength is heard.

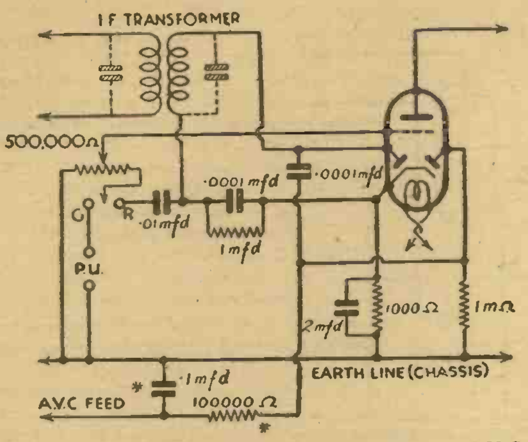


*Fig. 1.—The double-diode-triode, arranged for A.V.C. with delay, with provision for gramophone pick-up. The circuit shown is that usually used for this valve in a superhet. Components marked * are liable to considerable modifications.*

THE PICK-UP AND A.V.C.

How to Connect a Pick-up in Various Multi-electrode Valve Circuits

IT is quite a simple matter to connect a gramophone pick-up to an ordinary straight detector circuit, and even if it is an all-mains arrangement the provision of automatic grid bias presents little difficulty; many modern sets, however, use some form of automatic volume control, and when this takes the form of a special valve such as the double-diode-triode the addition of a gramophone pick-up becomes more difficult and the most experienced constructor may be excused if he finds himself hopelessly bewildered by the circuit tangle of a double-diode pentode.

All these special A.V.C. valves have one thing in common—they make use of a small diode for detection and reserve the main portion of the valve for low-frequency amplification. Quite obviously the diode cannot be fed by the pick-up as it is quite impossible to make this form of valve into an L.F. amplifier, so the gramophone connection must be made direct to the low-frequency portion of the A.V.C. valve. A moment's reflection will show that there is no alternative to this arrangement, as it would not be satisfactory to tap into the grid circuit of the output valve owing to the amplification of the single stage being insufficient to raise the relatively small output from the gramophone pick-up to volume sufficient to operate a loudspeaker.

The diagrams, Fig. 1 and Fig. 2, both show circuits for using the popular double-diode-triode, and each is complete with pick-up connection; it will be observed that in these illustrations a two-way switch is used to accomplish the change-over from gramophone to radio as this is preferable to incorporating a plug and jack.

A Simple Scheme

The circuits shown employ identical pick-up connections but differ slightly on the radio side. Both are arranged for delayed A.V.C., but the former is most suitable for use in a superheterodyne receiver, where the detector is not preceded by a tuned circuit.

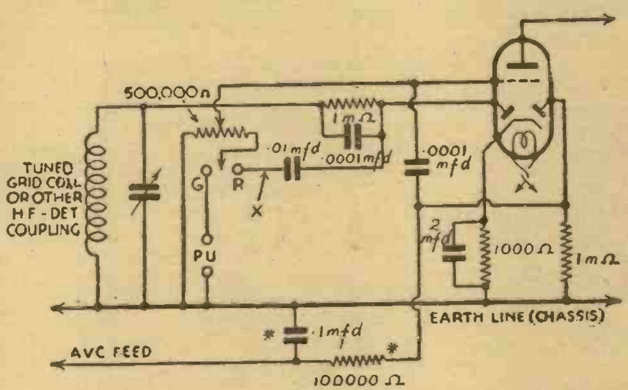


*Fig. 2.—The double-diode-triode, arranged for A.V.C. with delay in a "straight" receiver, and fitted for reproducing gramophone records. A filter may be required at "x" in sets inclined to instability. Components marked * are liable to modification.*

A glance at Fig. 1 will show that it would be most inconvenient for use in a straight set using the normal ganged condensers where the rotating plates are all in metallic connection with each other, as neither side of the condenser is connected to earth.

For straight sets the arrangement shown in Fig. 2 is suitable as the tuned circuit has been moved to bring one side of the tuning-condenser direct to earth; these two variations are explained in detail to prevent the possibility of confusion being introduced by the slight rearrangement necessary to include the pick-up, and will enable the reader to identify the circuit that should be chosen when introducing a pick-up to a set already using a double-diode-triode for automatic volume control.

In the circuits already described, and also in those dealt with below, the volume control is so arranged that it functions on both radio and gramophone, a combination that is valuable and seldom described, although its advantages are obvious.

The Double-diode-tetrode

The correct way of introducing a pick-up into a diode-tetrode circuit is shown at Fig. 3. As in the other circuits, the change-over is accomplished by a simple single-pole double-throw switch. The diagram is complete and, therefore, no further comments are necessary except to draw attention to the ease with which the low-frequency portion of a diode-tetrode is overloaded. Consequently, care should be taken to select a volume control with really satisfactory grading.

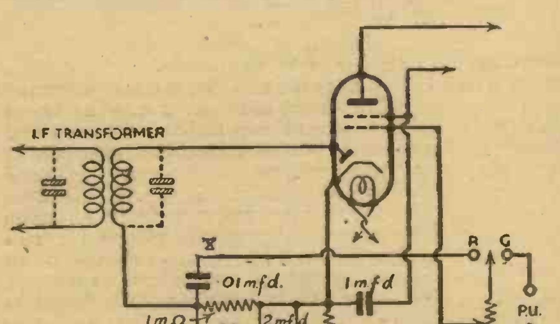


*Fig. 3.—The single-diode-tetrode for A.V.C. and gramophone reproduction. The arrangement shown is suitable for use in a superhet. Connections to anode and screen are normal. An H.F. filter may be necessary at "x" in certain circuits. Components marked * are liable to modification. Value of bias resistor varies widely with different makes of valve. That recommended by valve maker should be used.*

The Pentode

Fig. 4 shows the double-diode-pentode

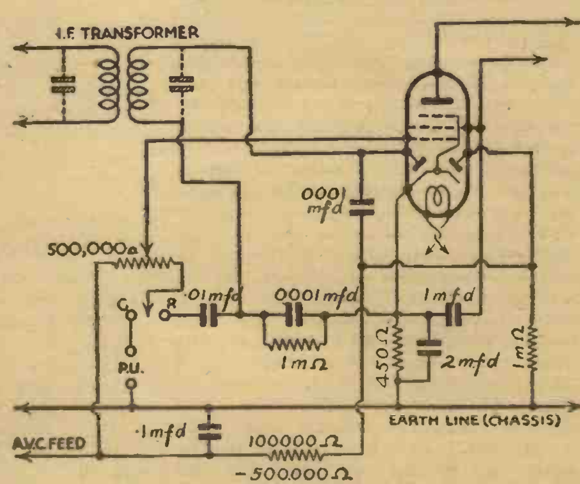


Fig. 4.—A pick-up added to the double-diode-pentode, arranged for delayed and corrected A.V.C. in a superhet. Connections to anode and extra grid are normal and not changed by the addition of the pick-up.

THE PICK-UP AND A.V.C.

(Continued from previous page).

arranged for use in a superheterodyne to give delayed and corrected A.V.C. or reproduction of gramophone records. The circuit is, necessarily, complicated but the actual addition of the pick-up section is very simple.

Fig. 5 also shows the addition of a pick-up to a double-diode-pentode circuit which is arranged for use in a straight receiver. When using a pick-up with this type of valve it is often necessary to shield the leads as they are apt to cause mains hum in the speaker unless they are kept very short. This is due to the relatively high sensitivity of the pentode portion.

In all these circuits care has been taken to so arrange them that they are entirely free from the radio section and to ensure that one side is, in each case, sensibly at earth potential. Consequently, it is often unnecessary to shield the leads to secure stability.

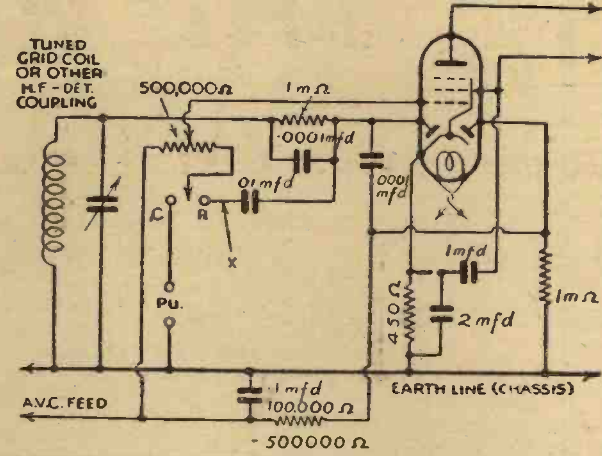


Fig. 5.—The double-diode-pentode for corrected and delayed A.V.C. with the addition of gramophone switch and terminals. Connections to anode and extra grid are normal. An H.F. filter may be desirable at "x" in some cases.

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

Station Efficiency

CONSIDERABLE controversy appears to be raging round the exact definition of efficiency, or the operating of a receiving station, and judging by the correspondence already received there are apparently two very distinct schools of thought, namely, those who maintain that the very spirit of amateur radio demands that home constructed equipment should be used, and those who put forward the view that it is quite immaterial whether, say, the receiver is home constructed or a multi-valve commercial model of the communications type.

If careful consideration is given to the matter, it would seem that the participants in the discussion are really losing sight of the main object of amateur radio, that is, improving their own knowledge of the subject and making what contributions they can to its general progress. While it cannot be denied that the enthusiast who is out to take the hobby in a serious vein would, undoubtedly, acquire a far greater and sounder knowledge of radio by undertaking the constructional work of as much of his apparatus as that which comes within the scope of the average amateur's ability, it must also be realised that time plays a very important part in some amateurs' activities, and in many cases, it is this factor alone which prevents the construction of a large or elaborate receiver and eventually necessitates the purchase of a commercial product.

Another point is that the amateur who constructs his own equipment obtains far greater interest and thrill out of the results obtained, but against this must be placed the efficiency of home-constructed receivers compared with some of the commercial models. The experimenter of many years standing can, no doubt, design and assemble a receiver which will satisfy all his requirements, but these 100 per cent. men are naturally in the minority, so one has to consider the vast numbers of enthusiasts who, while very keen on their hobby, have not yet had the opportunity of acquiring the experience and skill of the older members.

From the details available, we are inclined to imagine that the whole controversy has been started by log reports which have been compiled by stations who operate multi-valve commercial receivers, and knowing the high efficiency usually obtained with such designs, many members have quite naturally raised the question as to whether the logging of stations with such apparatus demands any great experience or skill and, in fact, whether such logs can be taken as a true indication of the amateur's enthusiasm and capabilities.

The smaller the receiver the higher has to be the efficiency of both operator and aerial installation and, to carry this line of argument just a stage further, it cannot be denied that far greater interest and instructional experimental work can be obtained by seeing what results can be secured with a small receiver therefore, it would seem that this in itself opens up a very wide range of activity, especially for newcomers to the game.

As usual we would like to hear other members' views, but please make them as concise and interesting as possible.

Foreign Broadcasts

ONE of our members, No. 6180 of Ramsgate, has been kind enough to send us a copy of a very interesting programme sheet from the Broadcasting Corporation of Japan, and he informs us that copies can be obtained from the Foreign Department, The Broadcasting Corporation of Japan, Tokyo. The stations concerned are JVW, operating on 41.34 metres, and JZJ on 25.42 metres.

Belgrade

THIS short-wave transmitter in Yugoslavia commenced a series of transmissions on April 1st on a wavelength of 49.18 metres, and general news items, lectures, and comments in English are radiated daily at 10.25 p.m.

News from S. Africa

MEMBER No. 6520 states in a letter we have just received: "Thanks for my certificate of membership received on Saturday, March 23rd. It is really something worth possessing, and I am going to have it framed.

"Regarding DX, I find that now winter is setting in here in South Africa conditions become remarkably poor on the short-wave bands. It is, however, strange that reception on 49 metres is becoming better. Further, I also noticed that Radio Saigon and Radio Filipino, as well as two Chinese stations on 25 metres, are coming in better now than during the summer months.

"In the early mornings the American short-wave stations are coming in quite good, but they too are now getting weaker."

A Member's Thanks

THE following letter from member 6487, of Tottenham, speaks for itself:

"I should like, through the medium of PRACTICAL WIRELESS, to sincerely thank the anonymous person who delivered a box of radio gear at my house while I was laid up with German measles, and refused his name to my mother. If you are reading this letter, A. J., I should like you to drop me a line as I'd like to write and thank you personally. Wishing the last of the radio weeklies every success in the future."

DX Contest

MEMBER No. 6436 writes as follows: "With regard to the DX Contest, by all means let us have one. The harder it is, the more interesting it becomes, as well as taking your mind off the present international situation. I own a small RX; it is a home-made 0-v-2 using pentode output. I make all my own gear and the aerial is an inverted L, running North—East. I am trying hard to get an A.C.R., but I am not getting enough time to listen owing to work, but some day I hope to send you the necessary veri's."

AIMS OF THE B.L.D.L.C.

THE purpose of the club is solely to bring together all those listeners who specialise in the reception of stations situated in distant parts of the world. It is intended to form a community of kindred minds, and its aims are encouragement of DX reception, mutual help and comradeship.

The B.L.D.L.C. has no commercial aims. Membership is free. Members can, therefore, still belong to all other similar clubs with similar aims without further incurring any additional financial responsibility through their membership of the B.L.D.L.C.

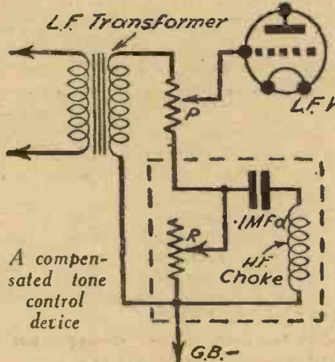
In order to give members the opportunity of exchanging ideas, the services of the entire technical staff of PRACTICAL WIRELESS are placed at the disposal of every member.

PRACTICAL WIRELESS, furthermore, will set aside a special section in which reports of reception, constructive articles, information, etc., and the internal affairs of the club will be discussed.

Practical Hints

Compensated Volume Control

ONE effect of reducing the loudspeaker volume below certain limits is that the "quality" becomes worse. The reason is that the ear is less responsive to both high and low notes, especially at low sound levels; as a result the "middle frequencies" are heard quite well, but the high and low ones can scarcely be detected. Under such conditions music seems to lack all "punch" and "vigour" so that most of the enjoyment in listening is lost. To remedy this



A compensated tone control device

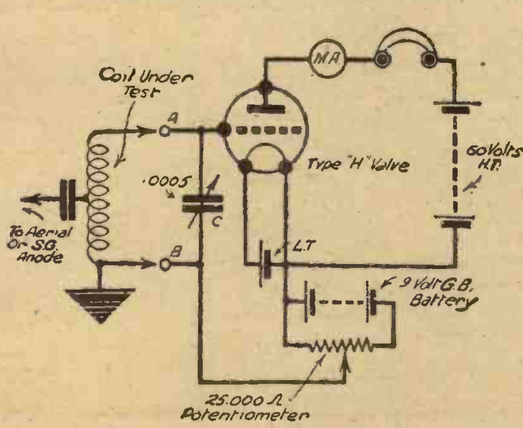
defect, I have successfully tried the simple system illustrated in the accompanying diagram.

The extra components required are enclosed by a broken line. P is the usual potentiometer volume control and R is an additional variable resistance. When the potentiometer is set to "full volume" the tone compensating circuit has no appreciable effect, but it comes into play as volume is reduced. Since the choke and condenser "tune" to the middle frequencies they allow these to "leak away" to a certain extent and emphasis is thus given to the higher and lower notes. By experimenting with the setting of resistance R a position can be found with which the tone is automatically balanced for any setting of the potentiometer.—J. DAVEY (Harrow).

Comparing Coil Efficiencies

READERS making their own tuning coils will find the following dodge useful for accurately comparing the efficiencies of two or three different types. Of course, the coils could be tried in a set, but that method is very slipshod and does not furnish any reliable data. A much better system is represented by the circuit diagram where the coils under test are connected in the grid circuit of an anode bend rectifier, in whose anode lead is included a milliammeter reading up to 2 mA, and a pair of 'phones.

First of all, points A and B are short-circuited and the 25,000 ohm G.B. potentiometer is adjusted until a reading of exactly zero is shown on the milliammeter. Next a coil is connected to A and B and also to the aerial, or anode of an S.G. valve. The local station is then tuned in on condenser C and the milliammeter reading carefully watched. It will be noticed that the current increases as the tuning circuit is brought to resonance with the transmission, and it is the maximum deflection of the milliammeter needle which must be observed. Other coils can then be substituted for that already tested. Each must carefully be tuned to the same transmission, and it is the maximum deflection noted in each case. The coil which produces the greatest increase in anode current is the most efficient at the wavelength of the particular transmission tuned in. Of course, tests must be made always with the same valve in circuit, in order to make accurate comparisons.—C. WITHALL (Pinner).



A simple method of comparing the efficiency of coils.

THAT DODGE OF YOURS!

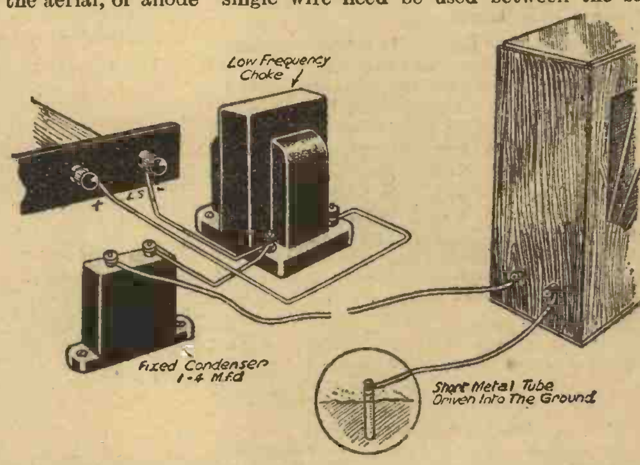
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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 168.

Extending the Speaker Leads

DURING the summer months many listeners are desirous of taking the loudspeaker into the garden. On the face of things all that is required to do this is a long piece of twin flex that can be attached to the set at one end and to the speaker at the other. But many readers who have tried that method will have been disappointed by the much poorer reproduction obtained. It is obvious that the flex introduces a fairly appreciable capacity which produces a decided loss of high-note reproduction. In addition to this the flex may carry the anode current of the output valve, so that if H.T. is derived from the mains there is always a possibility of a shock being felt on handling the wires, and a definite danger of causing a short-circuit especially when the mains are D.C. It is better in every way to fit a choke-capacity output arrangement, so that only a single wire need be used between the set and speaker. The "earth return" can be made at the speaker "end" by means of a short metal rod pushed into the ground.



Method of connecting a loudspeaker when it is to be used at a distance from the set.

The arrangement is clearly shown in the sketch. A low-frequency choke is connected directly across the loudspeaker terminals, and this carries the anode current to the last valve. A large fixed condenser (anything from 1 to 4 mfd. will do) is joined between that L.S. terminal which is connected to the plate of the output valve, and the loudspeaker. The second speaker terminal is joined to an odd length of metal tube, which can be pushed into the soil in the corner of a flower bed. This applies equally well whether the speaker is a moving-coil, balanced armature, or any other type.—J. WATERS (Clapham).

Multiple Speaker Matching

In This Article a Common Problem in P.A. Work is Discussed

As mentioned elsewhere in this issue one of the most important points in the output stage is the load provided for the valve. With a single speaker this is not a difficult proposition, but when two or more speakers are to be used certain difficulties may arise. As mentioned, the formula for matching the speaker is $N=\sqrt{\frac{R}{Z}}$ where N is the turns ratio of the output transformer, R the optimum load of the output stage and Z the impedance of the speaker. This method may be extended with a little help from Ohm's Law to problems of matching involving any number of speakers of different impedances taking different amounts of the output power.

This type of problem is common in systems of large power output. In the cinema the main speakers behind the screen must be given most of the power output from the amplifier, and only a little is fed to the monitoring speaker in the projection room. In recording work the cutting head is provided with a major portion of the available power, and the monitor takes just sufficient to provide a comfortable level for listening.

In P.A. work any demand may be made, and it is very common for an amplifier to feed power to several outgoing lines of different impedances requiring different amounts of the power output.

Let us consider the methods available for splitting the AF power developed in the anode load of the output valve in any desired proportion.

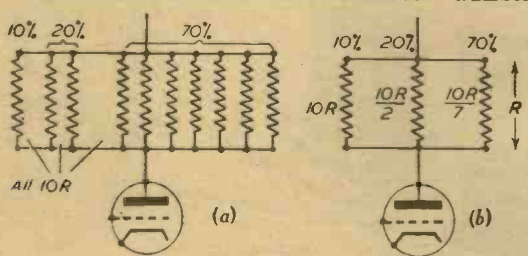


Fig. 2. — Unequal distribution of power obtained by grouping load resistances.

Optimum Load

Suppose the valve represented in Fig. 1 has an optimum load of R ohms. If the single load of R ohms in Fig. 1 (*a*) is replaced by two loads in parallel each of 2R ohms as shown in Fig. 1 (*b*) it is evident that the effective resistance of the combined loads will remain R ohms, and in addition that in each of the two loads in parallel one-half of the output power will be available.

Equally well, if the single load were replaced by three loads in parallel of 3R ohms each, one-third of the power output would be dissipated in each of the three loads.

This idea may be extended further so that we may make up the load by 10 resistances in parallel each of 10R ohms. The output power is divided into ten equal parts, the total load remaining R ohms as before. These resistances may now be grouped together as shown in Fig. 2 (*a*), each group of resistances dissipating a different amount of power, and these groupings may then be replaced by single resistances of equivalent value. In Fig. 2 (*b*) the output has been resolved into three portions of 10, 20 and 70 per cent. of the total power output, respectively, by the substitution of three resistances in parallel of 10R, $\frac{10R}{2}$ and $\frac{10R}{7}$, respectively in place of the single load resistance R.

The load may be imagined as split into one hundred equal parts which may be grouped together in any way desired to give different percentages of the total power output.

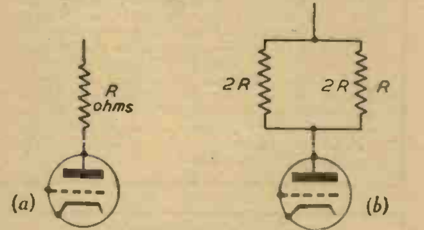


Fig. 1.—Showing the division of power in the anode circuit by two loads in parallel.

Distributing the Power

If we desire to distribute the power into a number of parts of a%, b%, c%, . . . n% of the total output, the anode load R may be replaced by loads in parallel of resistance $R_a=\frac{100R}{a}$; $R_b=\frac{100R}{b}$; $R_c=\frac{100R}{c}$; $R_n=\frac{100R}{n}$.

This only holds as long as a+b+c+ . . . n=100 as the output power cannot be split up into only 30 and 50 per cent. of the total, leaving 20 per cent. undisposed of. This would mean that the total effective load would not be R ohms and the entire argument would then fall.

Now that the output power may be distributed as desired, the next step is to match the speakers required to the output stage by replacing the loads R_a, R_b, R_c, etc., by output transformers of the correct ratios to match the impedances involved. Assuming that the loads are as above, the primary impedances of the output transformers are respectively 10R, $\frac{10R}{2}$ and $\frac{10R}{7}$. If the speaker impedances are in order, Z_a, Z_b, and Z_c, the transformer ratios will be respectively

$$\sqrt{\frac{10R}{Z_a}};\quad \sqrt{\frac{10R}{2Z_b}}\quad \text{and}\quad \sqrt{\frac{10R}{7Z_c}}$$

These ratios are calculated by the customary matching formula mentioned in the first place.

Matching Transformers

In practice it is unnecessary as well as uneconomical to have several matching transformers. A single transformer with a primary impedance of R ohms and with secondaries of ratios as calculated above may be used with as good effect.

In general, to feed power to a number of speakers or lines from an output stage requiring an anode load of R ohms, the primary of the output transformer should be designed for an impedance of R ohms, and the secondary ratio for any given load dissipating a percentage n% of the total available power is $\sqrt{\frac{100R}{nZ}}$, where Z is the impedance of that particular speaker or line.

Perhaps it would be as well to consider a practical case to illustrate the method of attacking the problem.

Practical Problem

It is required to feed power to four separate loads simultaneously from an output stage of optimum load 4,000 ohms, the conditions required being:

Load 1—5-ohm speaker taking 10 per cent of total power; Load 2—15-ohm speaker taking 20 per cent. of total power; Load 3—30-ohm speaker taking 20 per cent. of total power; Load 4—600-ohm line taking 50 per cent. of total power.

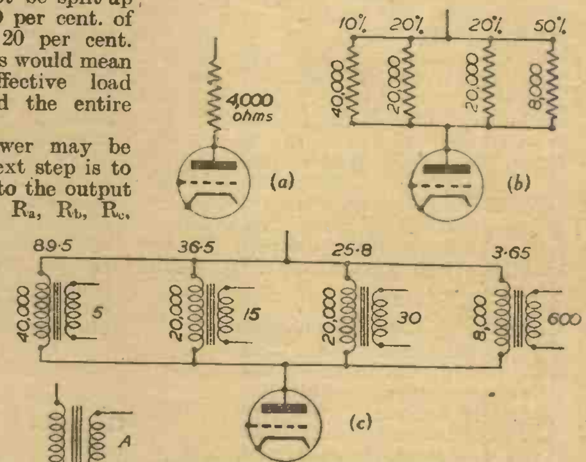
The first step is to split the anode load in such a way as to divide the output power in the proportions required, namely, 10%, 20%, 20%, and 50%.

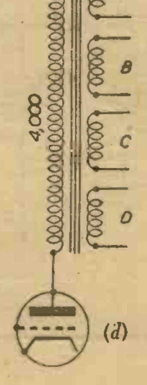
The 4,000-ohm load may be replaced by four separate loads in parallel:

Load 1 $\frac{100 \times 4{,}000}{10} = 40{,}000$ ohms.

Loads 2 & 3 $\frac{100 \times 4{,}000}{20} = 20{,}000$ ohms.

Load 4 $\frac{100 \times 4{,}000}{50} = 8{,}000$ ohms.





	Impedance	%	Ratio
A	5 ohms	10	89.5
B	15	20	36.5
C	30	20	25.8
D	600	50	3.65

Fig. 3.—Successive steps in working out the problem.

These four loads are now replaced by four output transformers to match these loads and the four impedances involved.

The four transformers are as follows:

Load 1. Primary 40,000 ohms. Secondary 5 ohms.

(*Continued on page 166*)

The Short-wave Four

(Concluded from page 139, April 27th issue)

IT should have been mentioned, when stating the total consumption, that the bias for the output pentode is fixed at 4.5 volts.

Dealing now with the construction and assembly of the chassis, it will be seen that essential measurements are included in the wiring diagrams on page 139. These measurements, when read in conjunction with the front panel details given in Fig. 3, will provide the centres for the principal components, the lengths of the extension controls completing this requirement.

Fig. 3 depicts the front view of the 'phone panel, and the loudspeaker control panel is similarly fitted, but to a separate angle-piece of aluminium.

A pair of sharp dividers, or other suitable instrument, should be used to mark off the centres for the sockets, the elongated sockets being fashioned by filing after drilling two ⅛in. holes sufficiently close together to conform with the panel slot, the actual positions for drilling being scribed on the ¾in. arc (radius) indicated in Fig. 3.

Having also drilled a ⅛in. hole for the pivot socket of the panel, it will then be a simple matter to mark off the fixing hole centres.

When finally fitted, the pins of the plug in each case should not foul with the periphery of the slot or top pin socket.

The loudspeaker panel, after being mounted on an aluminium angle-piece—which should be cut and filed to the same width and length of the actual panel when fitted—is then screwed to the underside of the chassis in the position indicated in Fig. 2.

The on-off switch in this particular model is of the key pattern, this having been handy at the time of construction.

The top-cap connector for the detector valve V2, is supported by a short length of copper strip, this strip serving to keep the choke and resistance away from the envelope of the valve which, of course, is metallised.

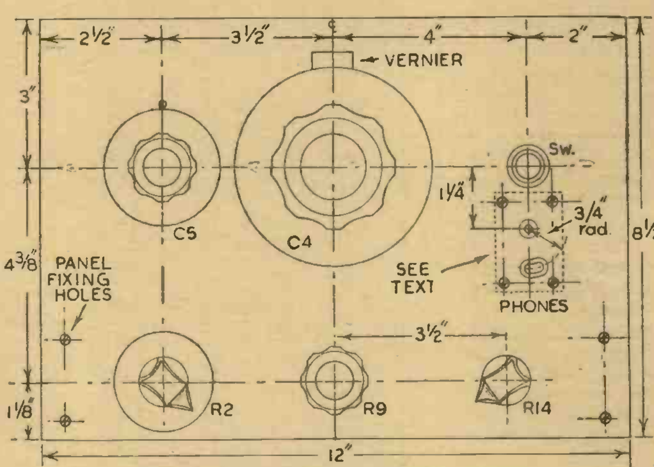


Fig. 3.—Panel layout and drilling diagram.

Wiring

The grid connection for the screen-grid valve V1 is the top cap, this valve being of the short-wave type, and the lead, which passes through the chassis (see Fig. 2) by the hole "X," connects with the aerial insulating pillar "A" by passing through the centre and finally soldering to the head of the pillar terminal screw. There are no connections to the pillars A1 and E other than those shown externally in the diagram.

All wiring should be carried out with good quality push-back wire or 18 S.W.G. tinned copper wire and sleeving, but whatever method is adopted, the connections to the reaction potentiometer should be of 18 or even 16 gauge tinned copper wire suitably insulated.

The connections to the T.C. of V1, the on-off switch, and the control panels for phones and loudspeaker are as follows:

Letter reference is employed for following the through chassis connections for holes 8, 9 and 10. In the case of No. 8 hole, the leads "I" and "h" are respectively the series connection between the load and decoupling resistors R7 and R8, and the connection between the H.T. end of the H.F. choke and the coupling condenser to V3-C9.

Three leads pass through hole No. 9 (a, b, c), these being the H.T. and L.T. negative battery leads and the G.B. positive lead, all being connected to one side of the key switch.

At hole 10 there are three connections (d, e, f), the lead "d" connecting R13 to the pivot socket of the phone panel, to this socket also being connected one side of the condenser C11, as depicted by "k."

R12 connects through "e" with the contact member of the 'phone panel, as will be seen on studying the circuit diagram Fig. 1. The lead "f" is the negative or earth lead from the negative filament socket of the valve-holder V3 to the other side of the on-off switch.

The connections to the loudspeaker panel will be better understood if comparative reference is made with the circuit diagram.

Operation

The receiver should be roughly adjusted first of all by setting the potentiometer R6 to approximately midscale, the H.F. gain control R2 being then set to about 75 degrees.

The reaction should now be increased just sufficiently to establish the signal, so that the potentiometers R4 and R5 may be adjusted without the receiver going into oscillation when the maximum amplitude is obtained.

The adjustment of R4 and R5 remains fixed for all wavelengths above and including the 12- to 26-metre band, but for operation on the 9- to 14-metre band, it will be found necessary to make a marginal re-adjustment to R5. W.R.H.

LIST OF COMPONENTS

Resistors
One 4,000 ohms ½ watt (Bulgin).
One 5,000 ohms ½ watt (Bulgin).
One 10,000 ohms ½ watt (Bulgin).
One 25,000 ohms ½ watt (Bulgin).
One 30,000 ohms ½ watt (Bulgin).
One 50,000 ohms ½ watt (Bulgin).
One 100,000 ohms ½ watt (Bulgin).
One 1 megohm ½ watt (Bulgin).
One 4 megohm ½ watt (Bulgin).

Potentiometers
One 50,000 ohm (without switch) type "M" (Erie).
One 100,000 ohm (without switch) type "M" (Erie).
One .25 megohm (without switch) type "M" (Erie).
One .5 megohm (without switch) type "M" (Erie).
One 400 ohm (without switch) type "M" (Erie).

Condensers (Fixed)
One 100 mmfd. (cup type) (T.C.C.).
One .002 mfd. (Tubular) (N.S.F.).
Two .01 mfd. type (PC 101) (Bulgin).
Four .1 mfd. type (PC P1) (Bulgin).
One .5 mfd. type (PC P5) (Bulgin).
Two 2 mfd. type (EC15) (Bulgin).

Condensers (Pre-set)
One 70/100 mmfd., type SW126 (Bulgin).

L.S. Control Panels
Two L.S. Control Panels (B.M.P. (Clix)).

Choke H.F.
One type 1010 (OFRA) (Stratton and Co.).

Choke L.F.
One type LF16 (Bulgin).

Condensers (Variable)
One 18 mmfd. type 1094 (POWRX) (Stratton and Co.).
One 160 mmfd. type 1131 (PRINK) (Stratton and Co.).

Valve and Coil Holders
One 4-pin type 949 (Stratton and Co.).
One 6-pin type 969 (Stratton and Co.).
One 7-pin type X147 (B.M.P. (Clix)).
One 4-pin type X116 (lemon) (B.M.P. (Clix)).
One 5-pin type X116 (lemon) (B.M.P. (Clix)).

Switch (see text)
One type S124 key switch (Bulgin).

Brackets (Insulated)
Two type 1007 (Stratton and Co.).

Extension Control Outputs
Four type 1008 (Stratton and Co.).

Dials, Knobs and Drives
One type 1085 (DUNTE) (Stratton and Co.).
One type 1099 (DIFMR) (Stratton and Co.).
One type IP8 dial (Stratton and Co.).
Two type K92 small instrument knob (Bulgin).
One type 1086/9 (KNOJM) (Stratton and Co.).

Valves
The following HIVAC and TUNGSRAM valves were used, but any suitable equivalents will do.
V1, SG220S, V2, HP215, V3, L210; V4, PP2.

Coils, 6-pin
One type 6BB, 9-14 m. (Stratton and Co.).
One type 6LB, 12-26 m. (Stratton and Co.).
One type 6Y, 22-47 m. (Stratton and Co.).
One type 6R, 41-94 m. (Stratton and Co.).
One type 6W, 76-170 m. (Stratton and Co.).

Insulating Pillars
Three type SS (1in.) (Radiomart).

Flexible Coupler
One type F.C. (Radiomart).

Brackets for R2, R9, R14
Three type E.H.9 (cut down) (Bulgin).

Plugs, Spades
Four type MP12 plugs engraved H.T.—, H.T. +, G.B.—, G.B. + (B.M.P. (Clix)).
Two type R415 spade terminals (red, black) (B.M.P. (Clix)).

Chassis
See text (Peto-Scott).

Batteries
H.T. 120v type (Exide).
L.T. 2v type (Exide).
G.B. 9v type (Exide).

Miscellaneous
Wood screws.
Wire (Bulgin).
Sleeving (Bulgin).
Flex (Bulgin).
Screened Flex (Bulgin).

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

(See also page ii of cover)

No. 77

FLUXES FOR SOLDERING

Metals.	*Fluxes.*	*Fluxes generally used.*
Iron	Chloride of zinc	Chloride of zinc (killed spirit)
Steel	Sal-ammoniac	
Copper	Chloride of zinc	
Brass	{ Resin { Sal-ammoniac	Resin
Zinc (new) } Zinc (old) }	Chloride of zinc	
Lead (with fine solder)	Hydrochloric acid	
Lead (with coarse solder)	Tallow and resin	
Tin	Tallow	
Pewter	Resin and sweet oil	

COMPOSITION OF SOFT SOLDERS

Solder.	*Composition.*	*Melting-point*
Fine	1½ parts tin, 1 part lead	334°F.
Tinman's	1 part tin, 1 part lead	370°F.
Plumber's	1 part tin, 2 parts lead	440°F.
Pewterer's	1 part tin, 1 part lead and 2 parts bismuth	203°F.
Wood's Metal	1 part tin, 2 parts lead, 4 parts bismuth, 1 part cadmium	165°F.

A mixture of 1½ parts tin and 1 part lead fuses at a lower temperature than any other mixed proportion of these metals.

COMPOSITION OF HARD SOLDERS

Solder.	*Composition.*
Hard brazing	3 parts copper, 1 part zinc
Hard brazing	1 part copper, 1 part zinc
Softer brazing	4 parts copper, 3 parts zinc, and 1 part tin

No. 78

SPECIFIC RESISTANCE OF VARIOUS MATERIALS.

SUBSTANCE	SPECIFIC RESISTANCE	SUBSTANCE	SPECIFIC RESISTANCE
Advance	19.2×10^{-6}	Krupp Metal	33.4×10^{-6}
Argentan	11.2×10^{-6}	Lead	7.8×10^{-6}
Calido	39.3×10^{-5}	Manganin	16.5×10^{-6}
Climax	34.7×10^{-6}	Monel Metal	16.1×10^{-6}
Constantan	19.3×10^{-6}	Nichrome I	38.8×10^{-6}
Copper	0.63×10^{-6}	Nichrome II	42.6×10^{-6}
Eureka	18.5×10^{-6}	Nickel	3.9×10^{-6}
Excello	36.0×10^{-6}	Platinoid	18.4×10^{-6}
Ferro-Nickel	11.1×10^{-5}	Resista	29.9×10^{-6}
German Silver	13.0×10^{-6}	Rheostan	17.5×10^{-6}
Ideal	19.3×10^{-6}	Rheostine	29.9×10^{-6}
Pure Iron	3.48×10^{-6}	Rose's Metal	25.4×10^{-6}
Soft Steel	4.6×10^{-6}	Superior	34.3×10^{-6}
Hard Steel	17.9×10^{-6}	Therlo	18.4×10^{-6}
Soft Cast Iron	29.3×10^{-6}	Wood's Metal	22.2×10^{-6}
Hard Cast Iron	38.9×10^{-6}	Zinc	2.1×10^{-6}

No. 79

WEIGHT OF SHEET EBONITE.

Thickness (inch)	*Weight of 1 sq. ft. (oz.)*	*Area (sq. in.) of 1 lb.*	*Area (sq. in.) of 1 oz.*
⅛	13	176	11
3/16	20	117½	7½
¼	26	88	5½
⅜	39	56	3⅔
½	52	44	2¾

APPROXIMATE WEIGHT OF 1 CUBIC INCH OF METALS

	Lb.		*Lb.*
Platinum	0.78	Nickel	0.31
Gold	0.69	Wrought Iron	0.28
Mercury	0.49	Steel	0.28
Lead	0.41	Cast Iron	0.26
Silver	0.36	Tin	0.26
Bismuth	0.35	Zinc	0.26
Copper	0.32	Antimony	0.24
Brass	0.31	Aluminium	0.097
Magnesium	0.063	Duralumin	0.101

No. 80

TABLE OF SLIDE RULE GAUGE POINTS

Known value on Slide	Required value on Rule	Set to On Slide	Set to On Rule
Pounds per square inch	Atmospheres	485	33
Pounds per square inch	Water, head, feet	13	30
Pounds per square inch	Water, head, metres	33	25
Pounds per square inch	Inches, mercury gauge	25	51
Inches, water gauge	Pounds per square inch	360	13
Inches, water gauge	Inches, mercury gauge	14	1
Inches, mercury gauge	Atmospheres	30	1
Atmospheres	Kilos per square centimetre	89	92
Pounds per square foot	Kilos per square metre	87	425
Pounds per lineal foot	Kilos per lineal metre	41	61
Pounds per lineal mile	Kilos per kilometre	71	20
Pounds per cubic foot	Kilos per cubic metre	39	625
Cubic feet of water	Weight in pounds	17	1060
Cubic feet of water	Gallons (imperial)	17	106
Gallons of water	Weight, kilos	103	490
Pounds of water (fresh)	Pounds of water (sea)	38	39
British thermal unit	Calories	250	63
British thermal unit per pound	Calories per kilogramme	9	5
Foot pounds	Kilogrammetres	340	47
Horse-power	Force de cheval	72	73

No. 81

TABLE OF SLIDE RULE GAUGE POINTS—(*continued*)

Known value on Slide	Required value on Rule	Set to On Slide	Set to On Rule
Pounds per H.P.	Kilos per cheval	300	134
Horse-power per hour	Kilowatts (B.T.U.)	134	100
Watts	Horse-power	5	.0067
Circle, diameter	Circle, circumference	226	710
Circle, diameter	Circle, side of inscribed square	99	70
Circle, diameter	Circle, side of equal square	79	70
Circle, diameter	Circle, side of equal equilateral triangle	72	97
Circle, circumference	Circle, side of inscribed square	40	9
Circle, circumference	Circle, side of equal square	39	11
Circle, area	Inscribed square area	300	191
Square, side	Square, diagonal	70	99
Inches	Centimetres	50	127
Inches, eighths	Millimetres	40	127
Feet	Metres	292	89
Yards	Metres	35	32
Miles	Kilometres	87	140
Square inches	Square centimetres	31	200
Square feet	Square metres	140	13
Square yards	Square metres	161	51

No. 82

TABLE OF SLIDE RULE GAUGE POINTS—(*continued*)

Known value on Slide	Required value on Rule	Set to On Slide	Set to On Rule
Square miles	Square kilometres	112	290
Acres	Hectares	42	17
Cubic inches	Cubic centimetres	36	590
Cubic feet	Cubic metres	106	3
Cubic feet	Litres	3	85
Cubic yards	Cubic metres	51	39
Gallons	U.S. Gallons	5	6
Bushels	Cubic metres	110	4
Ounces (Avoirdupois)	Grammes	67	1900
Ounces (Avoirdupois)	Kilogrammes	670	19
Pounds (Avoirdupois)	Kilogrammes	280	127
Hundredweights	Kilogrammes	5	254
Tons	Tonnes	62	63
Feet per second	Metres per minute	7	128
Feet per second	Miles per hour	22	15
Feet per minute	Miles per hour	264	3
Yards per minute	Miles per hour	88	3
Miles per hour	Metres per minute	12	322
Knots (nauts) per hour	Metres per hour	33	38
Pounds per square inch	Kilogrammes per square centimetre	128	9

A Novel Bending Tool

Constructional Details of a Simple Press for Bending Sheet Copper and Aluminium

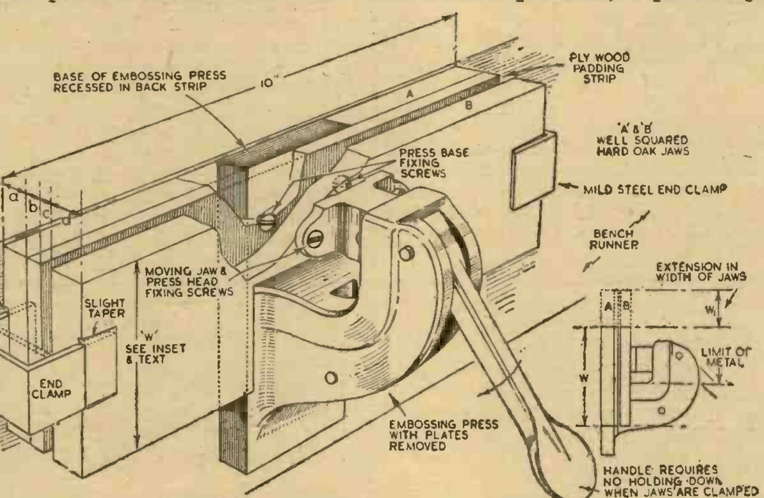
A VERY necessary tool for the home constructor is a bending vice that will provide clean flexures for the more pliable metals—copper, aluminium, brass and certain soft steel of reasonably light gauge. The simple bending vice, shown in the accompanying illustration, will be found particularly useful for the purpose, especially where an ordinary wood-worker's vice is not available.

When deciding upon a suitable method of construction, it was found that an old embossing press provided the desired pressure. When obtaining one of these embossers from a second-hand dealer's, and after a preliminary examination, it was found that the removal of the name plate fixing screws was all that was required in the way of alteration.

With both plates removed it was then

The jaw B is fitted after the assembly just described, as the holes in the press head, through which the fixing screws pass, are in direct line, and can be conveniently used—at least in this particular case—for inserting a screwdriver to fix the padding strip and base screws; this will be clear on referring to the illustration.

The inset diagram shows how an extension W1 may be made in the width W if deeper bending is required to that depicted by the limits in the illustration, the pattern of the particular press casting determining the limit to the edge of the metal. By cutting away the jaw B to bridge the press as depicted, a greater degree of rigidity is given to the ends of this jaw, whilst at the same time, the U clamps about to be mentioned afford a better purchase; a plain strip of



General arrangement of a simple bending vice.

noted that the maximum movement of the press head was 3/16in., thus by allowing 1/8in. gap between the proposed wooden jaws c, the correct thickness of both jaws and the intermediate padding strip a, b and d could soon be determined. It is not intended that gauges above 16 S.W.G. be handled by this vice, so 1/8in. is ample for adjusting the metal along the bending lines.

Oak Jaws

To provide a flush mounting, the base of the press is recessed as depicted, consequently the jaw A is made up with two pieces of oak, carefully planed, these pieces being positioned on the bench runner with the vice in the most convenient place, then screwed down with three well-countersunk screws to each side.

Both jaws A and B are of well-seasoned oak, the intermediate strip, which was necessary to bring the width up to the desired limit of the movement, being of good quality plywood. This "padding" strip, as it is called here, also serves the purpose of reinforcing the fixture of the press base to the bench, since after fixing down the base and each section of A as mentioned, the extra screws necessary for the padding strip should be long enough to pass right through the jaw to the bench runner.

wood is not, after considering this point, advisable.

Side Clamps

Owing to the slight "give" which may be apparent at the ends of the jaws after clamping the metal, two U clamps are provided to ensure a more even distribution of pressure for acute bends, and the method adopted is clearly defined. Fairly heavy gauge mild steel is used for each clamp, with the edges slightly rounded to facilitate fitment over the tapered edges of the jaw.

It will be noticed that these U pieces slide into slots provided between the jaw and the bench, thus when the metal to be bent is positioned, it only remains for the end clamps to be tapped over the jaw, after pressing down the handle.

If it is desired that the handle of the press be kept down under pressure in addition to the end clamps, a simple method is to attach a strong spring to the bench, a suitable hook being provided which will conveniently slip over the thin part of the handle; this consideration, however, is not included in the illustration, as the essential features only are dealt with in regard to the adaptation of the embossing press.

Understanding Valve Curves

A Simple Explanation of Valve Characteristic Curves and their Meaning. By Frank Preston

IT appears that many of those readers who have been enrolled as radio mechanics in the R.A.F. have been asked questions relating to valve characteristic curves in their examinations. Fortunately for them, this subject has been dealt with in previous issues of this journal and also "The Practical Wireless Encyclopædia." Nevertheless, the subject is one of importance which is deserving of further study, especially by other readers who propose to apply for entrance as R.A.F. radio mechanics.

At this point it is worthy of note that a number of PRACTICAL WIRELESS readers have already been accepted for service, some of them being so successful in the preliminary test that they have immediately been given the rank of Leading Aircraftman; that is an excellent start, and I have heard from readers who find the new life very congenial.

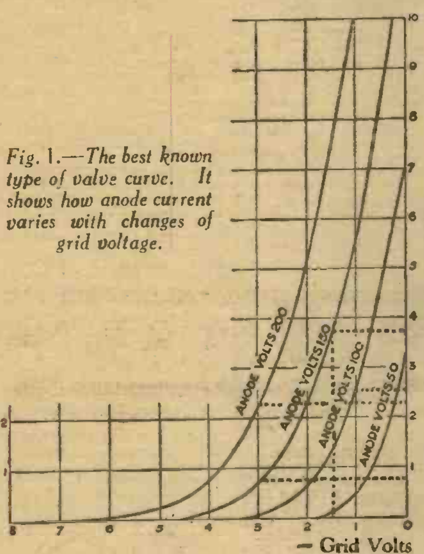


Fig. 1.—The best known type of valve curve. It shows how anode current varies with changes of grid voltage.

Anode Current-Grid Volts

But that is rather beside the point for the moment. There are a large number of different types of valve curve, and it would not be possible to deal with them all in a single article. Additionally, before some of them can be fully understood it is necessary to have a fair knowledge of valve theory. The simplest and most widely used characteristic curves are those known as anode current-grid volts curves. These are plotted to show the variation in anode current with changes in grid voltage.

An example is given in Fig. 1, where it will be seen that several curves are given on the same graph. These show how the position is affected by employing different anode voltages. For the particular mains triode represented by the curves in Fig. 1 it may be seen, for example, that if 150 volts is applied to the anode and the grid given a negative bias of 1½ volts, the anode current is approximately 3.75 mA; if the G.B. were increased to —3 volts the anode current would be reduced to about .75 mA, assuming the anode voltage to remain unchanged. But if the anode voltage were increased to 200, in addition to raising the G.B. voltage to 3, the anode current would be about 2.25 mA.

Finding Mutual Conductance

From the same curve it is possible to find the mutual conductance of the valve. As is well known, the mutual conductance is the change in anode current brought about by altering the grid voltage by one volt. For convenience, mutual conductance is taken when the anode voltage is 100 and the initial G.B. voltage is zero. By looking at Fig. 1 again it will be seen that the curve drawn for an anode voltage of 100 meets the zero grid volts upright at 7mA. If you now follow the upright line from 1 volt on the base line you will find that it meets the 100-volt curve directly opposite a point on the anode current upright representing 2.5 mA. Thus, by increasing the G.B. voltage from zero to — 1 volt the anode current is reduced by 7 minus 2.5, or 4.5 mA. That means that the mutual conductance of the particular valve represented is 4.5 mA/volt.

Slope

The various points referred to above are indicated by broken lines in Fig. 1. Another name for mutual conductance is slope. The reason for this will also be clear from Fig. 1, for it will be seen that the more steeply the curve rises the greater will be the difference between the anode current at zero and -1 grid volts. In other words, the mutual conductance is greater when the curve has a steeper slope, or makes a greater angle with the horizontal.

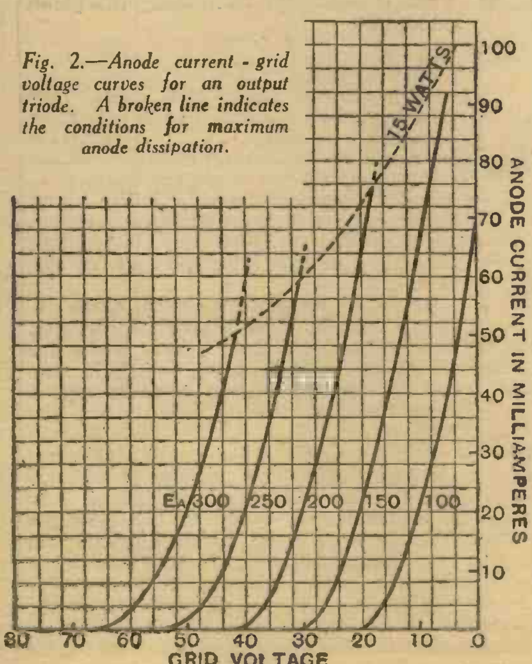


Fig. 2.—Anode current - grid voltage curves for an output triode. A broken line indicates the conditions for maximum anode dissipation.

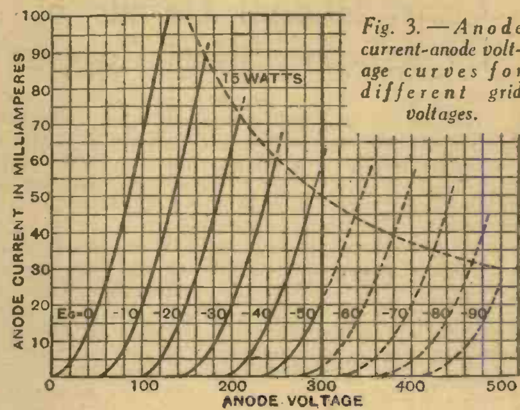


Fig. 3.—Anode current-anode voltage curves for different grid voltages.

Maximum Anode Dissipation

The type of curve just dealt with is used for all triodes, whether they are general-purpose, detector, L.F. or power valves. In showing the anode-current-grid voltage curves for a large power output valve, however, it is not unusual to add another curve as shown in Fig. 2. This is usually drawn in a broken line and cuts across the other curves. Its purpose is to indicate the grid voltage and anode current, at different anode voltages, which are maxima for the particular valve.

To put the matter in another way: it is known that any valve has a certain maximum dissipation (15 watts for that represented by the curves in Fig. 2) and that if this dissipation is increased the valve will suffer. If we examine Fig. 2 we may see that the "15-watt" curve cuts the 250-volt-anode curve at a point which represents approximately 58 mA. Multiplying 58/1,000 A by 250 volts we get 58/4, which is, roughly, 15 — and this answer is in watts (voltage times current in amps).

Anode Current-Anode Voltage

Another type of characteristic curve is often drawn for power valves, this being shown in Fig. 3. It is an anode current-anode voltage curve, and therefore shows how anode current varies with anode voltage. Here again, however, the grid voltage must be taken into consideration because it affects the anode current. That is why several curves are drawn for different grid voltages.

By drawing what is known as a load line—a straight inclined line joining points of maximum current and maximum voltage—it is possible to use a set of anode current-anode voltage curves plotted for an output valve to determine the A.C. output of the valve.

For S.G. and Pentode Valves

The anode current-anode voltage curves for an S.G. valve have a shape quite different from those for triodes, as can be seen in Fig. 4. Instead of the anode current showing a steady rise as the anode voltage rises, it first rises to a peak, falls, rises again and then straightens out.

(Continued on opposite page)

UNDERSTANDING VALVE CURVES

(Continued from facing page)

This point will be appreciated by comparing Fig. 4 with Fig. 5, which shows curves for a battery variable-mu H.F. pentode. In the latter case the curves are "ironed out" and are comparatively flat. The curves for an output pentode are similar in form. The same result is achieved in the case of modern tetrodes of both H.F. and L.F. types by the scientific positioning of the electrodes. This is a matter which is more concerned with valve design than with characteristic curves, and must be overlooked in this article.

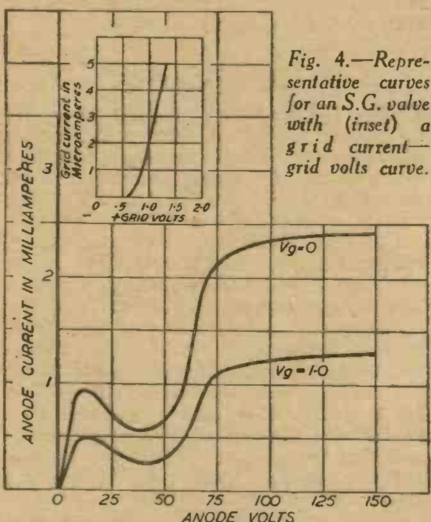


Fig. 4.—Representative curves for an S.G. valve with (inset) a grid current—grid volts curve.

Grid Current

Another type of curve is shown inset in Fig. 4. This is a grid volts-grid current curve, the current being shown in microamps (millionths of an amp.). In the example represented it will be seen that grid current does not flow until the grid is made positive to the extent of about .6 volts. Of course, grid current must be avoided except in the case of class B valves, and in most cases it is necessary to apply a negative bias to ensure that grid current does not pass. With the valve in question, however, bias is not necessary. If the curve crossed the upright line from the zero point a certain amount of bias would be required if the valve were to operate efficiently. In the case of most valves the curve comes entirely on the left of the zero grid volts line, showing the necessity for grid bias.

There are many other types of valve curve, but these cannot be dealt with here because of the limitations of space. At least, sufficient has been written to show the general principle of the characteristic curves.

Nomenclature

Before leaving the subject, however, there is one point which must be explained. It concerns the symbols used to indicate anode current, anode voltage, etc. In general, the method is to use a capital letter to indicate voltage and current, and a small one just below and to the right of it to show whether reference is being made to the anode, grid or screen. Most manufacturers employ the letters E and I for voltage (E.M.F.) and current respectively, and a, g and s for anode, grid and screen. Thus, anode voltage would be shown as E_a, and grid current as I_g. Occasionally, the letters V and C are used to indicate voltage and current, and p and g for anode (plate) and grid. If that method of notation is employed, anode voltage is given as V_p, and grid current as C_g.

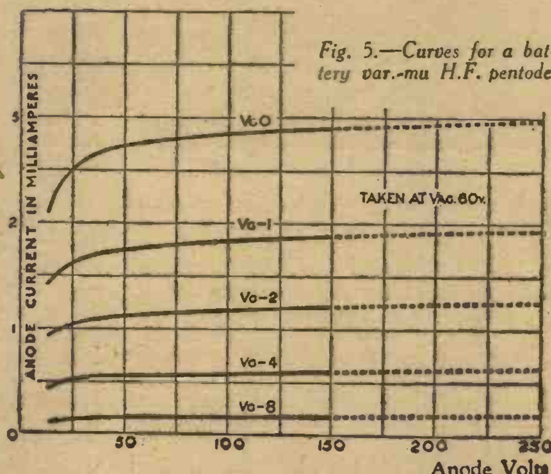


Fig. 5.—Curves for a battery var.-mu H.F. pentode.

RADIO CLUBS & SOCIETIES

THE CROYDON RADIO SOCIETY

Hon. Publicity Sec.: E. R. Cumbers, 14, Campden Road, S. Croydon.

THE Croydon Radio Society's first war-time session ended on Thursday, April 4th, in St. Peter's Hut, S. Croydon. The vice-president, Mr. G. S. Vellacott, was in the chair, and he called upon the hon. treasurer to present his balance sheet for the past session. The meeting unanimously agreed to continue next session with the low subscription of 3s. 6d. as it was urged that the society's activities should not be debarred from anyone on account of too heavy a subscription in these times of many calls on our purses. After further discussion, the balance sheet was adopted, and all officers were re-elected.

To conclude the evening the society's popular chairman, Mr. P. G. Clarke, gave a programme of records on his new quality amplifier, made specially for the night. In his selection Viennese Waltzes were particularly appreciated, and in contrast was "Riffin the Scot," a so-called "swing number," which had the effect of making Mr. Clarke wish he had not chosen it. The next session will begin in October, and PRACTICAL WIRELESS readers who are able to come will be welcomed at every meeting. A special effort is being made to persuade members themselves to talk of their own experiments, and it should be recalled that in this session just past over three-quarters of the programmes were given by members.

BRISTOL EXPERIMENTAL RADIO CLUB

Headquarters: 21, King's Corridor, Old Market Street, Bristol, 2.

Publicity Manager: D. J. James, 40, Robertson Road, Eastville, Bristol, 5.

THE second annual general meeting of the Bristol Experimental Radio Club will be held on Tuesday, May 7th, at 8 p.m., at club headquarters. Will all members please make a special effort to attend this meeting, as the policy of the club for the forthcoming year is to be decided. New officers and committee are to be elected.

All experimental radio enthusiasts in the district are invited to join. The annual subscription is very low.

It has been decided that experimenters in the Services may attend meetings free of charge for as long as they are in Bristol—so let's see plenty of khaki and blue on Tuesday evenings! Any further details required may be obtained from the publicity manager.

SURREY RADIO CONTACT CLUB

Headquarters: Cafe Royal, Croydon.

Hon. Sec.: S. A. Morley, 22, Old Farleigh Road, Selsdon.

THE club's 44th meeting was held at the above address on April 6th, after an informal opening. Mr. Milne (G2MI) was asked to give his promised lecture on an Automatic Transmitter. This he did with his well-known thoroughness. It consisted of two telephone multi-contact pre-selectors purchased from a well-advertised second-hand retailer of wireless components.

The secretary will be pleased to receive any prospective members anxious to visit our club.

Open to Discussion

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

Radio Training Manual

SIR,—I feel I must express thanks to PRACTICAL WIRELESS for the step taken in publishing the "Radio Training Manual," which I feel sure must fill a long-felt want. I have been fortunate in obtaining enlistment in the R.A.F. as a radio mechanic and I find that you have to read quite a number of books to refresh your memory on the wide knowledge of the subject that is expected by the R.A.F. Although I am professionally engaged in radio, I still find time to read and learn quite a lot from PRACTICAL WIRELESS, which I have taken for years. I have, with one exception, all your books, and find them extremely useful. Wishing your paper the success it deserves.—BERNARD H. POOLE (Brecon).

Reception Conditions

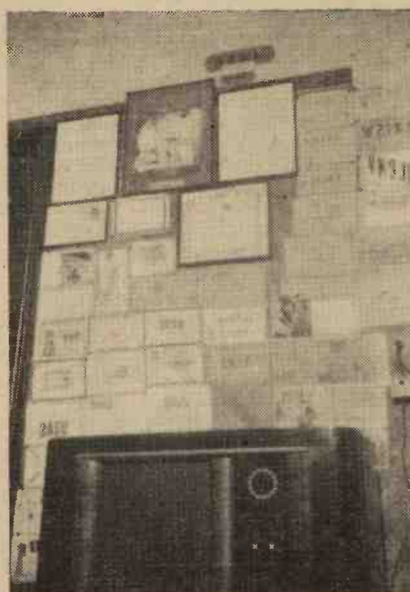
SIR,—I have noticed in recent issues quite a number of DX logs submitted by readers, and it occurred to me that fellow S.W.L.'s may be interested to hear about reception conditions at this QRA. Between March 1st and March 21st I heard, amongst other "hams," the following: W1, 2, 3, 4, 8 and 9; HA3B, 6T, 9Q; ES5D, IE4G; LY1S, YUMAY, EADAP, DAP, DBA; I1JKV, IRE; TI2RA, PY2LN, CO2AM, K4FAY, 4FKC, 4DSE; PK1OG, KA1ME, 1RV, 1LZ and 1AF. The B.C. bands gave VLQ, VLQ2 and VUD2 as additions to DX stations heard. From March 21st to April 4th no DX was heard; in fact, Europeans were not coming in at all well. For 10 days the only "ham" heard on 20m. was HA3B, vainly trying at the time to contact XU1B. The 20m. band is now opening up again and W's and real DX should be heard again soon. Of course the bad conditions were due to the severe magnetic storms which severely interfered with radio communications both on the American and this side of the Atlantic. I listened on April 7th between 17.15 and 17.45 on 20m. and heard W1, 2, 4, 8 and 9; HA7P, 3B, 8C; ES1E, EA7BA and KA1ME, so the band is much better now. I enclose a photo of my den, showing receiver, etc., here. The receiver is an AW4 S/H (Bush BA53), and the antenna is a 66ft. inverted-L.—A. HART (Ilkeston).

Full-wave Detection

SIR,—I have read with much interest, but with little enlightenment, Mr. Ford's letter in your issue dated April 20th.

I have been unable to trace the publication in which he stated his "new theory of detection," but the short statement of it in his letter is difficult to understand. I withdraw the innuendo in my previous letter that he is not serious. Nevertheless, he refers to radio frequencies as if they behave entirely differently from lower frequencies, and appears to be confused between unmodulated and modulated waves. As far as rectification is concerned, however, there can be no essential differences and the same theory should be capable of explaining the rectification of alternating current of all kinds, whether of high or low frequency or of wave sine form or complex.

I am of the opinion that Mr. Ford's



A corner of Mr. A. Hart's den.

difficulty is purely one of nomenclature and partly due to confused thought. It would perhaps clarify the nomenclature difficulty if it is appreciated that the "push-pull detector" is strictly a "by-phase half-wave rectifier." A typical full-wave rectifier is the well-known "bridge" arrangement, and I maintain that, given perfect rectifiers, this will undoubtedly give full-wave detection of radio frequencies whether of the form A sine pt or (A B sine wt) sine pt.

It would no doubt interest many readers if Mr. Ford contributed an article to these pages giving the grounds on which he bases his opinion "that full-wave detection of radio frequencies is impossible."—"EMPIRICIST" (Ickenham).

Dead Spots

SIR,—I have been reading your fine paper for about four years, during which time it has been useful to me in many ways. I am very interested in the letters on Dead Spots, as I find that this trouble occurs in my locality too. I have yet to hear signals from stations in Canada or South Africa. At different times I have used one, two and three-valvers on phones. The aerials used up to date have been a single-strand aerial, indoors, 10ft. long, running N.N.E. to S.S.W., and a 50ft. indoor aerial zigzagging five times across the room. The apparatus is housed on the second floor, so I have been obliged to use a capacity earth. The only possible solutions that I can offer to the problem are that the Americans are using beam transmission while the Canadians and South Africans are not, or that we have been listening in when the Canadians and South Africans have not been operating. I do not think that my kit is at fault, as I have heard stations in Australia, America, France, Spain, Germany, Italy and Russia. I shall look forward with interest to any further correspondence on this subject.—A. ATKINS (Clevedon, Somerset).

Station HCJB, Ecuador

SIR,—Other listeners may be interested in a station I logged a short while ago. It was station HCJB, Quito, Ecuador, on 24.08 metres, and is heard at very good strength here. Transmissions in English take place at 00.00 B.S.T. and 03.00 B.S.T. every day except Tuesday mornings. Reports are requested and should be sent to: The Voice of the Andes, Radio Station HCJB, Casilla Postal, 691, Quito, Ecuador, South America.

I would very much like to see the return of "Leaves from a Short-Wave Log," as it was with the aid of this page in the July 29th, 1939, issue that I learned quite a lot about this station after I had logged it.—MALCOLM C. CRAIK (Dundee).

Prize Problems

PROBLEM No. 398

JACKSON had a simple three-valve short-wave receiver in which reaction did not appear to function very smoothly. The reaction condenser was joined on the earth side of the reaction winding, and he thought that perhaps things would be better if he connected it on the anode side of the reaction winding. He made the change in wiring, but when he tried it out could get no reaction at all. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 398 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, May 6th, 1940.

Solution to Problem No. 397

The heater winding on Fergusson's transformer was intended to supply the standard 4 volts at a few amps., but the D.C. wiring would have had the heaters wired in series, and, consequently, the valves would not receive the correct voltage and thus they failed to function.

The following three readers successfully solved Problem No. 396, and books have accordingly been forwarded to them:

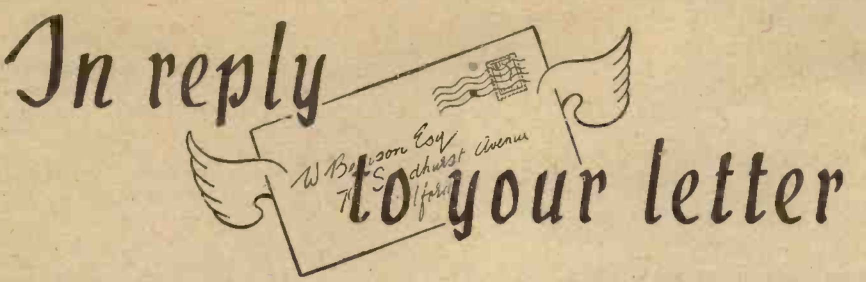
G. D. Roberts, "Winfield," Nelson Gardens, Wisbech, Cambs; D. W. Hunter, 75, Daneland, East Barnet, Herts; S. Collins, 15, Jesmond Street, Failsworth, Lancs.

Correspondents Wanted

P. W. BARNETT, L.N.E.R. Station House, London Road, St. Albans, wishes to correspond with any young reader, about 16, who is interested in general radio. He is also desirous of getting in touch with a local radio club.

E. A. Pratt, 56, The Limes Avenue, New Southgate, N.11, would like to get in touch with a reader (about 15 years) interested in S.W. listening.

I. G. Topping, 2, West Street, Harrow, Middlesex, wishes to get in touch with any reader who possesses a New Times Sales "All-wave Screen-Grid Four," with a view to comparing performances and solving one or two difficulties with reception.



L.F. Coupling

"In a set which I wish to build you specify a Transfeeda. As I have never heard of or seen one of these things before, I would be much obliged if you could inform me through your pages the price of this component, what it is, and where I could purchase one."—A. M. (Nelson).

THE item in question is a complete parallel-fed transformer coupling unit. That is, it consists of an L.F. transformer, a resistance and a condenser. The resistance is tapped so that a portion may be used if desired as a decoupling component, or, alternatively, the entire resistance may be used for the anode load, with an external decoupling resistance included if desired. The original component is not now on the market, but an equivalent substitute will be found in the Bulgin range, type L.F.10. It is known as a "Transcoupler," and the pre-war price was 10s. 6d.

Public Address Equipment

"Can you explain if it is necessary to have a licence for the use of public address equipments; if so, how much and where can I obtain one? Also the terms for record playing."—V. P. (Sth. Farnborough).

A LICENCE is not needed for the use of the equipment, provided that, if it employs any patented circuit, the apparatus has been built under licence. This is obtained from the Marconi Company at Electra House, Victoria Embankment, W.C. If you use standard gramophone records, however, you should communicate with the Performing Rights Society at 33, Margaret Street, W.1, regarding the payment of royalties for such use.

Bias Problem

"I have a standard transformer-coupled output stage and am in a difficulty regarding bias. When the plug is removed from the battery the performance is all that is desired, but as soon as the plug is put back reception is weak and poor. I have tried a new battery, replacement of the valve and secondary winding for break, but I cannot find any such fault as exhausted bias battery, weak valve or short. I should be glad if you could help me."—P. H. (Normanton).

THE fact that the insertion of the plug affects results proves that the grid circuit (transformer flex lead and plug) is complete, and therefore the trouble is most likely due to the fact that the minimum bias you can apply is too much for the valve. This could be due to a low H.T. voltage, or the use of the wrong type of valve. In some cases it has been found, however, that G.B. batteries are marked with wrong polarity and we therefore suggest that you try reversing the particular batteries you are using. A negative potential must be applied to the grid.

Aerial Coupling Coil

"I have been making one or two coils lately and am rather puzzled by the effects of the primary or aerial winding. Although I have used the same number of turns I have found that signal strength is varied by the spacing of the winding and I should like to know whether this is usual, or whether I have done anything wrong in the winding. (A sketch of the coil was attached.)—G. I. (Co. Antrim).

THE number of turns on a primary winding is not the sole factor in an H.F. transformer. For highest efficiency the primary should be coupled *inductively* to the secondary and any capacity coupling which exists will affect efficiency. Unfortunately it is not possible entirely to avoid capacity coupling, but you will find if you use a very fine wire primary, wound in such a way that turns of wire make a slight angle with the secondary turns, and with a fair spacing between the two windings, selectivity would be much higher than if you use a thick wire primary wound exactly parallel to the secondary. A good plan for experimental purposes is to make a former for the secondary sufficiently large to permit another former to be inserted inside it, and to provide two-pin and socket connections inside the coil. You could then wind different types of primary and insert them in the secondary in order to see the effects of the different windings.

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.

Multi-meter

"Is there any need to alter the series resistors used for voltage reading when using a D.C. milliammeter with rectifier for A.C. voltage tests? I have made a D.C. test meter, but now have obtained a meter rectifier and wish to add an A.C. range."—L. S. E. (Winchmore Hill).

WHEN the rectifier is included the meter movement will give a deflection proportional to the mean current. In practice it will be found that the scale reading is actually increased by 11 per cent. and thus, instead of 1 mA, the scale will indicate 1.11 mA (R.M.S. A.C.). Thus, you can either read your scale with the necessary modified reading, or preferably use a separate set of resistors which will, of course, all have to be slightly lower than those used for the D.C. ranges. Some interesting details on this subject will be found in the Westinghouse Company's booklet No. 11b.

Speaker Position

"I am rather disappointed by the results given by my new speaker. This has been stated to be a very good model and I know my set is good as it is designed for quality. The reproduction is not, however, satisfactory for the price I have paid, and I wonder if you can give me any advice in the way of improving it."—H. R. (Blackheath).

WHILST your set may be quite good from the theoretical point of view and the speaker may also be good theoretically, there may be several points resulting in the inferior results. Firstly, there may be need for some form of tone correction to cut out resonances. Secondly, you may not be correctly matching the speaker to the set. Thirdly, the results may be seriously affected by the acoustics of the room. If you placed the set and speaker in a modern recording studio, for instance, it would perhaps sound excellent, but the furnishings of your room may be having a marked effect on the high notes, or lack of furnishings, bare floors, etc., may be hardening the tone. Therefore, you should attend to these points before making any attempt to modify either set or speaker.

REPLIES IN BRIEF

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

C. P. (Manchester, 8). We think the most satisfactory process would be to communicate with the makers of the set or their nearest local service agent.

E. A. B. (Itchen). The trouble is undoubtedly interaction between the two parts, not the correct injection. The oscillator must be perfectly screened.

W. S. (Earls Barton). Some diagrams are theoretical and some pictorial. In one or two cases actual wiring diagrams are given, and for others blueprints are available.

D. W. H. D. (Stow-on-the-Wold). Write to Southern Radio or one of the other advertisers in our Small Advert. Sections.

R. L. (W.12). Write to Foreign Correspondence Department, Station JZI, Tokyo, Japan.

E. A. M. (Denton). There was a circuit using a battery in the manner indicated which was popular at one time. It was known as the Prince Trigger circuit. The idea has been superseded by modern arrangements.

T. J. M. (Landore). Any standard amplifier may be used. We hope to describe a small A.C. amplifier in the near future.

L. H. T. (Bristol, 3). The issue in question is now out of print. You will find details in the small booklet issued by the Westinghouse Company.

T. M. (Nelson). You cannot use the A.C. or rectified A.C. for the battery valves, owing to hum troubles.

A. H. P. (Broughton-in-Furness). A series resistance of the variable type should be used. A 25 or 30 ohms component would be suitable.

D. G. (Chelmsford). The data will be included shortly in our Radio Engineer's Pocket-book pages.

K. W. (Cambridge). Messrs. Premier Radio can supply a kit for your purpose.

S. S. (Bradford). The voltage should not be higher than 66. Check your battery carefully.

H. A. (Shoreham). Make sure the grub screws are well inside the knob and fill the space above with Chatterton's Compound or some similar insulating material.

P. M. A. (Reigate). The panel may be of wood, but it would be desirable to dry it thoroughly and then impregnate with paraffin wax or well shellac it.

The coupon on page 168 must be attached to every query.

MULTIPLE SPEAKER MATCHING

(Continued from page 158)

$$\text{Ratio } \sqrt{\frac{40{,}000}{5}} = 89.5.$$

Load 2. Primary 20,000 ohms. Secondary 15 ohms.

$$\text{Ratio } \sqrt{\frac{20{,}000}{15}} = 36.5.$$

Load 3. Primary 20,000 ohms. Secondary 30 ohms.

$$\text{Ratio } \sqrt{\frac{20{,}000}{30}} = 25.8.$$

Load 4. Primary 8,000 ohms. Secondary 600 ohms.

$$\text{Ratio } \sqrt{\frac{8{,}000}{600}} = 3.65.$$

Separate transformers are a wastage of weight, space and money, so all the primaries are combined into one. A common primary designed for an impedance of 4,000 ohms is used, and the four secondaries are linked to it by the ratios calculated above. The steps in the calculation are represented in Fig. 3.

Similar results would have been obtained by substituting particular values for each of the output channels in turn in the general formula given above, i.e.:

$$\text{Turns ratio} = \sqrt{\frac{100R}{nZ}}$$

This method is by far the quickest way of arriving at the result, but one should use the slower method until the system of working is fully understood.

VALVE INSTALLATION

(Continued from page 151)

The bias obtained by means of a resistor or resistance is often referred to as the "self bias" scheme. H.F. valves of the variable-mu type may have a variable resistance in place of the fixed resistance used in L.F. stages so that the bias voltage may be varied, and the gain of the valve also modified. The bias for some valves of this type may be as high as 30 volts for "cut off." Maximum bias results in minimum gain and vice versa, and as the screen current also varies with the bias it is usual to connect the bias potentiometer as part of the screen potential divider to keep a balance of things.

Metallised coatings of a valve should always be joined direct to earth, although care is necessary to avoid a short-circuit to the screen. This point is of importance when a top-cap anode is used as this will be in direct contact with H.T. and the H.T. will be short-circuited if the anode lead touches the screening coating. If a valve of the type having the screen joined internally to the cathode is used, a short-circuit between screen and earth would short-circuit the bias resistor should one be included.

BOOKS RECEIVED

WIRELESS. By C. L. Boltz, B.Sc. 278 pp., 123 illustrations. Published by John Gifford, Ltd. Price 10s. 6d.

THIS is a text book covering the principles of radio and deals with fundamentals from the elementary facts about electricity up to the superhet and television. The chapters are as follows: Waves; Elementary Facts About Electricity: Alternating Waves; Choosing the Signal; The Valve; Valve Detection; L.F. Amplification; H.F. Amplification: Loudspeakers; The Straight Set; The Superhet; Short Waves; The Mains and Types of Receivers; The Gramophone; Television. The book is written in simple language and there is an absence of the usual pages of formulæ which generally render this type of book rather frightening for the beginner. Only essential formulæ are dealt with.

METALLURGICAL AND INDUSTRIAL RADIOLOGY. By Kenneth S. Low. 86 pp., 42 illustrations. Published by Sir Isaac Pitman and Sons, Ltd. Price 7s. 6d.

ALTHOUGH not a wireless book, this deals with radiology and is indispensable for metallurgists, welders, moulders and others who are interested in modern X-rays. After covering the general principles the book deals with apparatus, technique, and such specified branches as stereoscopy and tomography.

TELEVISION DEVELOPMENT

JUST prior to the outbreak of war the culmination of the strenuous efforts of the two R.M.A. television committees, one of which was concerned with matters of policy, and the other with solving the multitudinous technical problems, was made manifest in the organisation of the Radiolympia Exhibition. Since then but little has been heard of the activities of these committees, but it is known that their work has in no way been completely stopped. At a recent meeting a leading manufacturer expressed the opinion that he felt some form of television service would be initiated in the not too distant future. This falls into line with the repeated pleas made by Thermion in this journal that the present mode of living forced on the general public as a result of war-time lighting restrictions could be alleviated by an entertainment provided by a television service. It is wrong to regard television as a luxury service, for the whole problem should be treated as a necessity to meet or counter technical and commercial competition from those neutral countries who are not in any way upset by war's burdens. It is known that the authorities responsible for the defence of this country have been approached by the leading manufacturers, and optimism prevailed that a solution would be found to give some form of television service, although it was as yet unknown whether the link between receiver and transmitter would be radio or line.

Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS

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

STRAIGHT SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF) ..	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow) ..	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow) ..	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen) ..	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P) ..	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

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.

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

LATEST PATENT NEWS

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

NEW PATENTS

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

Latest Patent Applications.

5779.—Fletcher, H.—Transmitting device for wide frequency band operation. March 30th.

5569.—Ferranti, Ltd., and Darbyshire, J. A.—Thermionic valves. March 28th.

6058.—Marconi's Wireless Telegraph Co., Ltd., and Norwood, H. C.—Calibrating scales for use in radio-receivers. April 3rd.

6048.—Marconi's Wireless Telegraph Co., Ltd., and Payne, G.—Reduction gear devices. April 3rd.

6051.—Marconi's Wireless Telegraph Co., Ltd., and Price, T. H.—Modulation systems for radio, etc., transmitters. April 3rd.

6052.—Marconi's Wireless Telegraph Co., Ltd., and Wassell, H. J. H.—Spot-adjusting mechanism. April 3rd.

6046.—Marconi's Wireless Telegraph Co., Ltd., Rust, N. M., Brailsford, J. D., Oliver, A. L., and Ramsay, J. F.—Variable capacity devices. April 3rd.

6047.—Marconi's Wireless Telegraph Co., Ltd., Rust, N. M., Brailsford, J. D., Oliver, A. L., and Ramsay, J. F.—Radio circuit arrangements employing potential-variable capacity devices. April 3rd.

5869.—Mullard Radio Valve Co., Ltd.—Mosaic electrodes for television transmitting tubes. April 1st.

Specifications Published.

519515.—I. M. K. Syndicate, Ltd., Nagy, P., and Byron, D. H.—Phonic-motor devices for television and like systems.

519444.—Hazeltine Corporation.—Antennæ.

519448.—Philco Radio and Television Corporation.—Push-pull amplifier circuit.

519594.—Electrical Research Products, Inc.—Television image-transmission.

519464.—General Electric Co., Ltd., and Bloch, A.—Means for suppressing radio interference produced by electrically-propelled vehicles.

519490.—General Electric Co., Ltd., and Rossignol, R. Le.—Thermionic amplifiers.

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

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PRACTICAL WIRELESS 4/5/1940.

Classified Advertisements

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COMPONENTS.—Mains energised Celestion 8-in., Rola 5-in., Blue Spot 66k. unit, 3 gang condenser, valves, Tungsram 6A7, 76, BVA, VM4, 12s. 6d., Beethoven 4v. baby portable, 30s., less batteries.—T. Brown, Springfield House, Hartburn, Stockton-on-Tees.

OLDHAMS.—Ex-Police, slightly used, unspillable 2v. 7 amp. Accumulators, suitable for Lamps, Portables, etc. 2/- each. Also 6v. 38 amp. accumulators, slightly used, suitable for A.R.P. emergency lighting, etc., 10/- carriage forward. Special terms for trade. See also last week's issue.—London Central Radio, 23, Lisle Street, W.C.2. Gerrard 2969.

LITERATURE

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

LOUDSPEAKER REPAIRS

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MORSE TRAINING

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QUALIFICATIONS.
All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.
(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.
(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.
(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.
ACCEPTED candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three calendar months, and will be paid £3 10s. 0d. weekly during training. Subsistence allowance of £1 5s. 0d. weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £246, if 25 years of age or over, with a corresponding reduction of £12 per annum for each year under 25 on joining (payable monthly in arrear) if service is satisfactory, and must be prepared to serve in any part of the United Kingdom.
NORMAL age limits 23 to 60.
CANDIDATES should indicate on their applications for which vacancy they wish to be considered—a, b or c.
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BANKRUPT Bargains. Brand new 1939/40 models, makers' sealed cartons, with guarantees, at less 40% below listed prices; also Midgets, portables, car radio. Send 1½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

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

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. 1½d. stamp for Lists.

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A GAS-MASK BOX RECEIVER — See Page 171

A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 399.

Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 11th, 1940.

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NEW SERIES

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No. 89

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Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
⅞"	18	10½	1½"	15¾	16½	30	36	55
1"	18	10½	½"	5¼	8¾	16	19½	30
,,	,,	,,	¾"	7⅞	12	21½	26	40
,,	,,	,,	1"	10½	14	25½	31	47
,,	,,	,,	1¼"	13⅛	16	30	35½	55
,,	,,	,,	1½"	15¾	18	33½	40	62
1¼"	18	10½	½"	5¼	10½	19	23½	36
,,	,,	,,	¾"	7⅞	14½	26	31½	49½
,,	,,	,,	1"	10½	17	31½	38½	58
,,	,,	,,	1¼"	13⅛	20	36	44	66
,,	,,	,,	1½"	15¾	23	42	50	73
1½"	18	10½	½"	5¼	12	22	27	41
,,	,,	,,	¾"	7⅞	16½	30	37	56
,,	,,	,,	1"	10½	20	36	44	67

No. 90

SHORT-WAVE COIL DATA—(*continued*)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
1½"	18	10½	1¼"	13⅛	23	43	52	78
,,	,,	,,	1½"	15¾	26½	48	58	90
½"	20	14	½"	7	6½	12	14½	22
,,	,,	,,	¾"	10½	8¾	16	19	29
,,	,,	,,	1"	14	10	18½	22½	34
,,	,,	,,	1¼"	17½	11½	21	25	40
,,	,,	,,	1½"	21	13	23½	29	45
¾"	20	14	½"	7	9	17	21	32
,,	,,	,,	¾"	10½	12½	22	27	42
,,	,,	,,	1"	14	14	27	33	50
,,	,,	,,	1¼"	17½	17	30	37	57
,,	,,	,,	1½"	21	19	35	42	65
⅞"	20	14	½"	7	11	19	23	35
,,	,,	,,	¾"	10½	14	25	31½	48

No. 91

SHORT-WAVE COIL DATA—(*continued*)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
⅞"	20	14	1"	14	17	30	37	57
,,	,,	,,	1¼"	17½	19	34½	42½	65
,,	,,	,,	1½"	21	22	40	48	72
1"	20	14	½"	7	11½	21	26	40
,,	,,	,,	¾"	10½	15½	28	34½	53
,,	,,	,,	1"	14	18½	34	41	63
,,	,,	,,	1¼"	17½	21½	39	48	71
,,	,,	,,	1½"	21	24	45	54	82
1¼"	20	14	½"	7	14	25½	31	47
,,	,,	,,	¾"	10½	19	35	43	65
,,	,,	,,	1"	14	23	42	51	74
,,	,,	,,	1¼"	17½	27	48½	59	90
,,	,,	,,	1½"	21	30	55	67	103

No. 92

SHORT-WAVE COIL DATA—(*continued*)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
1½"	20	14	½"	7	16	29	35½	54
,,	,,	,,	¾"	10½	22	40	49	73
,,	,,	,,	1"	14	26½	48	59	90
,,	,,	,,	1¼"	17½	31	56	69	105
,,	,,	,,	1½"	21	35	63	78	120
½"	22	18	½"	9	8¼	15	18½	28
,,	,,	,,	¾"	13½	11	20	25	38
,,	,,	,,	1"	18	13	24	29	44
,,	,,	,,	1¼"	22½	15	27	33	51
,,	,,	,,	1½"	27	17	31	37	57
¾"	22	18	½"	9	12	21½	26	40
,,	,,	,,	¾"	13½	16	29	35	54½
,,	,,	,,	1"	18	19	34	42	64

No. 93

SHORT-WAVE COIL DATA—(*continued*)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
¾"	22	18	1¼"	22½	22	40	48	72
,,	,,	,,	1½"	27	25	45	54½	82
⅞"	22	18	½"	9	13½	25	30	45
,,	,,	,,	¾"	13½	18	32	40	62
,,	,,	,,	1"	18	22	40	47	71
,,	,,	,,	1¼"	22½	25	45	55	82
,,	,,	,,	1½"	27	28	50	62	92
1"	22	18	½"	9	15	27	33	50
,,	,,	,,	¾"	13½	20	36	45	68
,,	,,	,,	1"	18	24	44	53	81
,,	,,	,,	1¼"	22½	27	50	61	92
,,	,,	,,	1½"	27	31½	57	70	107
1¼"	22	18	½"	9	18	33	40	61

No. 94

SHORT-WAVE COIL DATA—(*continued*)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
1¼"	22	18	¾"	13½	25	45	55	82
,,	,,	,,	1"	18	30	53	65	100
,,	,,	,,	1¼"	22½	34	62	76	115
,,	,,	,,	1½"	27	39	70	85	135
1½"	22	18	½"	9	20	36½	46	70
,,	,,	,,	¾"	13½	28	51	62	96
,,	,,	,,	1"	18	34	62	76	115
,,	,,	,,	1¼"	22½	40	72	88	135
,,	,,	,,	1½"	27	45	83	100	150
½"	24	22½	½"	11¼	11	19	23½	35½
,,	,,	,,	¾"	16⅞	14	25	30	42
,,	,,	,,	1"	22½	16	29	36	55
,,	,,	,,	1¼"	28	18½	34	41	63

(*See also page 185*)

Practical and Wireless
★ PRACTICAL TELEVISION ★

EVERY WEDNESDAY
Vol. XVI. No. 399. May 11th, 1940.

EDITED BY
F. J. CAMM

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

ROUND THE WORLD OF WIRELESS

DX Reception

MUCH has been written from time to time about DX or long-distance work, and many listeners think that this is the most interesting part of radio. Although extensive logs may be compiled by listeners who only just hear the call sign and then immediately try to get another station, this is not real DX work, and the test of the efficiency of a station and the way in which it is handled is better judged by the constancy of reception and the time for which it may be received. If you are able to tune in quickly one of the weaker American stations and hold it for an hour this will give more satisfaction than mere wandering round the dial to see how many stations can be heard in an hour. However, in this issue we give some details of the latest methods of getting long-range results, and also give constructional data of a Home-Service receiver built on Diversity Receiver lines. The principles involved may be adapted to a standard receiver, and may even be incorporated for all-wave receiver working.

Surprise Packet for B.B.C.

A PACKET was recently delivered to the B.B.C. containing eight bone discs and a covering letter stating that they were a year's subscription to *London Calling*, the B.B.C.'s Overseas Programme journal. The discs bear the name of the listener, J. S. Clunies Ross, and the value on one side, while on the other is stamped the emblem of the Keeling or Cocos Islands. They are the currency of these islands, and the listener, who is Governor and owner of the Cocos, issues the currency.

Kipling's Jungle Book

THE recent broadcast series of "Just-So Stories" is to be followed up by new Kipling programmes, beginning on June 1st. This time Val Gielgud has chosen the "Jungle Book," and the immortal Mowgli, with his wolf foster-parents, his friends, Akela, Bagheera, Kaa, the snake, and his bitter enemy, Shere Khan, will be the principal characters.

George Formby at Nottingham

PERMISSION has been given by Mr. George Black for some Saturday-night broadcasts from his theatres. One of these will be heard on May 11th, from the Empire, Nottingham, where the star turn will be George Formby, with the concert party with which he has been touring in France.

"Phoney Island"

DICKY HASSETT, who has become a popular favourite with listeners for his impersonations of street cries, is to be featured in a new series which Francis Worsley will produce under the title "Phoney Island." The first of these programmes will be broadcast in the Home Service on May 14th.

"Phoney Island" is said to be a well-known but entirely decrepit inland amusement centre and the ramshackle round-about emporium is advertised as a "going concern"—"going" is the word to describe it. "It has," runs the advertisement, "a very good turnover and during the last ten years has paid well—about a halfpenny in the pound." Its marine lake is well known to anglers, yachtsmen and swimming enthusiasts and, in consequence, is entirely deserted. Dicky Hassett's efforts to resuscitate this amusement morgue should provide him with plenty of amusing situations.

Vera Lynn, popular vocalist with Ambrose, who is shortly going into a West End show. Her records top the sales list, and are very popular with the troops.

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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.

"Stage Door"

ERNEST LONGSTAFFE who had always hankered after a back-stage broadcast entitled "Stage Door," suggested such a programme to John Watt, B.B.C. Director of Variety, last autumn; but the war came along and stopped it. However, this being perhaps a telepathic age, the idea cropped up again when the O'Gorman Brothers suggested a show with the same title.

Longstaffe, having armed himself with a collaborator in the shape of Dick Pepper, drove with him to Birmingham, to see Dave and Joe O'Gorman's performance in pantomime. After the show, they returned to their hotel and got to work with pencil and paper; and, eventually, at about 3 a.m. they arose from the table with their plans laid.

Dick Pepper and Ernest Longstaffe will make the O'Gormans work hard in the characters of two men in the theatre bullied by the local manager into doing everything, from conducting the orchestra to pulling up the curtain, working the limelight or going on and doing a double turn.

"Pinnochio"

TO quote the words of a famous film critic, "In 'Pinnochio' Walt Disney has made a film so good that it crowns the the first fifty years of cinema." John Watt and Henrik Ege have prepared a special radio version of this remarkable full-length colour cartoon, and it will be broadcast on May 9th. A special radio score and musical arrangements are being written by Wally Wallond, who has been responsible for the music side of all the Disney radio adaptations. His work on "Snow White" is particularly memorable. In "Pinnochio" his task will probably be the hardest yet attempted in the history of film adaptations of this kind.

A DIVERSITY RECEIVER

A Novel Dual Set for Reception of the B.B.C. Home Service

By W. A. FLINT

THERE are still many areas where reception of the B.B.C. Home Service is very inadequate, the usual complaints being fading or distortion, and sometimes both.

Field strength measurements with an "R" meter have shown that the comparative strength of the transmission, both on 391 and 449 metres, varies considerably even in daylight in some districts. These changes are not so serious, however, as the distortion and blasting which accompanies them when the receiver in use is A.V.C. controlled. The better the set and the more A.V.C.-controlled stages in use, the more acute the distortion becomes.

Further experiments have shown that a simple straight receiver without A.V.C. gives good reception over reasonable periods without distortion, but suffers from the drawback of fading—in fact, at times, the programme has become practically inaudible.

On the other hand, a modern superhet fitted with an efficient A.V.C. circuit holds the volume reasonably constant, but at times introduces very severe distortion and blasting.

These experiments led to the belief that if it were possible to have two simple straight receivers—one tuned to 449 metres and the other to 391—and feed their two outputs into a common amplifier, we should have a receiver which would be free from distortion and at the same time counteract fading, for it would be quite probable that as one faded the other transmission would not, and vice versa, so that the "mixed" output to the amplifier would remain substantially constant. How well such an idea works listeners may probably remember if they have ever listened to a B.B.C. relay from America, and then tried to pick up the American transmission direct. The B.B.C. use a "diversity reception" scheme, and the relay is usually very much better than the results to be obtained direct.

Two Receivers on One Chassis

The essence of the receiver under review, therefore, is a combination of two receivers on one chassis. Each receiver consists of an H.F. and detector stage—one being tuned to 449 metres and the other to 391 metres—and for simplicity's sake devoid of all controls. Tuning (and reaction, if necessary) is by means of preset condensers, and volume control is effected after the detector stages, that is, on the common amplifier itself.

The theoretical diagram is shown in Fig. 1. Dealing with section A (the top portion of the diagram) it will be seen that an ordinary type of screened pentode valve is used for the H.F. stage. This valve is designed for operation with the same voltage on the screen as the anode, and is fitted with the control grid brought out to the top cap, thereby appreciably reducing the inter-electrode capacities and consequently imposing less damping on the tuned circuits; and also making the screening of leads carrying H.F. currents unnecessary, provided that reasonable care is taken with the layout.

Screen Current Consumption

Another reason for the use of this type of valve is that it avoids the expense of a screen/cathode resistance and condenser network, and also a volume control, and makes the receiver more simple and cheaper to build and operate. Further, the valve actually used (Tungsram SP4B) has a total anode and screen current consumption of less than 4 mA and is therefore very economical in operation.

Note that the absence of any control on the H.F. stage makes it possible to use a common bias resistance and condenser for both valves and further reduces the cost of construction.

Preceding the SP4B valve is a Bulgin C.6 aerial coil. It will be noted that as the receiver is intended for medium-wave reception only, no wave-change switches are required and the long-wave windings have been shorted out. The same remarks apply to the H.F. transformer (type C.7) which couples the H.F. valve to the detector. This H.F. transformer has its untuned primary connected between H.T.+ and the anode of the SP4B valve, and no decoupling or voltage-dropping resistances are used, presuming, of course, that the maximum H.T. does not exceed 250. (If this occurs, voltage-dropping resistances and decoupling condensers will have to be included in both anode and screen H.T. lines in order to reduce the voltage to 250 maximum.)

A power-grid detector is employed with a grid leak of 250,000 ohms and a grid condenser of 0.0001 mfd, as this will handle strong signals without distortion if and when the receiver is used near to the transmitter.

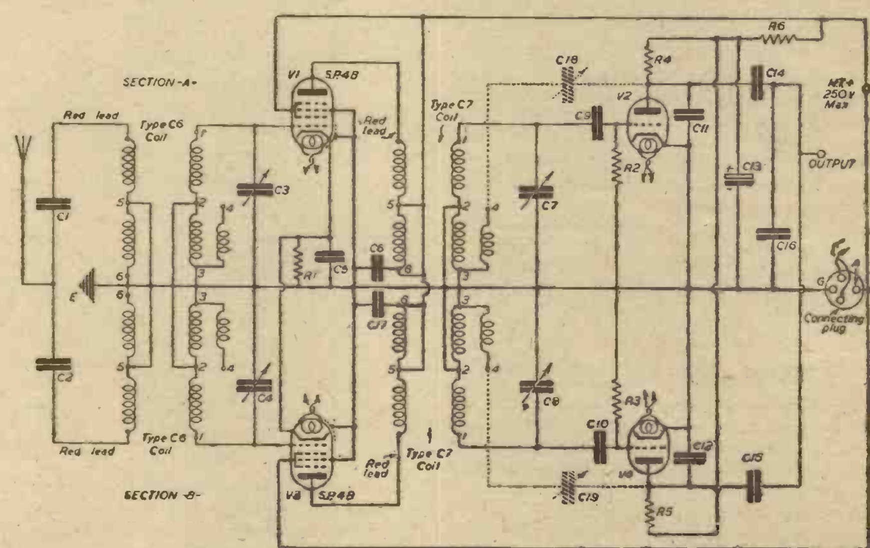


Fig. 1.—Theoretical circuit diagram of the diversity receiver described on this page.

H.T. is applied to both detector anodes by a decoupling filter consisting of resistance R6 of 10,000 ohms and an 8-mfd. surge-proof electrolytic condenser (C13). This type of condenser does not limit the voltage, but is capable of withstanding the excessive voltages usually present when a receiver is first switched on, and consequently is less liable to breakdown.

In each detector anode is a 50,000 ohms (R4 or R5) load resistance across which the L.F. signals are developed and fed via 0.002 mfd. coupling condensers (C14 or C15) to the common amplifier in the normal resistance-capacity coupling circuit.

A 0.0001 mfd. condenser from anode to "earth" and from the "grid" side of each coupling condenser to "earth" (C11, 12, 6 and 17), completes the H.F. filtering. The receiver is of such a simple nature that H.F. chokes were not found necessary in the detector anode circuits and were accordingly omitted.

(To be continued)

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 0.0006mfd. 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

A Gas-mask Box Receiver

Constructional Details of a Handy Two-valve Midget Portable

THIS midget receiver is built into one of the ordinary cardboard gas-mask boxes, which also contains both the L.T. and H.T. sources of supply.

First of all, the box has to be marked out. The three grid-bias batteries forming the H.T. supply are placed at the left-hand end, and a piece of 5-ply wood measuring 5⅛in. by about 3in. is fixed in position to hold these batteries secure. This can be accomplished either by glueing the sides of the wood or by screwing it from the outside of the box. The top edge of this piece of plywood should coincide with the top edges of the box—thus leaving a space of about 1½in. between it and the box bottom. This allows for the various battery leads to pass easily underneath. It is interesting to note that the total anode current is only .5 mA.

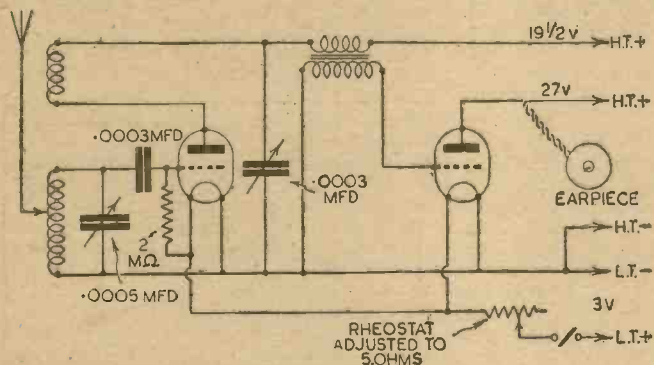


Fig. 1.—Theoretical circuit diagram of the simple midget portable described in the text.

For the L.T. supply a type 800 cycle battery is used. This is placed on top of the three grid bias batteries, but care should be taken to see that they do not make contact electrically. The left-hand box "flap" can be screwed down to the piece of plywood in order to hold this battery in place. About ½in. should be trimmed off this "flap" to make its end flush with the plywood.

There should now be a space left at the right-hand end of the box measuring about 5in. by 3½in. and this is where the receiver fits in.

The baseboard is cut from 5-ply and measures 3½in. by 3in. The panel (3-ply) is 5in. by 3½in., is screwed on to this, and then the whole should just slide into the space mentioned previously. Enough room is left between the panel and the box-lid to allow for the controls.

Constructional Details

And now for the actual construction of the receiver, the general arrangement of which is shown in Figs. 2 and 3. Other than the Bulgin midget L.F. transformer, and the coil, there are no components specified. The receiver should be built from the best and most suitable parts on hand, and then wired up from the theoretical circuit in Fig. 1.

The coil is home-made from the details given for the "A.R.P. One" in the September 30th, 1939, issue of PRACTICAL WIRELESS. In this case the former is 2in. diameter to allow for the bulb of the HL2 valve to be mounted inside it. There are various ways in which to mount the completed coil. In the original design, one of the ends was fixed to the baseboard by means of an adhesive.

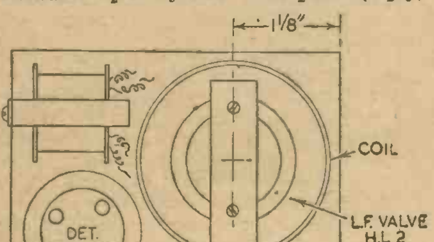
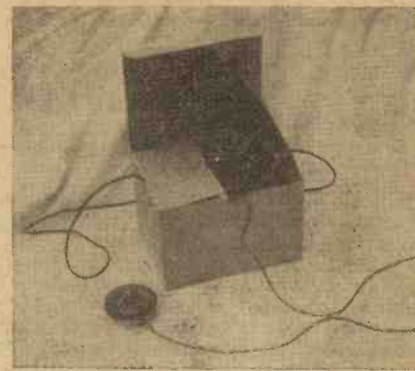


Fig. 2.—Plan view, showing lay-out of coil, valve-holders, and transformer.



View of the complete receiver housed in a gas-mask box.

Just a word about the valves. In the set described a Mullard PM2DX is used in the detector position, but various types can be tried, and the one found to work best could be used. For the L.F. stage an Osram HL2 is strongly advised, as this is definitely just right for the job.

Earpiece and Aerial

The earpiece is taken from an old pair of 'phones, and is connected to about 3ft. of flex. For the aerial a length of rubber-covered wire is passed through the four small holes found to be punched in the box, and takes the place of the string normally used with these boxes. Both ends of this wire should be knotted to prevent them from coming out of position. One end is also connected to the tapping on the grid coil. The receiver should work the earpiece quite well with this wire slung over the shoulder in the usual way, and one can walk about listening to signals. Slight directional effects will be noticed; for example, facing north or south will bring a signal in at better strength than any other direction.

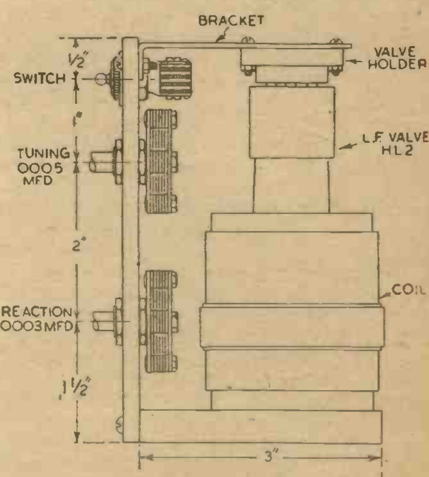


Fig. 3.—Side view, showing valve-holder bracket which supports the L.F. valve within the coil.

If the tuning and reaction knobs are not too large the earpiece should rest comfortably on the panel when not in use, and, with its attached length of wire coiled up, the box can be easily closed. It then has the appearance of quite an ordinary gas-mask box.

Comment, Chat and Criticism

Tschaikowsky's Music

A Further Discussion on the Work of the Great Russian Composer, by Our Music Critic, Maurice Reeve

IN a short discussion of Tschaikowsky's music, one is filled with rather conflicting emotions. That some of it is great music cannot be denied; that other numbers are not on the same plane is equally evident to all but biased minds. Its great popularity in England and America is apt to be rather misleading. It is a popularity as great, in some ways, as that of Beethoven, yet two people could hardly occupy more different places in one's heart and affections.

His magnificent command of orchestral colouring, his typical Slav pessimism (so attractive to us in all Russian music) coupled with his ability to metamorphose himself almost without warning into a zest for the sensualities of life, the poignant romanticism of his melodies, the slightly Oriental flavour of some of his scores; all these, together with other qualities, enable us to let his music grip us, and sweep us out of our humdrum lives into the unattainable world of passionate romance, vodka, scimitars and Eastern bazaars. Could it ever fail to attract? Tschaikowsky runs the whole gamut, but whereas a master like Beethoven almost always holds his forces under such perfect control, Tschaikowsky must be considered, almost always, a man of moods. He lets his feelings run away from him.

Sixth Symphony

Consequently his major works, even the glorious sixth symphony lack the unity, the directing purpose and the steady continuity that are our wonder and admiration in Beethoven and Brahms. It would be as impossible for a movement of the character of the scherzo from the sixth symphony, or even the waltz from the fifth, to creep into one of theirs as it would be for a camel to go through the eye of a needle. Brilliant as the one is and tender and wistful the other, they simply don't belong where they have been placed. They are the offspring of a creature of moods, and not of a man of consistent planning and designing.

With the exception of the Romeo and Juliet masterpiece, Tschaikowsky reached his maturity rather later than most of the leading musicians. This was, no doubt, partially due to a lack of concentration in his early manhood, which was clearly revealed during his studies at the school of jurisprudence. Consequently, the period of full mature creation is short when compared to some standards. But the tragically sudden death when only fifty-three must not tempt us to exaggerate this phase of his development. Had he been spared another twenty years, and even at that age he would not have been a patriarch, the imagination wobbles at the thought of what he might have given to the world. For there was obviously plenty more that he wished to say, his inventiveness, his philosophy, and his idiom were nothing like exhausted. One feels that his seventh and eighth symphonies would have shown as marked an advance on the fifth and sixth as they, in their turn, did on their immediate predecessors.

Operas

With one exception, Tschaikowsky's operas are hardly known to the average Englishman—that exception is "Eugene Onegin," based on a story by Pushkin. "The Queen of Spades," too, might be known to those who travel far and seek long, but few outside the ranks of the dilettante know much about it. The other operas Tschaikowsky wrote were "The Oprichnik," "Vakula the Smith" (later re-written as "Oxana's Caprices"), "Joan of Arc," "Mazeppa," "The Sorceress," and "Iolanthe." There are also some fragments from operas which he either destroyed by reason of an artistic conscience, or which were left uncompleted. Best known are the numbers from "The Voyevoda." All the operas are, not unnaturally, very popular and frequently performed in Russia.

The Oprichnik were the soldiers who formed Ivan the Terrible's bodyguard, and the libretto, Tschaikowsky's own, concerns some of their adventures and tragedies. On its first production it was very successful, and all his Moscow colleagues attended the first performance. But Cui and others pointed out its faults, particularly in the libretto, and Tschaikowsky was left somewhat dispirited.

Vakula is based on Gogol's love story of Vakula and Oxana, and was written for a competition. Tschaikowsky made a curious mistake in feverishly working to get it completed a year too soon, also he talked about it to everyone, and thus broke the rule of anonymity. But matters were smoothed out, and he easily won the contest.

"Eugene Onegin" was the next one and, with this, Tschaikowsky leapt to fame as an operatic composer of international reputation. Tschaikowsky was almost entirely responsible for the libretto, which consists mainly of word for word extracts from Pushkin's own text. It was first produced in 1879. Although possessing faults, it exercises an irresistible appeal, and at least three of its numbers are beloved in the concert room: Lensky's Aria, Tatiana's Letter Song, and the beautiful Valse in the fourth scene.

I can only deal briefly with the other three operas that earned Tschaikowsky fame, and an increase of reputation. "Joan of Arc" was produced in 1881, and Tschaikowsky wrote the libretto based on a Russian translation of Schiller's tragedy, "The Maid of Orleans." He records in letters how he was greatly harassed with the rhyming; there was apparently no rhyming dictionary in Russia then. It was a great popular success though Cui, as usual, led the criticism from St. Petersburg.

"Mazeppa" came next and Tschaikowsky founded his libretto on Pushkin's poem, "The Battle of Poltava." Tschaikowsky, however, not being a nationalist composer, failed to secure unity of purpose with the wonderful spirit of the great poet's treatment of the famous Cossack chief, and his depredations and wild carousing. Much beautiful music lacks the patriotic fervour that Moussorgsky might have given the subject, whilst the almost unrelieved gloom and tragedy of it become almost overwhelming. The entr'acte "The Battle of Poltava" is very popular in concert programmes. For the only time in the opera Tschaikowsky uses a folk tune here—the same one Beethoven used in his Rassamowsky quartet.

"The Queen of Spades"

After reviving "Vakula the Smith," and producing a dead failure, "The Sorceress," Tschaikowsky returned to his beloved Pushkin for inspiration, and commenced work on the famous short story "The Queen of Spades." His brother Modeste wrote the libretto. The story is briefly this. Hermann, a poor officer, is tortured by an insatiable longing for riches. He is told that an old Countess, whose niece he loves, possesses the secret of the three lucky cards. Should she divulge it, however, she is doomed to die. Hermann breaks into the house, and so terrifies the old lady that she dies of fright without having revealed the secret, but afterwards her spirit appears to him and informs him which cards are the three talismen. With this knowledge he wins a fortune at the tables with the first two cards, but at the third game, the ace of hearts suddenly changes before his very eyes into the queen of spades, and the spirit reappears and mocks him.

There was one other opera, based on a Danish story, "King Rene's Daughter," which he styled "Iolanthe."

Although it was his lifelong ambition to excel in operatic creations, Tschaikowsky never approached the heights in this that he reached in some of his other work. Only two of them are ever likely to gain immortality. "Eugene Onegin" and "The Queen of Spades."

Tschaikowsky wrote six symphonies. Whereas the first three are hardly known, and not undeservedly, the last three are masterpieces known throughout the musical, and unmusical, world.

"Winter Dreams"

I cannot describe the first three in detail. Sufficient to record that the first, known as "Winter Dreams," was written in 1866, and was the first work of any magnitude that he attempted. The second, written in 1874, has earned for itself the *nom de plume* of the "Little Russian." Tschaikowsky makes of it one of his rare occasions for delving into folk song. It is a great advance on the first, but the composer was assailed with doubts about its loose construction, and his need to enlarge his knowledge of form and planning. The third, 1875, was dubbed the Polish for some unknown reason, because in it, Tschaikowsky seems to leave Russia far behind, and to come almost wholly under Western influence.

ON YOUR WAVELENGTH

By Thermion

Application of Variable-mu Valves to A.V.C.

WHEN the gain of a screen-grid valve is controlled by the application of negative bias to its control grid as, for example, in conventional A.V.C. arrangements, distortion is liable to be introduced into the signals being amplified when large values of negative grid bias are used to reduce volume on loud signals. The use of a valve having a variable-mu control grid materially assists in reducing this distortion. A further reduction can be obtained by feeding the screen grid through a dropping-resistance of relatively large value, so that, as the control grid of the valve is biased negatively and the anode current falls, the screen current, which is a constant fraction of the anode current, also falls and thus the screen voltage rises and increases the power-handling capabilities of the valve.

This latter effect can be considerably aided by providing the amplifying valve with a variable-mu screen grid, the "mu" of the screen grid and control-grid being variable in the same sense. With such valves the rate of decrease of the screen current with increase of negative grid bias on the control grid is more rapid, since current ceases to flow through the close-meshed end of the control grid opposite the close-meshed end of the screen-grid, and the average shadow ratio of the screen grid in the region in which current continues to flow falls. Thus the screen voltage rises more rapidly and distortion does not increase appreciably as the gain is decreased to maintain a constant output.

In operation, the screen voltage of such valves varies considerably as the gain-control operates, for example, from 30 to 200 volts, and this voltage change may be usefully applied for such purposes as tuning-indication, gain-control in other stages, selectivity control, etc.

The Gadget Racket

OUR old friend K. T. H., of Birkenhead, has sent me a fresh batch of advertisements for radio rackets in the form of wireless gadgets which do not live up to their claim. K. T. H., like your humble scribe, feels that the genuine inventor does not get a square deal, whilst the inventor of a racket can give a deal which is not square, but decidedly twisted. The profits are, of course, in round figures, for they have discovered, like Euclid, that the shortest distance between two points—the mug and his money—is to be careless with the truth. Some members of the public will believe anything. The proprietors of some of these rackets are foreigners, and they ride round in their Rolls-Royces, mit fur goats und diamonts on der vingers. Also mit their vell-known guarantee off der monesh back veneffer ya vant id, they are assured of a quick return. As the mock auctioneer puts it, ve lose on effery sale, but ids der kervantity vot ve sells vot makes der broffits. My advice to readers is to have nothing to do with these advertised radio rackets.

The Purchase Tax

THE Purchase Tax announced by Sir John Simon in his Budget speech cannot be immediately applied. As readers know, the tax is to be added by wholesalers to invoices sent to retailers, and undoubtedly the manufacturer who supplies direct to the retailer will be considered a wholesaler for the purpose of the tax. It is certain, therefore, that the price of radio-receivers will go up—an added reason why thousands will return to home-construction.

B.L.D.L.C. Convention

I SEE that a reader suggests that we should hold a convention of B.L.D.L.C. members. I invite members, therefore, to let me have their opinion of this suggestion, which would not be practicable unless some hundreds of our thousands of members turn up. Nor is it possible to go into the question of the cost of such a convention per member, unless the numbers are known in advance.

Sponsored Programmes

I AM told that the B.B.C. will reconsider the desirability of running sponsored programmes. There are reasons advanced why they should do so. In the first place, the Continental stations which took sponsored programmes from this country, and incidentally tens of thousands of English quids, have closed down on us. In the second place, with extreme paper shortage advertisers are finding it difficult to take space in daily papers. Most of the latter are booked up for months ahead, and it is impossible to have advertisements inserted in particular issues. All of the newspapers and most of the periodicals are reduced in size, thus further limiting the amount of advertising space available. This means that there must be thousands of pounds set aside for advertising which cannot be spent. This will have repercussions on home trade if allowed to continue. If advertisements do not appear, advertisers will sell fewer goods; that means loss of trade, loss of revenue to the State, and unemployment. The B.B.C., I imagine, are suffering a loss of revenue due to fewer licences. It is suggested that the B.B.C. should provide advertisers with an outlet for their cash. It must not be forgotten that the B.B.C. did at one time run sponsored programmes, but Sir John Reith once told me that the results were not such that the advertisers were anxious to renew the experiment. Times, however, have changed, and it may be that the present time is propitious to reconsider the matter. But are sponsored programmes wanted?

The Paper Shortage

EVERY reader is well aware of the paper shortage occasioned by the invasion of Norway, and the great increase in the price of such paper as is available. The price of paper is controlled, and the shortage is likely to increase. This means that prices will soar even beyond their present astronomical limits. For this reason it may be that wise readers are now purchasing technical books at the old price before stocks are exhausted, knowing that if paper is available for reprints, prices must go up. I therefore advise all readers to lay-in a stock of technical books before this eventuality. And once again I remind them that we issue a catalogue of our technical books. This war is essentially a war of technicians, and technicians require technical books. Buy them while the going is good.

After the War

A READER referring to the present shortage of service engineers asks the pertinent question: "What will happen after the war when the 20,000 radio engineers absorbed by the R.A.F. are sent back into civilian life?" If they are thrown back there will be no shortage, but I doubt whether this country will disarm to the same extent as hitherto. We have learned our lesson. We know that whilst we are dealing with nations whose word cannot be trusted it would be unwise to place ourselves in the same position as before. I do not, therefore, envisage a general disarmament when this fracas is ended. Also, there is bound to be a boom in the sale of wireless sets as in everything else. More and more service engineers will be required.

Can You Count or Cook?

IF you hold an engineering degree, or can prepare a balance sheet, or fly or mend a balloon—or only cook a dinner—the Royal Air Force may have a job for you.

Most urgent recruiting needs of the Air Force are for balloon operators for the balloon barrage; cooks and special duty clerks for the W.A.A.F.; qualified accountants to serve as Accountant Officers, and engineering specialists for the technical branches.

Holders of engineering degrees or engineering certificates, and practical engineers, are wanted as Engineer and Armament Officers. Their job is connected with the maintenance of the aircraft and engines, the guns and bombs of the R.A.F. An expert knowledge of telecommunication or radio engineering, or a science degree, are the qualifications for a commission as a Signals Officer. The age limits are 21 to 50 years for all these technical branches, and applications should be made at once to the Air Ministry (S.7.c), Kingsway, London.

New additions to the national balloon barrage call for yet more men, especially balloon operators.

Long-range Reception

Various Methods of Obtaining Reliable DX Results

By W. J. DELANEY

THE recent filip which has been given to real DX work by the broadcasting of news bulletins has led to many interesting queries by those who have previously not entered this branch of radio. Many listeners are, of course, quite satisfied if they can hear a few foreign stations, and as real DX work can only be carried out when suitable apparatus is used and properly handled, many are finding it difficult to get the results they desire. It should be remembered at this stage that there are two ways of receiving real DX stations. They may be heard weakly and in intermittent form, making it very difficult to follow a conversation, or they may be heard consistently and strongly, giving almost as good results as those obtained from some of the continental stations. Unfortunately for this purpose special apparatus will have to be used, and even then conditions may prevent the desired results being obtained, but we will show presently how some measure of reliability may be obtained.

Apparatus Needed

First of all, it is important to emphasise that although America may be received on a one-valve set, this is not the best type of apparatus to use. One H.F. stage will give some degree of range, but two H.F. stages, properly designed, or a superhet, are needed for making certain that the apparatus itself is good enough to give reliable results. At the same time such apparatus will remove the need for delicate handling, and even an inexperienced operator will have some certainty of getting long-distance signals. Next is the question of the wavelength. Although the short waves are more reliable for long-distance work, medium-wave signals can be received from America after midnight. Although it may also be possible to hear these stations before that hour, the high-powered nearer stations on this band will tend to blot out the weaker long-distance stations and, therefore, it is preferable to select a time when most of the nearer stations are off the air.

We have already dealt with the question of set operation in previous articles, and the importance of the reaction adjustment in giving sensitivity control must not be overlooked. Very often it will make all the difference between hearing the station and not hearing it, but in this article we are more concerned with the reliable reception of these long-distance stations and, therefore, will not consider reaction used as above. If there is any fading present a station which can only be heard when reaction has to be "juggled" will obviously not give reliable results over a period of time such as may be needed to follow a talk or similar item.

Aerial Design

After the choice of receiver comes the selection of the aerial. As certain American and other stations use "beamed" or directional aerials it is possible to obtain improved results here by also using a directional aerial, so arranged that it picks up maximum energy from the desired station. This means, if a number of different countries are to be received, that the aerial must be movable, and as most of the short waves are radiated by horizontal aerials, some similar arrangement should be used at the receiving end. If possible also the aerial should have some direct relation to the waveband in use, and this means that for short-wave working some form of horizontal directional dipole aerial array should be used. A Great Circle World Map and a compass will assist in arranging the aerial so that any doubt may be removed as to its direction before attention is turned to the problem of finding the station. As fading is one of the major problems of real long-distance work some attempt should be made to overcome its effects. Many ingenious schemes have been suggested from time to time to overcome fading, but the majority of them are only suitable for commercial installations. For the ordinary listener, however, there are two schemes which are well worth trying. One is the use of two aerials connected to a standard receiver, and the other is the use of a special receiver connected to the two aerials. This is known as "diversity reception," and on other pages in this issue will be found constructional details of a medium-wave receiver built on these lines for reliable results from the Home Service station in those parts of the country where reception is at present difficult. With the first-mentioned scheme, two aerials are erected in such a way that they may be spaced at different distances apart. They are then both joined to the aerial terminal of the receiver, and a station tuned in. If fading is present, one aerial is moved relative to the other and a position may be found where the fading effect is balanced out. This is obviously cumbersome, but may be felt worth while in some cases. Another idea is to erect the two aerials permanently, at a distance apart slightly less than one wavelength or a half wavelength of the centre of the waveband on which the receiver is to be used. The theory is that the fading signal will be picked up on both aerials, but the travelling wave will strike the two aerials out of phase, and thus a fading period on one aerial should coincide with a strong period on the other, and thus a more or less constant signal will be heard on the receiver.

An improvement on this idea is to have a double receiver, consisting of duplicated H.F. stages, or duplicate detector stages if H.F. is not needed, and each set is joined to a separate aerial. The outputs from the detector stages are then mixed and fed to the amplifying stages, and the same effect should be noted due to the out of phase signal. The idea may be seen clearly in the receiver described on page 170, and although this is designed for the reception of a single station the idea may be utilised for a general type of receiver by substituting tuning condensers of standard type for the pre-sets, and using in a similar manner to standard equipment.

LATEST PATENT NEWS

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

NEW PATENTS

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

Specifications Published.

519974.—Meier, K. H.—Method of and means for reducing disturbances in wireless reception.
519975.—Stevens, A. H. (Bush Development Co.).—Methods and apparatus for transmitting or receiving sound (or acoustic) vibrations.
520074.—Wired Radio, Inc.—Wired radio service system.
520075.—Fortescue, R. L.—Thermionic valve apparatus. (Addition to 504196.)
520028.—Ward and Goldstone, Ltd., and Yearsley, E.—Electric socket-contacts.
519883.—Belling and Lee, Ltd., and Strafford, F. R. W.—Aerial systems for radio-receivers.
520082.—Kolster-Brandes, Ltd., and Beatty, W. A.—Television receivers.
519904.—Kolster-Brandes, Ltd., and Smyth, C. N.—Electron-discharge devices.
519905.—Kolster-Brandes, Ltd., and Beatty, W. A.—Radio receiving-sets.
520036.—Thornton, A. A. (Philco Radio and Television Corporation).—Multi-voltage radio-receivers.
520041.—Standard Telephones and Cables, Ltd., and Gibson, W. T.—Thermionic valves.
520042.—Kolster-Brandes, Ltd., and Smyth, C. N.—Tuning arrangements for radio-receivers.
520106.—Marconi's Wireless Telegraph Co., Ltd.—Television and like transmitting cathode-ray tubes.
519921.—Vereinigte Gluhlampen Und Elektrizitats Akt.-Ges. — Visual tuning-indicator.

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

Old Circuits Revived

Interesting Details of Old Arrangements which are Worth Trying

SOME years ago the wireless amateur and experimenter used to think of his hobby in terms of "circuits" and whenever members of the "fraternity" met, such names as "Colpitts," "Hartley," "Meisner," "Armstrong," "Flewelling," and many others could frequently be heard. Many of those readers whose interest in wireless goes back over the past 15 years will recall most of these names, but to those who have only recently taken up the hobby the names will probably have no significance whatever. With the idea of refreshing the memories of "old hands" and of giving the younger generation a little food for thought, it is proposed to give brief particulars of some of the circuits that have been popular at various times during the past ten years or so. It would be quite impossible to mention all the circuits, so reference will only be made to those which were in the nature of "supers" or "stunts"; most of the others were merely embryos from which the circuits in use at the present time have been developed.

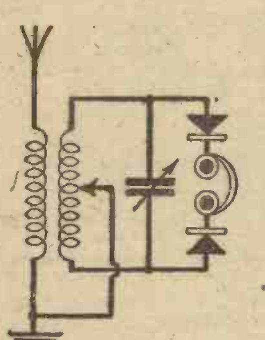


Fig. 2.—A crystal receiver using full-wave rectification.

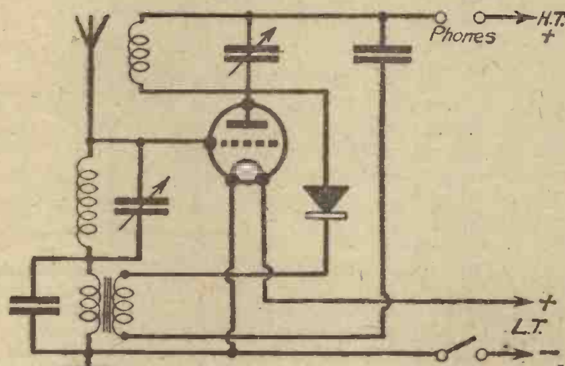


Fig. 4.—An early form of valve-crystal reflex circuit.

"Special" Crystal Circuits

Before passing on to the more elaborate arrangements it will be interesting to look at one or two modifications of the simple crystal set. In the earlier days, when components were particularly expensive, the crystal was as much as most of the more or less impecunious experimenters could afford, and for that reason it came in for a considerable amount of experimentation with a view to bringing its efficiency up to the highest possible level. One apparently simple way of increasing the signal strength from a crystal set was by the use of a dual arrangement, like that shown by Fig. 1. Two complete receivers were used in conjunction with two aerials and a single earth, but instead of operating a pair of 'phones, each one had to drive only a single earpiece. Theoretically, this system should provide twice as much volume as the more conventional one; in practice, however, there were a number of "snags" such as getting the two halves of the set into exact balance, matching the crystals, and finding a position for the aerials so that they did not tend to shield each other. In consequence of these difficulties, the final result was not always better or even as good as that obtained with a standard type of set. For the keen experimenter this circuit can still provide ample scope and is very interesting.

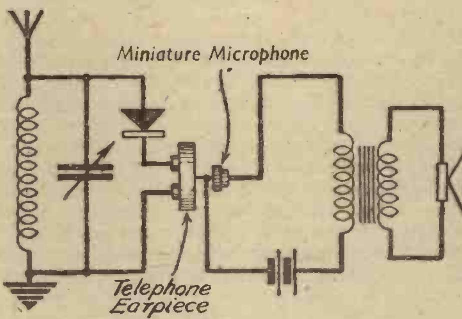


Fig. 3.—The arrangement of a microphone amplifier for operating a loudspeaker from a crystal set.

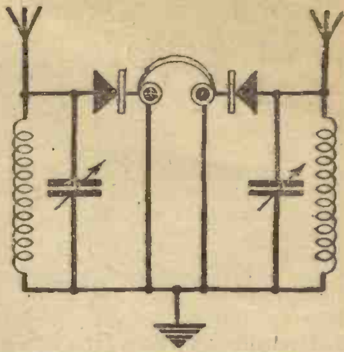


Fig. 1.—A simple circuit for obtaining increased volume from a crystal set.

Full-wave Detection

Another attempt to double the power of a crystal set was by the use of full-wave rectification, the circuit employed being somewhat like that represented by Fig. 2. Here again two crystals were made use of, but they were actually in series, with the 'phones connected between them. It can be seen that the principle of this arrangement is identical with that of a full-wave rectifier of the types at present used in A.C. eliminators. Although we can claim to have obtained quite satisfactory results with this circuit, there is no doubt that it is decidedly tricky and demands the use of almost identical crystal detectors, and of an accurately centre-tapped secondary tuning coil. Incidentally, the latter is most easily obtained by the use of the old-fashioned slider or by taking a number of tappings and finding the one most suitable.

Loudspeaker Crystal Sets

In the earlier days of broadcasting, numerous attempts were made to operate a loudspeaker from a crystal set without the use of costly valve amplifiers. The simplest of these, and one which met with some measure of success, was to attach a small microphone to an ordinary telephone earpiece and to connect this to a speaker through a high-ratio transformer; the general idea of the circuit connections can be gathered from Fig. 3. The idea appears to be perfectly simple and straightforward, but it was found very difficult to produce the extremely small and lightweight (as they must be) miniature microphones for the purpose. Consequently, in most cases a considerable amount of experimental work

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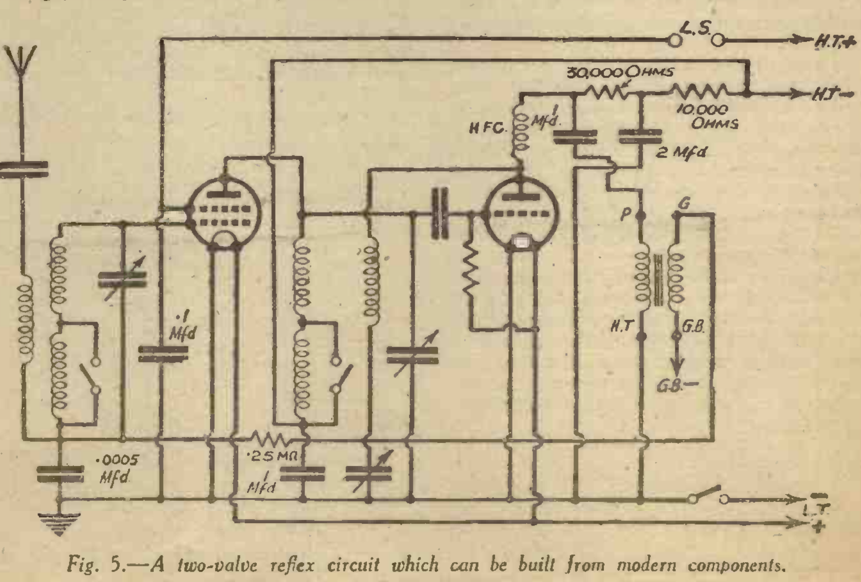

Fig. 5.—A two-valve reflex circuit which can be built from modern components.

OLD CIRCUITS REVIVED

(Continued from previous page)

was necessary before anything like satisfactory results could be obtained.

Reflex Circuits

Immediately following the crystal "era," and by which time components were cheaper and more easily obtainable, numerous circuits were evolved in which a crystal detector was used in conjunction with valve amplifiers. In some cases the valves acted purely as low-frequency or high-frequency amplifiers, but in others a single valve was made to amplify at both low and high frequencies. Circuits using the latter arrangements came to be known as "reflex" since the signal first passed through the valve and was amplified at high frequency; next it was rectified by the crystal and then passed back to the valve, which then magnified the low-frequency impulses. A simple and one-time popular reflex circuit is represented by Fig. 4, from which it can be seen that the valve is coupled to the crystal on the tuned-anode system, and the output from the crystal is fed back to the valve through a low-frequency transformer, across the secondary of which is connected a fixed condenser to act as a by-pass to the H.F. Still further to improve the efficiency of the arrangement, reaction was often obtained by coupling together the tuned anode and aerial coils. It was claimed that such a circuit was capable of results equal to those given by an ordinary three-valve receiver, and although this was a rather exaggerated statement the circuit was undoubtedly capable of wonderful things once a suitable crystal and L.F. transformer had been found. In reality, the "quality" was probably extremely poor, but this generally passed unnoticed, since it was as good as contemporary speaker and other components were capable of producing. The reflex circuit was always very popular, probably because the very idea of economising by making one valve do the work of two had a strong appeal to human nature. It is interesting to observe that the reflex is still "living" and that many amateurs would like to revive it. For the benefit of any readers who are interested in trying a reflex circuit with modern components, the circuit represented by Fig. 5 might be useful. In this case the crystal is dispensed with and an ordinary three-electrode valve employed as detector, a screen-grid valve serving the purpose of combined H.F. and L.F. amplifier. Ordinary dual-range tuners are employed and the values of the more important components are indicated.

Super-regeneration

At about the same time as the reflex circuit was meriting a good deal of attention other experimenters were trying to get a maximum amount of amplification from a single valve by a different means.

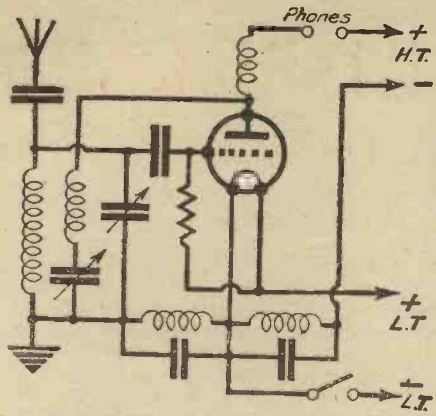

Fig. 6.—Circuit of the Armstrong Super-regenerative single-valver.

It was, of course, known that a detector valve could be made to amplify by feeding back into the grid circuit the H.F. currents appearing in the anode circuit—in other words, by applying reaction. This was satisfactory up to a point, but as the valve fell into self-oscillation (so producing the well-known heterodyne whistle) when more than a very limited amount of reaction was used, it was felt that the valve was not being made to operate at its full efficiency. The consequence was that two new circuits, known as the Armstrong Super-regenerative and the Flewelling, were invented by the American investigators whose names they still bear. With both of these circuits, which are shown in Figs. 6 and 7 respectively, the principle was practically the same, namely, that although the valve was allowed to remain in a state of oscillation the customary whistle was not heard, due to the fact that oscillation was periodically "quenched" or "damped." The quenching was provided by so arranging the circuit that the valve could oscillate at two frequencies at the same time; one of these corresponded to the signal being received and the other was of about 10,000 cycles, or just above audibility. As a result, the former oscillation was quenched by the latter at the rate of 10,000 times per second. At first, much difficulty was experienced in disposing of a constant "hiss" which marred reception, but by making various fine adjustments it could, at least, be reduced to so low a level that it was not very troublesome. Of the two circuits, the Flewelling was least used and never became very popular. The Armstrong, however, has remained in more or less constant use right up to the present time, and is, in fact, coming very much to the fore at the moment for the reception of ultra-short-waves.

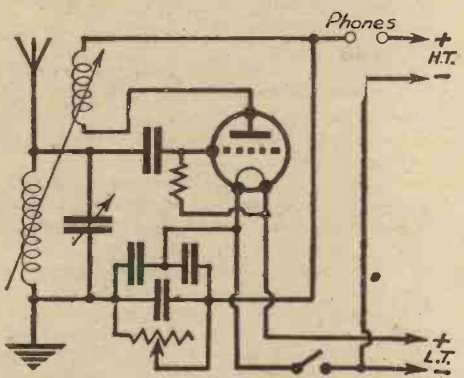

Fig. 7 (left).—The Flewelling circuit.

High-tension-less Circuits

In evolving new circuits the fundamental idea was almost invariably one of economy, of making one valve do the work of two, or of minimising the consumption of high-tension and low-tension current. We have already mentioned, some circuits whose main aim was to get equal efficiency with fewer valves, so now reference should be made to a scheme that was originated during 1924 for disposing of the high-tension supply. The circuit of a high-tension-less Det.-L.F. two-valve set is given in Fig. 8.

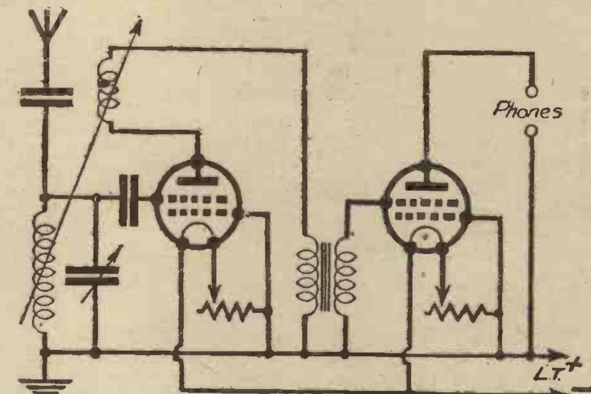

Fig. 8 (right).—Circuit of a two-valve set—L.F. high-tension-less receiver.

From this it can be seen that the valves are of the four-electrode type, having two grids; diagrammatically they are like the later screen-grid valves, but otherwise they have no resemblance. The inner grid is connected to L.T. positive, the outer one forming the usual "control" grid. With the special two-grid valve, the inner grid is very near to the filament, so that its small positive charge (derived from the accumulator) is sufficient to attract the electrons shot off from the filament and to give them so much impetus that they are able to pass through both grids and reach the plate.

A single-valve arrangement that met with a fair amount of success in the early days of broadcasting was that known as the Ultra-Audion circuit. A diagram of this is given in Fig. 9, from which it can be seen that a single coil was used both for aerial tuning and reaction. Instead of controlling reaction by the usual swinging coil or variable condenser method, it was done by adjusting the variable grid leak and filament rheostat. The circuit was extremely critical, and depended very much upon the correct choice of valve and associated battery voltages, but despite these disadvantages, however, the Ultra-Audion has often been known to produce excellent results when handled by the patient experimenter.

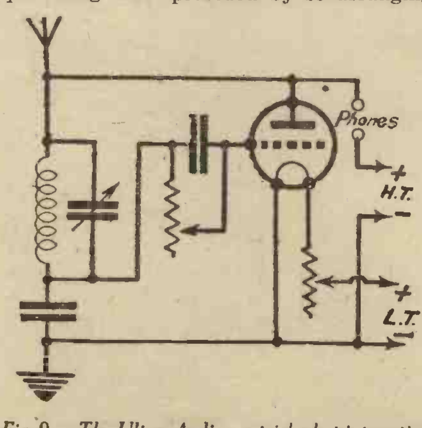

Fig. 9.—The Ultra-Audion, a tricky but interesting single-valve "super" circuit.

L.F. AMPLIFIER TROUBLES

A General Discussion on the Difficulties Experienced by Designer-constructors when Undertaking L.F. Apparatus — By L. O. SPARKS

THE general expression L.F. amplifiers covers a very wide range of circuits and apparatus, each serving the fundamental purpose of amplifying low-frequency signals but having individual characteristics according to the particular work for which they are designed.

It is not possible, in these articles, to deal with all the various types of amplifiers, so we must be concerned in this instance with the faults and peculiarities of such equipment, as the majority of them are common to most forms of L.F. apparatus. For the benefit of those undertaking constructional work of this kind for the first time, it should be noted that while certain forms of trouble will make their presence very obvious by rather painful sounds, there are other snags which necessitate the systematic use of meters to reveal them and to test for their complete elimination. In view of these inaudible defects, the constructor must not be lulled into a false sense of security or satisfaction if the initial tests appear to indicate that everything is 100 per cent. satisfactory. In the majority of cases it is really essential to employ meters or, at least, a milliammeter, to carry out the final check to determine if all operating conditions are in accordance with the valves in use. This applies to all amplifying equipment, but in particular to mains-operated circuits, which make use of much higher voltages than their battery-operated counterparts.

General Considerations

If the constructor undertakes the design of the amplifier, it is absolutely essential for him to take into consideration the following elementary rules or factors governing such circuits. A given output valve will only handle a certain amount of power without overloading and introducing distortion. This can be put another way by saying that a valve can only accept a certain maximum signal, the value of which will depend on the valve under consideration. This point cannot be stressed too much. It is a very common fault with amateurs to ignore the strength of the input to the first stage of the amplifier, and to provide too much amplification before the ultimate or output stage. This lack of consideration is not only wasteful as regards valves, components and current consumption, but it also produces most unsatisfactory results. The majority of these troubles can be eliminated by the constructor bearing in mind the actual amplification obtained from each valve and its associated L.F. coupling. Details showing how this can be done have been published in previous issues and, as the calculations involved are not complicated, it is hoped that the would-be designer-constructor will, in future, take the precaution of doing a little figure work before getting down to the actual constructional work.

Another item to bear in mind is the selection of the valve or valves; this will be governed, to a very great extent, by the output power required and the high tension, not overlooking current consumption in the case of battery-operated amplifiers, available. It is not good policy or design, for example, to select valves requiring high anode voltages and having large current consumption figures if dry batteries are to be used for the H.T. supply. Similarly in the opposite direction, it is equally bad practice to consider building a unit employing a rectifier having an output of, say, 350 volts at 120 mA's, if the amplifying valves only require 200 volts at 50 mA's. Such thoughtlessness would necessitate the use of condensers having a higher working voltage than the circuit requires and the incorporation of unnecessarily large voltage dropping resistances. Such items will all add to the constructional work and, incidentally, the cost of the amplifier without bringing any advantages.

Layout

Poor layout of components, the omission of suitable volume and tone controls, inadequate decoupling, badly executed wiring and the use of unsatisfactory components, are all items which must be given every consideration if a first-class job is required. If it is a question of funds, and this enters into most of our calculations, remember that *quality* before *quantity* applies most aptly to any work connected with the amplification of low frequencies.

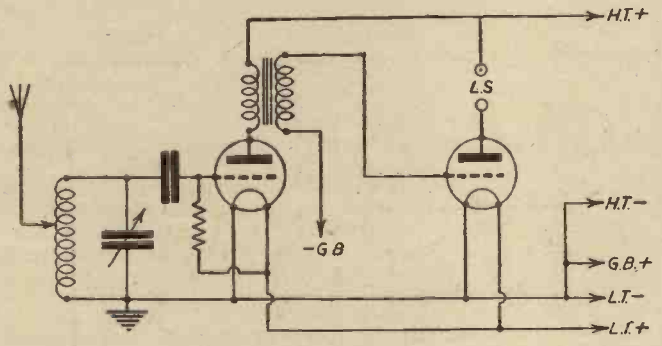

Fig. 1 (Below).—The anode circuit of a detector in its simplest form.

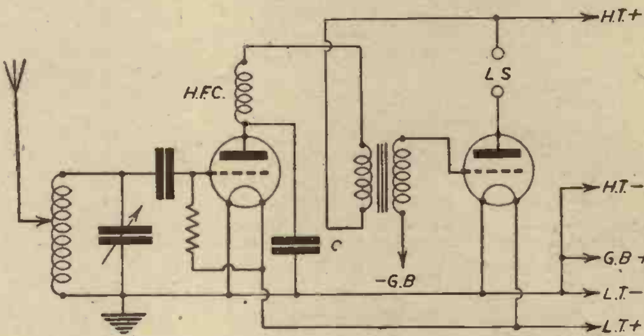

Fig. 2 (Above).—H.F. choke and by-pass condenser have been added to restrict the flow of H.F.

Instability

If the faults were tabulated in their proper order, instability would, undoubtedly, be very near the top of the list. Although the term is so closely associated with the detector and its preceding stages, it is surprising how many faults in L.F. circuits can be traced to the same form—but at a lower frequency—of trouble. It is, perhaps, due to the fact that most beginners think of instability only being connected with the detector and H.F. stages, that they do not associate some of the mysterious results they obtain from an amplifier to the same root cause.

The most common audible danger signals, denoting that L.F. instability exists in a circuit, are distortion and that peculiar

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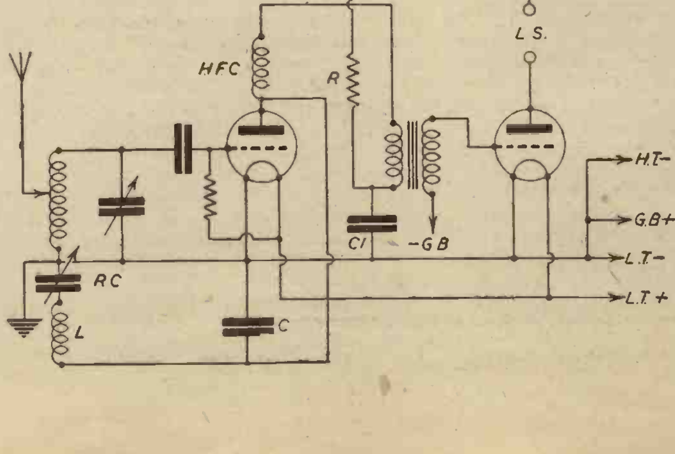


Fig. 3.—Circuit completed with normal anode decoupling components.

L. F. AMPLIFIER TROUBLES

(*Continued from previous page*)

beat note which, because of its similarity in sound, is often described as "motor-boating." The actual cause of these undesirable results is, speaking in a general sense, low-frequency currents and, possibly, a mixture of high- and low-frequency currents, not keeping to their proper paths. If the individual valve circuits are well designed, the L.F. signal should pass from the anode of one valve to the grid of the next, via, of course, the L.F. intervalve coupling. If, however, certain essential requirements are absent, then the L.F. currents will start to roam along paths which are, to them, really out of bounds. The most common track they choose to follow is formed by the H.T. supply positive line and, once they are allowed to start along that, then it is almost certain that trouble will be experienced, as a form of interaction or reaction will be created by the common coupling between anodes and through the H.T. supply, the negative side of which is always common with the filament or heater and the grid circuits.

Decoupling

The most effective way of eliminating these troubles is to take sufficient precautions to keep the H.F. and L.F. currents in their respective circuits. Fortunately, it is not a difficult matter to do this, and the method usually adopted is known as decoupling, the essentials of which are described below.

As the troubles are equally common in receivers as in amplifiers, we will deal with the anode circuit of a detector stage first, as this is the *first spot*, in a receiver circuit, where one is concerned with L.F. currents.

The circuit is shown in Fig. 1, where it will be seen that an L.F. transformer is used to couple the output from the detector to the grid circuit of the first L.F. valve, or, as the case may be, the output valve. When the signal, after being rectified by the detector, reaches the anode, it still has with it a certain proportion of H.F. currents. If we take the matter to a fine point, we could say that they are the last thing we want at that particular point, although, of course, if we did eliminate them completely we should have to devise other forms of reaction circuits. As the H.F. currents do arrive at the anode, however, steps have to be taken to stop them from getting through into the H.T. line and the other L.F. stages, so we introduce an H.F. choke, Fig. 2, together with a by-pass condenser C to lead the trapped H.F. currents back to earth. We also allow the unwanted currents to do some useful work by diverting some of them back to the earth line via the reaction circuit formed by the coil L and the variable condenser R.C.

In spite of these precautions, it is still possible for trouble to be caused by the H.T. positive line which is common to all anodes, therefore it becomes necessary to introduce *further traps*, and it is these which come under the heading of decoupling. In this particular case, such arrangements would be termed *anode* decoupling, to differentiate them from others which will be explained later. Fig. 3 shows the necessary additions to the circuit; the resistance R and the condenser C1 forming the complete decoupling, the resistance offering a further obstacle to H.F. currents from the anode, while the condenser provides a very easy path to earth for H.F. or L.F. currents which reach that spot.

The value of the resistance depends on the H.T. available, the H.T. required by the valve for its satisfactory operation and, bearing in mind the voltage which is *dropped across* a *resistance* when a *current flows* through it, the anode current consumption of the valve. In a mains receiver, where current consumption is not such a serious consideration, one can often use a resistance of 30,000 to 50,000 ohms but, with battery-operated circuits, a lower value often has to be selected in consideration of the items mentioned above. If conditions are such that one cannot afford to drop any voltage across R, then it is quite permissible to use a high inductance/low-current L.F. choke in place of R, as such a component usually has a very low resistance and would, therefore, not seriously affect the voltage on the anode.

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

THE response to the suggestion made recently that all members should show more active interest in the welfare of the club by communicating with headquarters has been wonderful. Letters have been pouring in from all parts of the British Isles, and what is still more encouraging and significant is the remarkable increase in membership during the last few weeks. It seems rather ironical that members should have responded to the suggestion just at a time when space in these pages is becoming a very important consideration. However, let the good work continue, as every endeavour will be made to give due acknowledgment to all writers, although we must ask you to appreciate that it may be necessary to deal with such matters in a very brief manner.

DX Contest

THE predominating note in practically every letter is the plea for a DX contest. It is very easy to say that such a contest would be greatly appreciated, but it must not be overlooked that it would also involve a considerable amount of work at headquarters, and while it is our desire to carry out members' wishes as far as possible, a certain consideration has also to be given to the more practical side. After analysing members' suggestions, the following scheme seems to be the most practicable, but before putting the idea into operation it is absolutely essential for the Editor to know the number of members who are sufficiently keen to give any contest their active and loyal support.

Here is the proposed scheme. To avoid the necessity of members obtaining verification cards, it is suggested that the Continents shall be split into zones, and during any given listening period it would be up to the members to log stations in the zone which would be selected and announced by headquarters. For example, during the first listening period, which could last for, say, a fortnight, we would announce that the zone to be covered would be Australia, and the members taking part in the contest would then have to log as many stations in that area as possible, making complete notes of the various transmissions received. Points would be awarded according to the number of stations logged, the completeness of the reports, and for the type of receiver used. The awards coming under the last heading would prevent the member who is using a small receiver being penalised by the man operating a multi-valve commercial outfit.

Team Spirit

THE second suggestion is that the team spirit should be developed, and by this we mean that certain awards would be given to, say, a number of members in any one town or, if this was not practicable, in a county. The idea behind this is to create a friendly rivalry between towns or counties which could be eventually classified as groups. Such procedure would eventually prove most advantageous to all members, as it would mean far closer co-operation between everyone, and encourage greater keenness in the hobby which is the life blood of the club.

The outline given is of necessity rather brief, but we hope that it is sufficient to enable you to make up your mind whether the scheme as a whole appeals to you and whether you are prepared to give it your active support. It should be mentioned that the contest would cover a period of three months or more, and that the winner or winners would, of course, be those who have scored the highest points during the total period.

The question of awards cannot be discussed at this stage, but as many members have already suggested, the true amateur is not concerned with entering such a contest with the ulterior motive of obtaining valuable prizes or, as it is more usually termed, pot-hunting. However, you can rest assured that the whole matter would receive the most sympathetic consideration from the Editor. Well, now, the next move is up to you. If you are willing to be a supporter just drop us a postcard (not letters) and simply say, "Yes."

Correspondence

IT must suffice this week if we say very many thanks to all members who have written to us. Where possible, their letters will be dealt with in more detail, but in the meantime please accept this acknowledgment as our appreciation of your letters.

Contacts

THE following members wish to make contacts:

Member 707, Field House, Windmill Hill, Nr. Hailsham, Sussex.

Member 6553, of 14, Clarence Avenue, Clarence Road, Handsworth, Birmingham, 21.

Member 6,559, "Ael-y-Bryn," Alltywerin Road, Pontardawe, Swansea.

Member 6,574, of 65, Rushton Road, Desborough, Kettering, Northants.

Member 6,569, of Pitcullen Garage, Bridgend, Perth.

Member 6,593, of 40, Kingsley Street, Leigh, Lancashire.

Member 6,613, of 5, Warren Road, Orford, Warrington, Lancs.

Member 6,623, of "Cartref," 56, Rectory Park Road, Sheldon, Birmingham, 26.

Member 6,311, of 8, Hadley Road, Ketley, Wellington, Shrops.

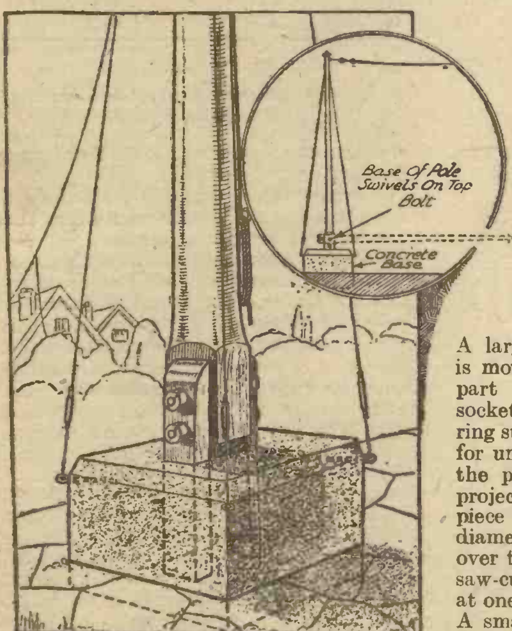
Member 6,634, of Folly Road, Armagh, N. Ireland (Mr. I. W. Ferris).

Practical Hints

Fixing an Aerial Mast

IN spite of the thousands of aerials one sees only a very small number are erected with a view to appearance as well as efficiency. A little trouble taken when the aerial is being installed will be amply repaid by increased service and will result in the aerial being less of an eyesore than would otherwise be the case.

A mast built on the lines of the accompanying drawing (which is self-explanatory) will be found very convenient in that it can be easily lowered for inspection and oiling by removing the bottom bolt and allowing it to swivel on the top one, the stays being loosened and used as guide ropes to assist in this operation. The concr te block, with the mast supports, is buried a few inches deep in the ground, its actual size depending upon the size and weight of the mast. For greater strength



Method of mounting an aerial in a concrete block.

the mast supports could project through the underside of the block and into the ground for some distance.—S. PARKER (Pinner).

THAT DODGE OF YOURS!

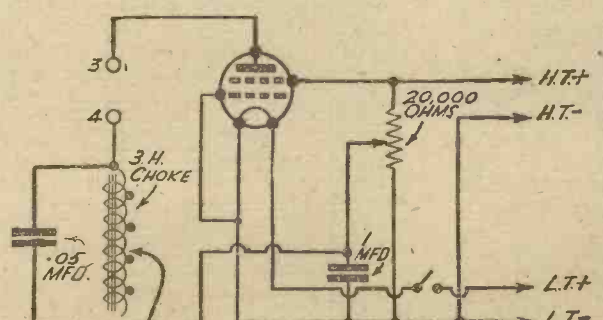
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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 188.

A Ganging Unit

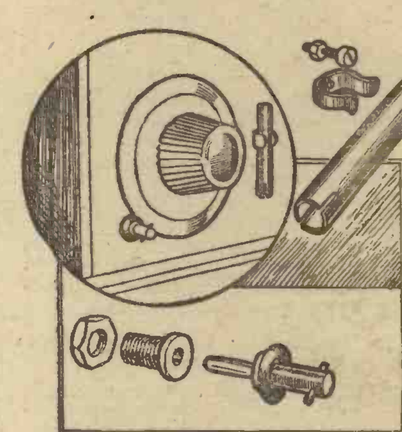
I RECENTLY wished to trim up a superhet and had no really good apparatus suitable for the purpose. After looking round the spares box I decided that I could build a modulated oscillator of the dynatron type, using the parts shown in the accompanying circuit. To the input terminals I coupled a standard medium-wave coil and condenser. The choke is a Varley type DP.18, and all the parts should be enclosed in an aluminium box or a wooden box lined with foil. The H.T. need not be greater than about 30 volts (actually I used two 15-volt G.B. batteries in series), and the valve is a standard non-variable mu S.G. The 20,000 ohm potentiometer is used to vary the intensity of the signal and the pitch of the note is adjusted by means of the choke tappings. A chart must, of course, be made up to give wavelength or frequency settings.—M. JOHNSON (Preston).



A modulated dynatron oscillator, which can be used with a tuner for wavelength checking, or for adjusting the trimmers in a set having ganged tuning condensers.

A Slow-motion Remote Control Device

IN short-wave receivers particularly, a good slow-motion control, with anti-hand-capacity control is essential. The arrangement illustrated may be made up to operate, on the standard 3in. ebonite dials. A large socket, such as the Clix No. 14, is mounted on the panel close against one part of the dial. A plug to fit the socket is then provided with a rubber ring such as may be obtained for one penny for umbrellas. Through the upper part of the plug a piece of stiff wire is passed, projecting about ¼in. on either side. A piece of ebonite tubing having an internal diameter to form a fairly comfortable fit over the plug end is next obtained, and a saw-cut made for a depth of about ⅜in. at one end to accommodate the cross wire. A small spring tool-clip from the popular stores is next screwed on the panel or inside the cabinet lid to accommodate the ebonite handle when not required. In use, the handle is removed and placed over the cross wire and rotated, during which it is pressed slightly so that the rubber ring presses on the edge of the dial.—D. HASKER (Hendon).



Details of a slow-motion remote control device.

Circuit Testing

WHEN testing continuity in circuits it often proves worth while to employ an ohmmeter, rather than a mere continuity tester, and this fact was forcibly brought home during the servicing of my set recently. I had made all the usual tests, but results on the set (an all-waver) were very poor, especially on the short waves. The set was given a careful examination and proved to be wired perfectly correctly and all joints were apparently sound. The valves were tested and found in order and coil connections were also found in order. All working currents and voltages were correct, yet results were definitely very poor. When a resistance meter was used to test between various earthed points I found, however, that between two such points on the chassis (which, incidentally, formed the link between coils and condensers) there was a resistance of over 5,000 ohms due to poor contact between the surface of the chassis and the leads which were bolted to them. I had originally used a pair of 'phones and battery to test continuity, and thus the high-resistance joint was not discernible.—D. WATERS (Warlingham).

That Elusive Decibel

A Simple Explanation of an Important Radio Unit

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

NOW that radio is playing such an important part in the life of the community under war conditions, it is only right that readers of this country's sole weekly wireless journal should take steps to become well versed in all the important fundamentals. Terms and expressions are often used quite glibly, but if a request is made for an explanation of what is inferred by these items, the individual is often at a loss to give this information with a clarity worthy of a PRACTICAL WIRELESS reader.

Continual habit has perhaps clarified the mind in connection with such terms as amperes, volts, watts, farads, etc., and it is realised that respectively they are the units of current, potential difference, power and capacity. Unfortunately, many of the units which we use today were settled long before radio became a practical proposition, with the result that to meet the needs of wireless, sub-multiples of these units are employed to avoid the use of decimals or fractions. The terms milliampere and microfarad are two that immediately come to mind because the currents and capacities dealt with in modern sets are minute compared with the heavy engineering practice existing when the units were evolved.

An Expression of Ratios

Now although these terms are, as a rule, fairly clear to the average individual, there is one which nearly always seems to cause difficulty because it is not so tangible or as easy to measure as the others. This is the word decibel, which the technician employs to express power ratios and gain or loss ratios between related quantities such as current or voltage. That is to say, the relation between the input and output of an amplifier would not be stated as two or three times but as so many decibels, and to get the whole idea of this unit ingrained into the mind it is necessary at first to conjure up some form of comparison so that the true state of things is really known.

Now gains and losses may run into high figures so those who evolved this unit simplified matters by resorting to simple mathematics. The first unit employed was the "bel," named after Graham Bell because of its employment in sound working with which the name of Bell is closely associated. Two powers, P_1 and P_2, are said to differ between themselves by n bels when

$$\frac{P_1}{P_2} = 10^n \text{ or } n = \log \frac{P_1}{P_2} \text{ bels.}$$

This is not by any means a complicated expression, as those with a knowledge of logarithms will readily appreciate. For the non-mathematically minded, however, it is simple to see how the equation works. If P_1 is 10 times P_2 then n is unity, while if P_1 is 100 times P_2 then n is 2 since $\frac{P_1}{P_2}$ =100 which is 10 squared. Similarly n is 3 when the ratio is 1,000, and for values between those given so n will vary between 1 and 3. Unfortunately, when this unit came to be applied practically it was found to be too large for much of the work, and in consequence the unit "decibel" was brought into use, this being simply one-tenth of a bel or N (decibels)=0.1 n where n is expressed in bels. The expression for the relation between the two powers P_1 and P_2 now becomes

$$\frac{P_1}{P_2} = 10^{0.1N} \text{ or } N = 10 \log \frac{P_1}{P_2}$$

and it will be seen that just the same as we realise automatically that the milliampere is one-thousandth of an ampere, so the decibel is one-tenth of the fundamental unit bel.

Practical Working

Under general practical conditions these two powers P_1 and P_2 will be compared by observing either the voltage developed across a given impedance or the current which flows through it. If the input and output impedances of, say, an amplifier are equal, then the power ratio will be proportional to the square of either the voltage or current. This is known from the simple Ohms Law expression which says Voltage (E)=Current (I) x Resistance (R), and since the power is voltage multiplied by current then

$$\frac{P_1}{P_2} = \frac{E_1 I_1}{E_2 I_2} = \frac{E_1}{E_2} \times \frac{E_1}{R} \times \frac{R}{E_2} = \frac{E_1^2}{E_2^2}$$

$$\text{or } \frac{P_1}{P_2} = \frac{E_1 I_1}{E_2 I_2} = \frac{I_1}{I_2} \times \frac{I_1 R}{I_2 R} = \frac{I_1^2}{I_2^2}$$

Our expression for decibels now becomes :

$$\left(\frac{V_1}{V_2}\right)^2 = \left(\frac{I_1}{I_2}\right)^2 = 10^{0.1 N}$$

$$\text{or } N = 10 \log \left(\frac{V_1}{V_2}\right)^2 = 10 \log \left(\frac{I_1}{I_2}\right)^2$$

$$\text{which becomes } N = 20 \log \frac{V_1}{V_2}$$

$$\text{or } N = 20 \log \frac{I_1}{I_2}$$

A Useful Table

As was mentioned earlier it is simply a case of endeavouring to get fixed into the mind the number to which the figure 10 must be raised in order to allow it to express the power or current ratios, and although those who use logarithm tables find it easy to carry this out, a table has been worked out for the benefit of readers and can be cut out for ready reference.

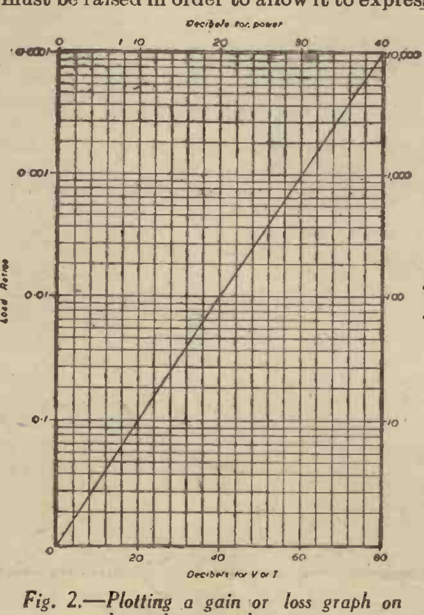


Fig. 2.—Plotting a gain or loss graph on logarithmic graph paper.

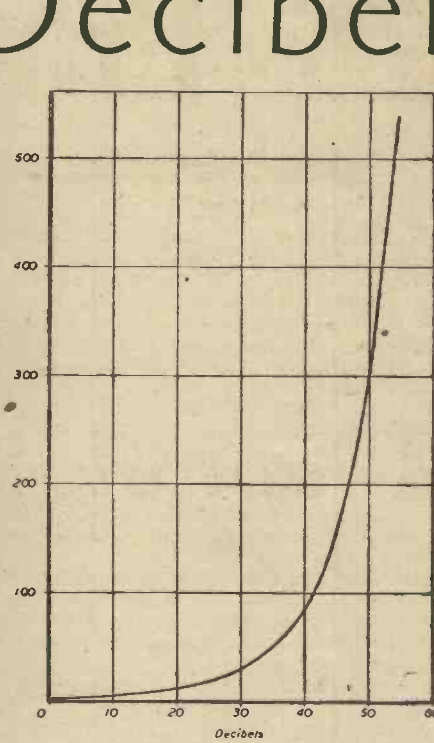


Fig. 1.—Graph showing the gain or loss ratios in relation to decibel equivalents.

It will be noticed that where the ratio of voltage or current is fairly low—actually up to the figure of approximately 30, the number of decibels used to express this fact exceeds the ratio. Beyond this point, however, it is seen that whereas the ratios become unwieldy the same fact expressed in our decibel notation is by no means large. The next time a technician says that he has cut down the input signal volts to his set by six decibels as a result of using a simple type of indoor aerial in lieu of an outdoor one, you will know that this is just another way of saying that he has approximately cut down his signal voltage by one half, since a 2 to 1 voltage ratio is seen from the table to work out at six decibels. Similarly, a 10 to 1 voltage ratio (or current ratio, of course) is said to be 20 decibels ; a 100 to 1 voltage ratio as 40 decibels and so on. It is very useful

(Continued on opposite page)

$\frac{V_1}{V_2}$ or $\frac{I_1}{I_2}$	N
1	0
2	6.02
3	9.54
4	12.04
5	13.98
6	15.56
7	16.90
8	18.06
9	19.08
10	20.00
15	23.52
20	26.02
25	27.96
30	29.54
40	32.04
50	33.98
60	35.56
70	36.90
80	38.06
90	39.08
100	40.00
500	53.98
1000	60.00

THAT ELUSIVE DECIBEL

(Continued from facing page

to commit a few common voltage ratios and the equivalent decibel notation to memory, as this will make the mental picture of what is happening under certain circuit conditions very much easier.

Expressing the Facts Graphically

It is easy to draw a graph to express the gain or loss ratios in relation to the decibel equivalents but if this is carried out on ordinary squared graph paper, inaccuracies will occur due to the cramping of the ratio ordinate as a result of the high figures that must be employed. This is seen in Fig. 1, and it is, therefore, far more business-like to use logarithmic graph paper. If this is done then the relation between the power, current or voltage ratios either for gain or loss in relation to the decibel equivalents is simply a straight line as shown in Fig. 2. The loss ratios are shown on the left vertical ordinate and the gain ratios on the right vertical ordinate. When working in voltage or current ratios then the number of decibels should be read off from the bottom horizontal ordinate, while for power ratios the top ordinate must be employed. Thus, from Fig. 2, it will be seen that a gain ratio of 100 in terms of voltage is the same as saying 40 decibels (usually shortened to 40 db), but in terms of power the decibels involved is one half this figure, that is 20. By familiarising himself with this chart the reader will soon be talking about decibels in their correct manner, and one of the difficulties so frequently associated with many radio matters will be relegated to the dim past.

A Spiral Screwdriver

Constructional Details of a Useful Tool for the Constructor or Serviceman

IT is often very difficult for the wireless enthusiast or serviceman to find a screwdriver to meet his requirements satisfactorily, and the tool illustrated was designed to solve the difficulty. This screwdriver is similar to the normal spiral screwdriver, but it has three main advantages over it. First, it is of a suitable size for the radio engineer; secondly, the spiral rod is interchangeable; and thirdly, it requires only one hand to operate.

Constructional Details

In Fig. 1 is shown the spiral rod S which is mounted inside a tube N, and is held against the ratchets L and E by the spring K, which is also housed in the tube N which projects up into the handle through a hole in the plate D. The object of the spring is to hold the spiral rod down on the bottom ratchets, and yet allow it to turn, freely when the handle is withdrawn.

The pitch of the spiral depends on how much force is required to tighten up the screws.

The tubular part of G slides into the gap M between the two tubes B and C, which are joined by the ring X (Fig. 2), so that when the tool is compressed it is kept rigid.

Between the components E and F at the bottom end of the tool, ball bearings are provided, which take the pressure when the handle is depressed. This pressure is not direct, as the component E also moves round.

The part G is not free to move round, as will be seen by reference to Fig. 3. Small pins O are screwed into the part P, and project through long, narrow slots cut in either side of G, so keeping the component G from moving round when the handle is worked up and down.

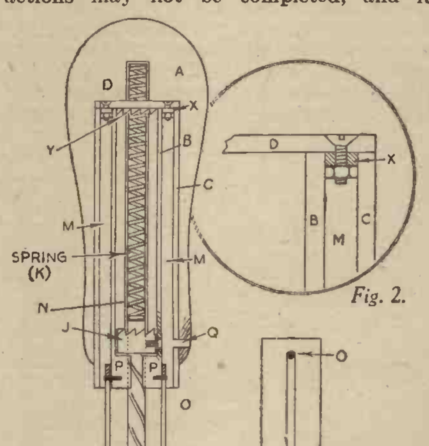
It will be appreciated that by arranging the ratchets L and E, as shown, the spiral rod can be replaced very quickly, with one of a higher or lower (or reversed) pitch, as required.

A hole Q is drilled through the lower part of the handle and tube B so that a bradawl can be inserted through to the grub screw in J, making it easy to separate the handle and part J.

It will be understood that the grub screw in the component T must always be facing the hole Q, and in order to make this possible J is cut as shown in Fig. 4. A groove being filed in the inner tube B to accommodate J.

Operation

First, having compressed the screwdriver a number of times, and the screw is almost tight, one of the compressing actions may not be completed, and it would be inadvisable to try to finish the tightening by trying to compress the driver any more. In order to avoid this the screwdriver blade can be turned once or twice (by the handle) to allow the ratchets at T on the disc D to come in contact with the ratchets on part T.



Sectional view and details of a spiral screwdriver.

SEPARATING THE CURRENTS

How Direct, High-frequency and Low-frequency Currents are Confined to Their Own Circuits by the Use of Chokes, Condensers and Resistors

By FRANK PRESTON

IN every receiver there are three kinds of current—direct, or D.C., H.F., and L.F. Normally, they should not be mixed together but confined to their own paths. That is why it is necessary to include components which serve to separate them and prevent any one taking an unwanted course.

One of the best examples of the mixture of these currents is in the anode circuit of a detector (see Fig. 1). The signal currents, or amplified signal currents, are applied to the grid of the valve, and it is the purpose of the valve to "rub out" the H.F. portion so that the L.F. or audio portion can be used to operate a pair of 'phones or an amplifier. The detector acts as a demodulator, in a manner which has often been described in these pages. Despite this, however, a certain amount of H.F. gets past the valve into the anode circuit, where it is mixed with the audio frequencies.

When reaction is employed a portion of the H.F. is passed through the reaction circuit and back into the grid circuit for further use. There still remains a certain proportion of H.F., however, and this should be prevented from passing along to the low-frequency amplifier, where it would cause distortion and instability.

Alternative Paths

There are two means of disposing of this "surplus" H.F.: it can be barred from passing the anode circuit, so that it must be "forced back" through the capacity of the valve to earth; it can be allowed to take an easy path to earth through an external circuit. Both of these methods, and a combination of them, are used in practice. The usual method is to include an H.F. choke between the anode and the anode-coupling component and also to connect a low-capacity condenser between the anode and earth. By this means the H.F. is prevented from passing into the inter-valve coupling circuit and is, instead, offered an easy path to earth.

Choke Reactance

But, it may be asked, how does the choke bar the progress of the unwanted H.F. and yet allow both L.F. and D.C. to pass without hindrance; and how does the condenser provide an easy path for H.F. without also permitting leakage of L.F. and D.C. To obtain a clear understanding of this it is necessary to refer to two fairly simple formulæ. The reactance (which for practical purposes may be considered as being equivalent to the effective resistance to alternating current) of a choke is equal to 2π multiplied by f, multiplied by L, where $\pi=3.14$, f is the frequency in cycles per second and L is the inductance in henries.

From this it is obvious that the reactance increases with the frequency, being zero for D.C. As a matter of interest the effective resistance of an average H.F. choke (with an inductance of 200,000 microhenries, or .2 henry) is approximately 1,300,000 ohms at 1,000 kc/s, and only 1,300 ohms at 1 kc/s or 1,000 cycles. Thus it may be seen that an H.F. choke offers 1,000 times as much resistance to an average radio frequency as it does to an average audio frequency. Its relative effective resistance to audio frequency is therefore negligible. The D.C. resistance is generally in the region of 100 ohms.

Condenser Action

The reverse is the case for a condenser, since its reactance is equal to $1/2\pi fc$, where C is in farads. In other words, its effective resistance is less for high than for low frequencies. If we take a capacity of .0002 mfd. as an example we find that its reactance at 1,000 kc/s is 800 ohms, whilst its reactance at 1 kc/s or 1,000 c/s is 800,000 ohms. This means that high-frequency currents can pass through the condenser 1,000 times more easily than can the low-frequency currents.

From these two sets of figures it becomes perfectly clear that almost the whole of the L.F. in the anode circuit will be passed on to the low-frequency valve and that almost all of the H.F. must be by-passed to earth. As we have seen that is precisely the result desired.

The Reaction Circuit

The reader may well ask what would happen if the small anode by-pass condenser were omitted. When there is a reaction circuit a large amount of the H.F. would be by-passed to earth through it, whilst some would pass across the small capacity provided by the valve itself. It is nearly always desirable to employ a by-pass condenser as shown, but an alternative method is to use a differential condenser for reaction control, as shown in Fig. 2. In that case, the capacity to earth remains constant regardless of the setting of the reaction condenser. There is, of necessity, some slight variation in effective H.F. resistance between the anode and earth, because of the reactance of the reaction winding, but this is of little practical importance.

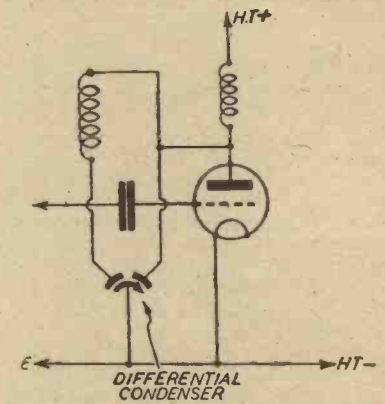


Fig. 2.—A fairly uniform anode-to-earth capacity is obtained by using a differential reaction condenser.

As many readers are aware, it is possible to replace the H.F. choke by a fixed resistor when this will not reduce the H.T. voltage applied to the valve to too great an extent. In that case the impedance of the resistor is greater than that of the by-pass condenser. In ordinary A.C. theory the reactance of a resistor is the same as the D.C. resistance, but at high frequencies the effective resistance is greater than this—mainly because of the magnetic field which is developed round the resistor. This also explains why a stopper resistance may be used, instead of an H.F. choke, in the grid circuit of an L.F. valve. This resistor "chokes back" any small amount of residual H.F. which passes the H.F. choke.

Decoupling

On the "H.T." side of the H.F. choke we have a mixture of D.C. (the high-tension supply to the anode) and L.F. We require the L.F. to operate the following amplifying valve, and we must prevent it from passing through the H.T. supply circuit and back to the detector grid circuit. Should any L.F. escape in this manner we have the form of instability known as "motor-boating," and additionally distortion is set up.

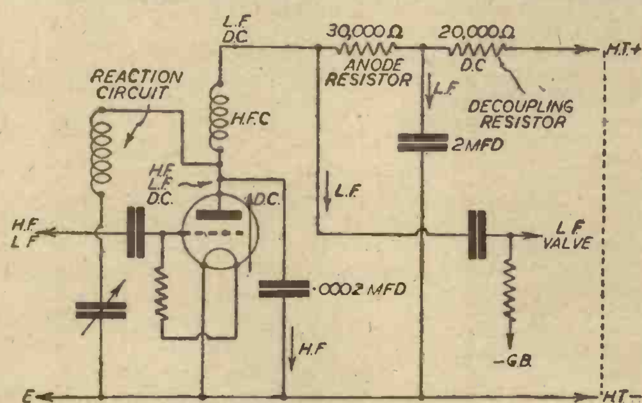


Fig. 1.—The anode circuit of a triode detector, with R.C.C. coupling, affords a good example of combined D.C., H.F., and L.F. currents.

Similar principles are employed in filtering out the L.F. from the D.C. as in separating H.F. and L.F. We use the so-called decoupling resistor between the anode-coupling component and H.T.+, and connect a fixed condenser between one side of this and earth. These components are shown in Fig. 1. If we assume that the effective resistance of the decoupling resistor is the same as its D.C. value, 20,000 ohms, we find that the reactance of the 2 mfd. by-pass condenser is much smaller. A condenser has, of course, an infinite resistance to D.C.

The reactance of a 2 mfd. condenser at

(Continued on facing page)

SEPARATING THE CURRENTS

1,000 cycles per second is only 80 ohms ; it is obvious, therefore, that any L.F. currents in the H.T. circuit would take the easy path to earth through the condenser rather than pass through the resistor. Thus, by combining the H.F. choke, by-pass condensers and decoupling resistor shown in Fig. 1 we have guided each of the three types of current along their proper courses and prevented their passage into other parts of the circuit.

L.F. Chokes

If it were inconvenient to employ a fairly high resistance for decoupling, because of the voltage drop across it, we could quite well replace it by an L.F. choke which has a low D.C. resistance combined with a comparatively high reactance. Thus, if we decided that a reactance of 50,000 ohms was suitable (at the average low frequency of 1,000 c/s) we could easily find the required inductance by modifying our formula: reactance $=2\pi fL$, to read $L=2\pi f$ reactance. By substituting in this formula we find that the required inductance is 50,000/6.28 times 1,000, or about 8 henries. Such a choke would have a D.C. resistance of no more than 100 ohms. In practice, a choke between 5 and 20 henries could be used.

BOOKS RECEIVED

PHOTO-ELECTRIC AND SELENIUM CELLS. By F. T. Fielding. 163 pp. 82 illustrations. Published by Chapman and Hall, price 7s. 6d.

THIS is the second edition of a useful manual on the operation and construction of the P.E. and Selenium Cells, and their uses in modern equipment. Photo-electricity is a growing art and many commercial enterprises rely upon apparatus using it for various purposes. Counting articles, testing for faults are only two of the various uses to which it is put. The chapters of the book deal with the P.E. effect: Making Selenium Cells; Amplification — valve and transformer; Building an Amplifier; Time delay circuits; The spectrum; Some Commercial Types of Photo-cell; Home experiments with Light-sensitive cells; The Photo cell in television and talking pictures; Industrial applications; The Photo-electric Gramophone; Uses in Advertising; Miscellaneous Applications; Potentialities of the Light-sensitive cell.

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).

Experimenters' S.W. Three

SIR,—Please accept a beginner's thanks for a fine circuit—The Experimenters S.W. Three. A grand publication PRACTICAL WIRELESS. I have just tried the set out here, and have received stations WCBX, DJR, W2XAD, HC1JB (The Voice of the Andes), and an Italian of which I did not hear the call-sign. I have no verification of these stations, but hope to have in the near future. The coils are home constructed.—NORMAN MORRIS (Bolton).

A Scottish Reader's Den

SIR,—I find your excellent paper is most useful for constructional work. I enclose a photograph of my den, the RX in the foreground being made from the Premier SG3 kit. The aerials are both indoor, and are constantly changed for experimenting.

Though conditions have been poor lately, I submit my log on 14 mc/s: K4, ES(3), LY(2), CE, I1(3), and EA7. I have also heard HBO, JZJ, VLQ, VLQ2; TAP, and the usual W's. I should like to get in touch with any listeners in my neighbourhood who care to drop me a line.—J. FRASER SHEPHERD (12, Park Place, Dunfermline, Fife).

Dead Spots

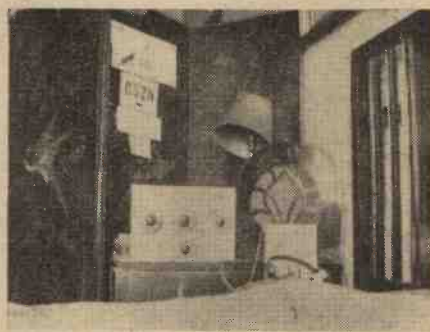
SIR,—The letters by J. Kidd and Eric Williams, published in recent issues of PRACTICAL WIRELESS, greatly interested me. I have been a short-wave listener since last October, and have heard signals from the usual DX corners of the globe. But of South Africa, not a solitary murmur, and Canada has been little better. I have heard CHNX, Nova Scotia, 48.9 m. at 5 a.m. B.S.T. on two occasions, March 8th and April 18th, but that is all.

My RX is a "Pye" model PS, with a 60-foot antenna running east to west.

Fellow readers might be interested to know that HCJB, Quito, Ecuador, S. America, 24.08 m., is "coming in" exceedingly good at the moment. Transmissions in English are broadcast at 12 midnight-1 a.m. and 3 a.m.-4 a.m. B.S.T. every day excepting Tuesdays. At the time of writing, Daylight Saving Time is not yet in force in America, when it is these times will, of course, be an hour earlier. The programmes consist of piano recitals by the station musical director, travelogues, talks by Ecuadorian personalities, and short vesper services. These transmissions are directed to North America, and broadcast by a new 10 kW. transmitter inaugurated on Easter Sunday.

The queerest news bulletin I have yet heard hails from HP5G, Panama City, 25.47 m. At 1 a.m. B.S.T. news items are interspersed with commercial announcements.—G. FILLEUL (Gosport).

SIR,—Regarding the letters from Mr. J. Kidd (Melton Mowbray) and Mr. Eric H. Williams (Wallasey) on the absence of signals from Canadian stations, I think I can offer a little advice regarding the reception of Canadian short-wave stations. The C.B.C. has two short-wave transmitters, and one is on the 48-m. band, the other on the 49-m. band. The call-signs are CHNS and CHNX, broadcasting from the Lord Nelson Hotel, Halifax, Nova Scotia, and the transmitting power is 500 watts. The CHNX station operates as follows: 12 noon to 04.15 G.M.T.;



A corner of Mr. J. Fraser Shepherd's den.

Saturdays, 13.00 to 04.30 G.M.T., and Sundays, 17.00 to 04.15 G.M.T. I have received this station, and a week ago received a verification card, but although I am a keen short-wave listener and use 'phones so that I do not miss any distant signal, I have never been able to receive any of the C.B.C. stations in the daytime. When you consider that stations using 20,000 watts, with a directional antenna beamed on Europe, cannot be received well on the 49-metre band till after 12 noon, you can quite understand why persons using 1, 2, 3, and 4-valve sets cannot receive C.B.C. transmissions. In conclusion, my receiver is an 0-v-1, and the antenna I am using with it is a dipole, erected about 45ft. high. The obvious reason for C.B.C. transmissions not being received in daytime over here is the wavelength it uses. Hoping this information will be of some help to the readers concerned.—H. TURNER (Arnold, Notts).

Prize Problems

PROBLEM No. 399

MELVIN decided that there was something wrong with the detector stage in his battery three-valver. He made a few experiments, but reaction was not very good and signal strength was also poor. He decided to try a modification in the by-pass capacity (after he had modified grid condenser and leak values) and he tried various condenser values up to .2 mfd. connected in series with the existing condenser, but there was no apparent difference with any of them. The existing condenser was not faulty. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 399 in the top left-hand corner and must be posted to reach this office not later than the first post on Tuesday, May 14th, 1940.

Solution to Problem No. 398

When Jackson changed his reaction condenser connections he overlooked the fact that the condenser was being earthed through the metal panel. In the original scheme this was in order, but by connecting the condenser to the other side of the reaction winding, he was earthing the winding and thus cutting out the reaction effect. He would also be short-circuiting the H.T.

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

J. S. Hill, 5, Manor Avenue, Roseberry Street, Brookfields, Birmingham, 18; W. J. Perry, 165A, Walton Lane, Liverpool, 4; F. R. Fredericks, 41, Linkside, Finchley, N.12.

A Service Problem

SIR,—If "Thermion" would like to hand my name and address to the dealer who is "stuck" with 93 sets it may afford him some relief—the dealer, I mean.

I have been a free-lance worker for about ten years, and employ the following instruments: Cossor 3343 ganging oscillator and 3332 oscilloscope, universal Avometer, Solar capacity analyser and resistance bridge, Avo valve tester and panels.

I spend most of my time amongst dealers in the Kent area, but if the dealer in question really requires help he can send a few sets at a time to the address given below until the surplus is removed.

Terms, 2s. per hour plus cost of replacements at Trade. Only mains receivers will be contemplated. I don't want the work particularly, but if he is in a jam I don't mind doing a spot of overtime to help his public.—A. E. ANDREWS (69, St. John's Park, Blackheath, S.E.3).

Medium Wave DX

SIR,—Recent letters concerning medium-wave DX have been very interesting and have tempted me to submit my experiences.

At the beginning of 1939 I purchased a small 3-valve battery set, and using an outdoor aerial 30 feet long and 15 feet high, I logged my first American—WEAF—which was transmitting on 455 m. The same month I logged five more Americans and one Canadian—WHAM, WBT, WOAI, WJ2B, WGY, and CJSC. During that period transatlantic reception was good, and even in June that year I received KOB on 254 m. which any experienced listener will admit is pretty good.

Since that period I have received W2JY, WJJD, WPMB, WJ2Y, WBZ, WENR, CKAC, WLB, EAJ7 and CHVC.

Wishing your fine magazine every success in these difficult times.—ERIC WILLSON (Stockport).

Correspondents Wanted

G. ARMSTRONG, The Rectory, Ballymoney, Co. Antrim, N. Ireland, wishes get in touch with any reader who would loan him a copy of PRACTICAL WIRELESS dated July 13th, 1935, containing details of F. J. Camm's 2-valve superhet.

A. Chadwick, 466, Darwen Road, Dunscar, nr. Bolton, Lancs, wishes to correspond with a reader about his own age (14 years), who is interested in S.W. work.

C. F. Baylis, 51, Lillins Avenue, Redditch, Worcs, is anxious to get in touch with a local reader who has some clean copies of PRACTICAL WIRELESS for disposal.

D. Nasey, 41, Town Terrace, Leeds Road, Huddersfield, Yorks, would like to hear from any reader who has a recent call-book for sale.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

(See also page ii of cover)

No. 95

SHORT-WAVE COIL DATA—(continued)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
½"	24	22½	1½"	33¾	21	38	46	72
¾"	24	22½	½"	11¼	15	27	33	50
,,	,,	,,	¾"	16⅞	20	36	45	68
,,	,,	,,	1"	22½	23	43	52	80
,,	,,	,,	1¼"	28	27	50	60	92
,,	,,	,,	1½"	33¾	30	56	68	105
⅞"	24	22½	½"	11¼	16½	31	37	56
,,	,,	,,	¾"	16⅞	22½	41	51	76
,,	,,	,,	1"	22½	27	49	60	90
,,	,,	,,	1¼"	28	31	55	67	100
,,	,,	,,	1½"	33¾	35	64	78	120
1"	24	22½	½"	11¼	17½	33	41	65
,,	,,	,,	¾"	16⅞	25	46	56	86

No. 96

SHORT-WAVE COIL DATA—(continued)

Diam. of Former	No. S.W.G.	Turns per Inch Spaced approx. One Diam. of S.W.G.	Length of Winding	No. of Turns	Tuning Range (Min. Cap. 30 mmfd.) .0001 Min.	.0001 Max.	.00015 Max.	.00035 Max.
1"	24	22½	1"	22½	29½	54	65	100
,,	,,	,,	1¼"	28	34	63	77	115
,,	,,	,,	1½"	33¾	39	70	86	135
1¼"	24	22½	½"	11¼	22	41	50	76
,,	,,	,,	¾"	16⅞	31	55	68	105
,,	,,	,,	1"	22½	36½	65½	80	125
,,	,,	,,	1¼"	28	43	78	95	147
,,	,,	,,	1½"	33¾	48½	88	107	165
1½"	24	22½	½"	11¼	26	47	57	88
,,	,,	,,	¾"	16⅞	35	63	78	120
,,	,,	,,	1"	22½	43	78	94	145
,,	,,	,,	1¼"	28	50	91	110	170
,,	,,	,,	1½"	33¾	56½	103	125	192

No. 97

STANDARD COLOUR CODES.

Resistances and Condensers.

The colour codes for fixed condensers and fixed resistors are identical, the standard for resistors being ohms and for fixed condensers mmfd.

Colour	Fig.	No. of Noughts.
Black	0	None
Brown	1	0
Red	2	00
Orange	3	000
Yellow	4	0000
Green	5	00000
Blue	6	000000
Violet	7	
Grey	8	
White	9	

The order of reading these colours is: Body Tip, Dot.

Example: Resistance with red body, black tip and orange spot will have value of 20,000 ohms. If there is no dot on the body it indicates that it is of the same colour as the body.

Multiple Condenser Blocks.

The highest capacity positive voltage	Red
The second highest do.	Yellow
The third highest do.	Green
The fourth highest do.	Blue
The fifth highest do.	Violet
Principal negative connection	Black
Second do.	Brown
Third do.	Grey
Centre connection for voltage doubler condensers	White

Where only two leads are used, positive is red and negative black.

Fuses.

60 mA.	Black	1 amp.	Dark Blue
100 mA.	Grey	1½ amp.	Light Blue
150 mA.	Red	2 amp.	Purple
250 mA.	Brown	3 amp.	White
500 mA.	Yellow	5 amp.	Black and White
750 mA	Green		

No. 98

Standard Colour Codes—(continued)

MAINS TRANSFORMER DATA

Primary zero	Black
,, 10 volts	Black & Green
,, 210 ,,	Black & Yellow
,, 230 ,,	Black & Red
,, 250 ,,	Black & Brown
Secondary Rectifier Heater	Green
,, High Voltage	Red
,, Valve Heaters	Brown
,, Additional Valve Heaters	Blue

Centre-tap leads are marked with the same colour as the appropriate secondary winding, but with a yellow line interwoven.

BATTERY LEADS

Highest voltage positive	Red
Second do	Yellow
Third do	Green
Fourth do	Blue
Low-tension positive	Pink
Common negative (L.T., H.T., G.B.)	Black
Max. G.B. negative	Brown
Second do	Grey
Third do	White

Any additional point, such as the fourth greatest G.B. negative, or fifth greatest H.T. positive, or positive bias, is violet, and any centre-tap is white.

No. 99

ABBREVIATIONS

A.—Anode, or plate.
A.A.—Artificial aerial.
A.C.—Alternating current.
Ae.—Aerial.
A.F.—Audio frequency.
A.F.C.—Automatic frequency control.
A.G.C.—Automatic gain control.
A.T.C.—Aerial tuning condenser.
A.T.I.—Aerial tuning inductance.
A.V.C.—Automatic volume control.
A.V.E.—Automatic volume expansion.
B.A.—British Association.
B.C.L.—Broadcast listener.
B.F.O.—Beat frequency oscillator.
B.O.T. Unit—Board of Trade unit = 1,000 watt-hours, or 1 kilowatt-hour.
C.C.C.—Closed circuit or secondary condenser, or S.T.C.
C.C.I.—Closed circuit or secondary tuning inductance, or S.T.I.
cm.—centimetre.
C.P.—Candle power.
C.W.—Continuous waves.
D.A.V.C.—Delayed A.V.C.
db.—decibel.
D.C.—Direct current.
D.C.C.—Double cotton covered.
D.E.—Dull emitter.
D.F.—Direction finding, or direction finder
D.P.—Difference of potential.
D.P.D.T.—Double pole double throw.
D.P.S.T.—Double pole single throw.
D.S.C.—Double silk covered.
DX—Long distance.
E.—Earth.
E.M.F.—Electro-motive force.
F.—Filament.
G.—Grid.
G.B.—Grid battery or grid bias.
G.C.—Grid condenser.
G.L.—Grid leak.
H.F.—High frequency (same as radio frequency).
H.F.C.—High-frequency choke.
H.P.—Horse power.
H.R.—High resistance.
H.T.—High tension.
I.C.—Intermittent current.

No. 100

ABBREVIATIONS—(continued)

I.C.W.—Interrupted continuous waves.
I.F.—Intermediate frequency.
I.P.—In primary (of transformer); start of primary.
I.S.—In secondary (of transformer); start of secondary.
kw.—Kilowatt = 1,000 watts.
L.F.—Low frequency.
L.F.C.—Low-frequency choke.
L.R.—Low resistance.
L.S.—Loudspeaker.
L.T.—Low tension.
mfd.—micro-farad.
mhy.—microhenry.
mm.—millimetre.
mmfd.—micro-micro-farad.
O.L.—Output load.
O.P.—Out primary (of transformer); end of primary. Also output.
O.S.—Out secondary (of transformer); end of secondary.
P.—Plate, or anode.
P.A.—Public address.
P.D.—Potential difference, same as D.P.
P.M.—Permanent magnet.
Pot.—Potentiometer.
P.V.—Power valve.
Q.A.V.C.—Quiet automatic volume control.
Q Code.—See pp. 23 & 24.
Q.M.B.—Quick make and break.
Q. P.-P.—Quiescent Push-pull.
R.F.—Radio frequency (same as high frequency).
R.M.S. Value.—Root-mean-square value.
Rx.—Receiver.
S.C.C.—Single cotton covered.
S.I.C.—Specific inductive capacity.
S.P.—Series parallel.
S.P.D.T.—Single pole double throw.
S.P.S.T.—Single pole single throw.
S.S.C.—Single silk covered.
S.T.C.—Secondary tuning condenser.
S.T.I.—Secondary tuning inductance.
S.W.G.—Standard wire gauge.
S.W.L.—Short-wave listener.
T.R.F.—Tuned radio frequency.
T.T.—Tonic train.
Tx.—Transmitter.

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Battery All-Wave Three (D, 2 LF (RC))	—	PW55
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The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.8.37	PW64
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The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
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Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
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A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
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
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D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
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Simple S.W. One-valver	23.12.39	PW88
Two-valve: Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
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Three-valve: Blueprints, 1s. each.		
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MISCELLANEOUS.		
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AMATEUR WIRELESS AND WIRELESS MAGAZINE

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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.		
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Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan. '36*	WM401
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All Metal Four (2 SG, D, Pen)	*July '33*	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May '35*	WM386
SUPERHETS.		
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'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.		
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Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
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SHORT-WAVE SETS. Battery Operated.		
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Rome Short-Waver	—	AW452
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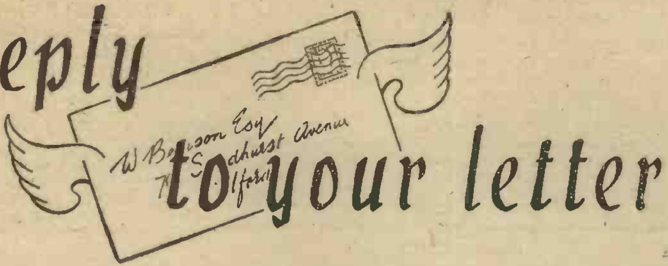
Home-made Coil Two (D, Pen)	—	AW440
Three-valve: Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July '35*	WM390
Four-valve: Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (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



Sagging Filament

"I had a well-tried 4-valve battery set which has given very good service until last week. I bought a new cabinet of the radio-gram type and suspended the set inside the lid part so that I could get at the controls without drilling the front of the cabinet. The set now works for a minute or so and then there is a faint click and the set stops. I took out the chassis and examined everything for loose wires or connections, but everything seemed O.K. and I switched on and the set went for an hour. As soon as I put it back it stopped after a few seconds as at first. I wonder if you have any idea what may be wrong?"—C. M. A. (Dewsbury).

ALTHOUGH there may be a fault inside one of the coils or other components we suggest that there is a possibility that one of the valves is responsible. You say the set has been in use for some time and that in the new arrangement it is suspended. This will mean that valves will be lying on their side and thus one of the filaments may be sagging slightly, and the faint click you hear occurs when the filament touches the grid. When placed so that the valves are upright the set will function satisfactorily as the filament will not then come into contact with the grid. Test this by connecting a meter and small single cell in series between filament and grid of the valves and turn them about, or alternatively perhaps you can connect a small meter across the grid and filament whilst the valve is in situ.

Condenser Leakage

"I am experiencing a bad crackling in my A.C. set, and in looking for any fault I notice that one of the small H.F. tubular by-pass condensers is covered with stuff like candle-grease. As the condenser does not pass current I fail to see that it can have broken down or developed any heat, and I should like to know whether or not I should suspect this component as being responsible for the trouble."—L. T. (Hull).

THE condenser has H.T. applied across it, as one side is joined to earth (H.T. –) and the other is joined to H.T. + either direct or through a resistance. If you examine modern condensers or catalogues you will see that they are rated just like a resistance—for a certain voltage working, and this is the maximum voltage which should be applied to the condenser. You have no doubt overlooked this (or a fault has developed which is resulting in an increase in the voltage applied to it) and this has caused the insulation to break down, resulting in arcing and heat which has melted the filling compound.

Loose Laminations

"In trying to cure a bad hum in an A.C. receiver I have come across a point which baffles me. I can hear the hum both through the speaker and also on the set itself, and when I hold the smoothing choke I can feel the hum quite strong. I should like to know whether this proves the choke is wrong in some way, and if so what type I should get."—S. E. R. (Weymouth).

THE purpose of the choke is to smooth out the pulsating supply delivered from the rectifier. It will be appreciated that the latter only turns the alternating supply into a "one-way" supply, and this is in the form of a rippling or pulsating direct current. This causes hum unless smoothed, and the choke, by reason of its inductance, does this. In your case the fact that you can feel the ripple tends to indicate one of two things. Either the windings are loose and vibrating with the pulsating current, or alternatively the laminations need tightening. The latter is more likely to be the trouble and you should, therefore, try to tighten the nuts or bolts which clamp the laminations together. If you cannot make much impression on the nuts a good idea is to pour some Chatterton's Compound over the core and this will fill the slight spaces which may be left between individual laminations and perhaps cure the trouble. We assume, of course, that the choke is of sufficiently high inductance value and is rated to carry the current present in your particular circuit.

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.

Wearite Universal Coils

"I have some Wearite coils lying spare and wish to make up a circuit published by you some time back. I seem to remember, however, that there was a distinguishing reference or something in these coils, and I should be glad if you could refresh my memory on this point."—G. D. (W.12).

THE coils in question were no doubt the Universal, Universal Type A and the Unigen. The Universal coils were first and had seven connections. The Universal Type A were similar in characteristics, etc., but had an additional terminal taken to a tap on the primary winding, for wave-change purposes. In the Universal the entire primary is in circuit on both medium and long waves. In the Unigen the pattern is exactly the same as Type A, but the coils were slightly modified from a constructional point of view. In characteristics they were similar. The primary is joined to terminals 4 and 5 (with the tapping on Type A and Unigen at 8); the secondary is between 1 and 3, with the medium-wave tap at 2 and a tap for connection of grid condenser to remove damping at terminal 7; whilst the reaction is joined also to point 3 (earth) and the other end is taken to terminal 6.

The coupon on page 188 must be attached to every query

Long-distance Results

"I have been following some of the letters published recently on the question of the non-reception of certain long-distance stations, and should like to know why I cannot get certain stations which are rated at higher power than those I do receive. I have a list of some American stations and I get one or two quite well, although they are rated quite low. More powerful ones, although I have tried at the published times, do not come in. Is the power-rating something not related to aerial radiation, or is there some other explanation?"—J. S. E. (Rickmansworth).

ALTHOUGH in some cases there may be confusion in the rated power, we think the most likely explanation is that in the case of the lower-powered stations a directional aerial is used, beamed on Europe. You may verify this point by listening to some of these stations at certain times when they switch over from the European beam to one directed in another direction. An announcement is made to this effect and you may then find that the station will disappear. On the other hand, the direction of your aerial may affect results, being directional to the stations you hear and at an angle to those you cannot hear.

REPLIES IN BRIEF

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

J. A. W. (Wolverhampton). We are not familiar with the particular type of rectifier sketched by you and are therefore unable to assist you. Perhaps it is faulty.

F. W. B. (Grimsby). The trouble may be induction from nearby power lines or re-distribution lines and we suggest you make one or two tests from this point of view.

F. C. R. (W.9). We certainly think that a pre-amp. is necessary and you may need two stages to obtain the same output as the pick-up. Standard R.C. coupling may be used, and the design is quite standard.

J. M. (Andoversford). Write to the stations in question for the Q.S.L. cards, and to the Radio Society of Great Britain for an Amateur Call Book.

A. B. (Epsom). We cannot quote prices as they are likely to be changed during the war. The best plan is to write to one of the firms who specialise in the supply of complete kits and they will make a quotation at the time of writing.

E. R. (Wrexham). The coils were supplied by the makers of the chassis and were ready assembled with switch. If they are unable to supply we suggest you try the Bulgin range of coils and appropriate switch.

H. W. G. (Harefield). The transformer should be left in circuit as the output arrangements are obviously for high-resistance components.

A. P. (Beeston). The Encyclopædia is undoubtedly the most useful book in your particular case.

R. B. (Brentwood). The adaptor may be obtained from Messrs. Bulgin or any local Bulgin stockist.

P. O-S. (Ashorfield). The ballast may be of the wrong type. These components are critical in the particular American sets mentioned. We regret that we have no details of the coil.

E. P. (Herne Hill). The leads should be soldered and, if possible, lead connectors should be used.

J. S. E. (Birmingham). 16 S.W.G. tinned copper is ideal for the purpose. The turns should be spaced by a distance equal to the diameter of the wire.

N. T. (Doncaster). 9 volts will be ample, and the maximum voltage should be used.

Notes from the Test Bench

Loose Screws

SOME home-constructors find that after a receiver has been in use for some time noises are introduced due to components coming loose, and as a result connections are also loosened. Much of this trouble may be overcome by proper constructional methods, and shakeproof washers are now obtainable quite cheaply from any good radio-dealer. If these are placed under the nut, or between a loop of wire or any other item which it is required to hold firmly, the toothed edges will bite into the metal and there is very little likelihood of the nut coming loose—even under the vibration which might be experienced from a large A.C. mains type of amplifier. Another good idea when an aluminium chassis is being used is to leave the burr which is raised by the drill and let this act as a form of sharp washer, which will act as the items mentioned above. In all cases, however, undue force should not be used when tightening nuts and bolts in ordinary radio construction—especially when they are attached to bakelite or other composition component cases.

Soldering Aid

ALTHOUGH instructions for carrying out soldering have been given many times in these pages, some constructors still find it difficult to get a really neat and sound joint. It has been found that a lot of trouble is caused by using too much flux and an iron which is not quite hot enough. The result is that the flux burns and the resultant "ash" prevents the solder from making good contact, and in most cases the entire parts will have to be cleaned again—preferably with methylated spirit. If only a small quantity of flux is used, and the iron is really hot, the flux will evaporate almost instantly and the solder will at the same time run and make contact. Another idea which prevents the use of too much flux is to use the resin-cored solder obtainable in coils, and with this the solder is applied to the iron whilst the latter is in contact with the point being soldered, and then flux and solder run together. The makers have arranged that there is only just sufficient resin in the solder for a proper fluxing of the joint.

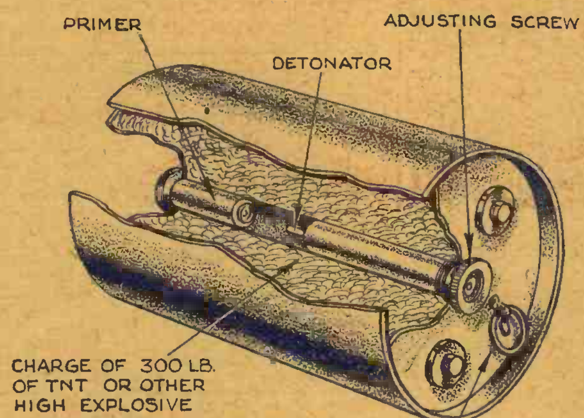
Classified Advertisements

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.

FREE ADVICE BUREAU
COUPON
This coupon is available until May 18th, 1940 and must accompany all Queries and Hints.
PRACTICAL WIRELESS 11/5/1940.

The DEPTH CHARGE

How the Dreaded Enemy of the Submarine Operates



A cut-away view of a short-range depth charge, showing internal arrangements

Read this Intensely Interesting Feature in this month's PRACTICAL MECHANICS

Other SPECIAL CONTENTS of the May Number:

WHEN THE R.A.F. FLY TO BERLIN
Well-known German landmarks which would guide our airmen.

THE PRINCIPLES OF THE SUBMARINE

MASTERS OF MECHANICS—HENRY FARMAN
Famous Aeroplane Inventor and Pioneer of Mechanical Flight.

ONE-STRINGED FIDDLES
How to Make Them.

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In the MAY

PRACTICAL MECHANICS

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Order a copy from your Newsagent to-day. 7D.

George Newnes, Ltd.

Newest Books For Electricians

(1.)

ELECTRIC WIRING (Domestic)

This book is intended for young men who are engaged in electric wiring and electrical contracting work, for plant and maintenance engineers in works and factories, and for those employed in the Service or Maintenance Departments of Electricity Supply Companies.

It provides a valuable supplement to the orthodox text books which are used in the theoretical study of electrical work, and describes and illustrates up-to-date practical methods of wiring houses. There is a special chapter dealing with the safety of such installations.

5s. net (By post 5s. 6d.)

(2.)

PRACTICAL DESIGN of SMALL MOTORS & TRANSFORMERS

Most books dealing with the design of electrical machinery can only be read with understanding by engineers having a fair working knowledge of higher mathematics. On the other hand, very few armature winders and others who are engaged in the actual construction of motors and transformers have this particular aptitude.

This new book presents the actual facts relative to the design of small motors, dynamos, and transformers in a way which will make an instant appeal to the practical man.

In place of complicated design formulæ, the necessary facts have been presented largely in the form of tables which enable the appropriate sizes of wire, etc., to be readily selected to suit any given conditions.

5s. net (By post 5s. 6d.)

(3.)

INSTALLATION & MAINTENANCE of ELECTRIC MOTORS

The vast increase in the use of electricity as a motive power in works and factories has resulted in the need for men capable of installing and maintaining electric motors of all types, ranging from fractional horse-powers to several hundred horse-power.

The book presents information on this subject in a form which renders it readily available for the plant and maintenance engineer in whatever industry he may be employed.

A feature of special interest is the large number of starter wiring diagrams. 5s. net (By post 5s. 6d.).

Ask your bookseller to get you the book or books you require, thus saving postage. Alternatively, send the form to the Publishers, with Postal Order (plus extra to cover postage), and the book or books will be sent direct to you.

To the Publisher, GEORGE NEWNES, LTD. (Book Dept.), TOWER HOUSE, SOUTHAMPTON STREET, LONDON, W.C.2. Please send me by return the book or books encircled below.

I enclose Postal Order value..................No............

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WHY THE GRID LEAK? — See Page 190

A NEWNES PUBLICATION

Edited by F. J. CAMM

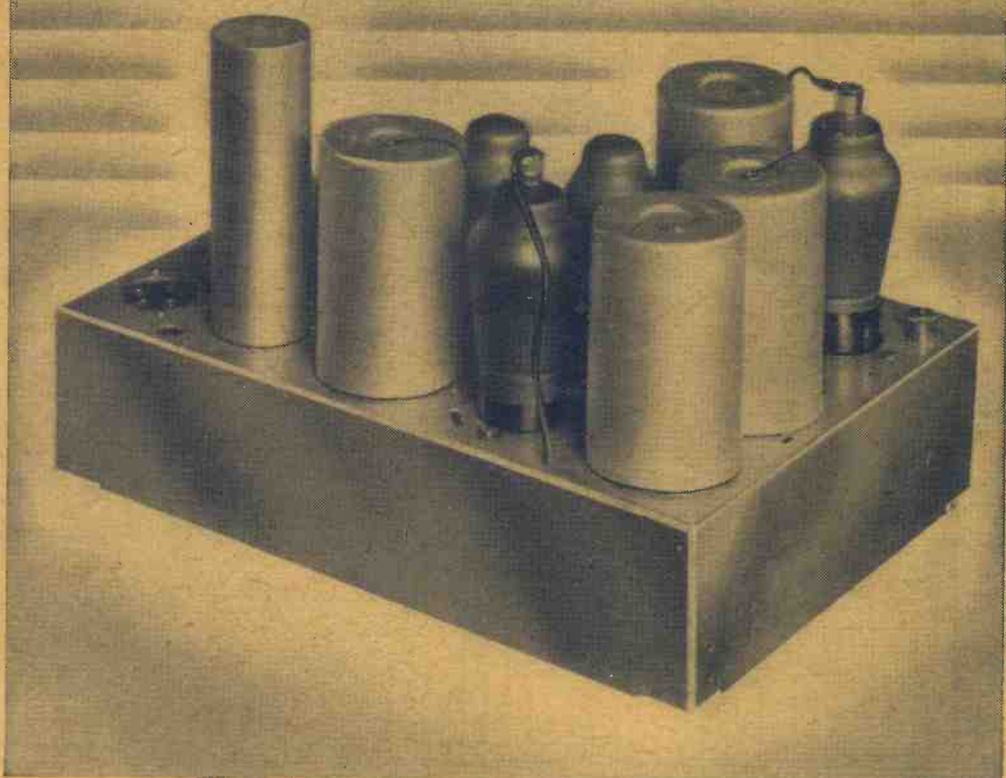
Vol. 16. No. 400.

Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 18th, 1940.

Contents



BUILDING A DIVERSITY RECEIVER

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 5 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	mA	Voltage Dblr.: Volts	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.36	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	2.090	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 FRESTO
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.

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.

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

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

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

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

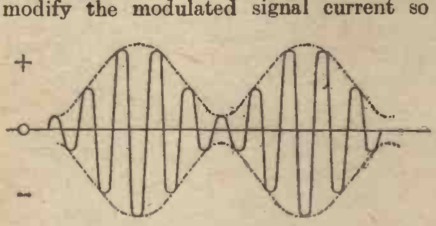


Fig. 3.—This diagram shows the form taken by a carrier wave modulated by a pure note.

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

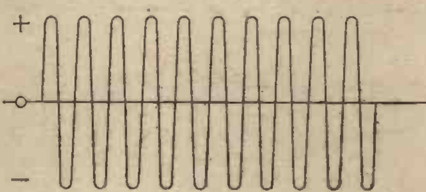


Fig. 1.—This diagram represents the carrier wave, which consists of H.F.

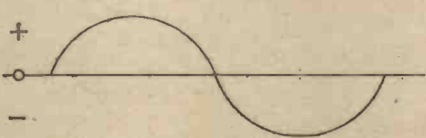


Fig. 2.—The L.F. or modulation curve.

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

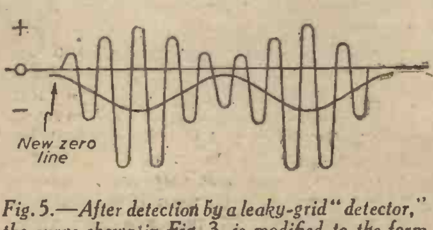


Fig. 5.—After detection by a leaky-grid "detector," the curve shown in Fig. 3. is modified to the form shown above. Thus the "mean" (corresponding to the modulation) is able to affect the anode circuit.

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

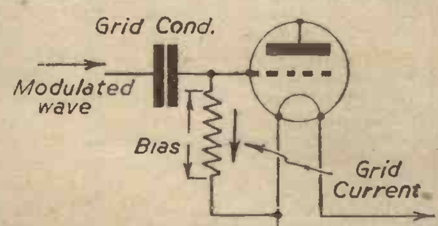


Fig 4.—Representative circuit of a leaky-grid detector.

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 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.

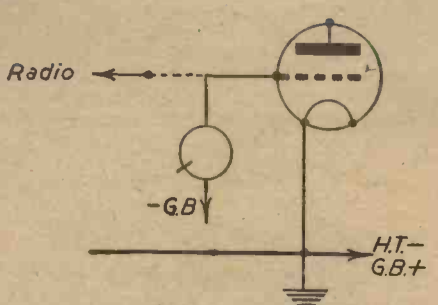


Fig. 1.—Normal connections for a pick-up with a battery-operated triode.

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 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 shown in Fig. 3. Values from .005 to .01 mfd. may be tried. If the bass is over-powering 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.

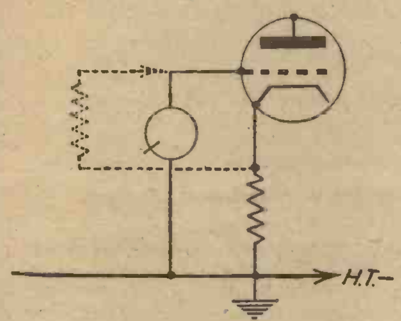


Fig. 2.—Normal connections for a pick-up in an indirectly-heated valve. If a detector, the grid leak is connected as shown by the broken lines.

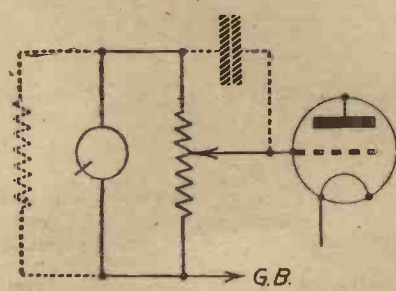


Fig. 3.—Connections for a piezo-crystal pick-up. The shunt and fixed condenser are referred to in the text.

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, workman-like compositions to a creator of master-pieces. 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.

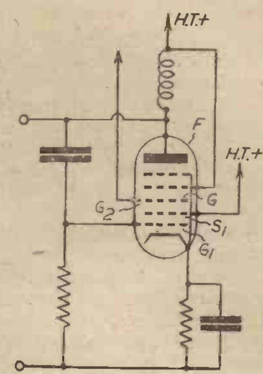


Fig. 2.—A five-grid valve for the special arrangement described here.

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.

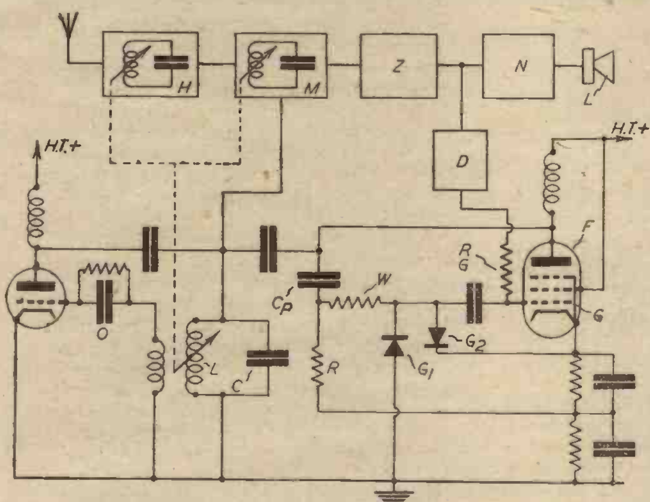


Fig. 1. (Left).—A usual arrangement of the pull-in tuning circuit.

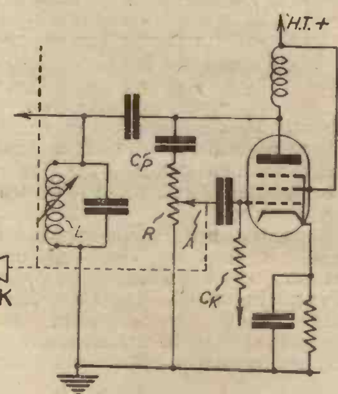


Fig. 3. (Right).—Manual control is provided by knob K.

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

(Continued on next page)

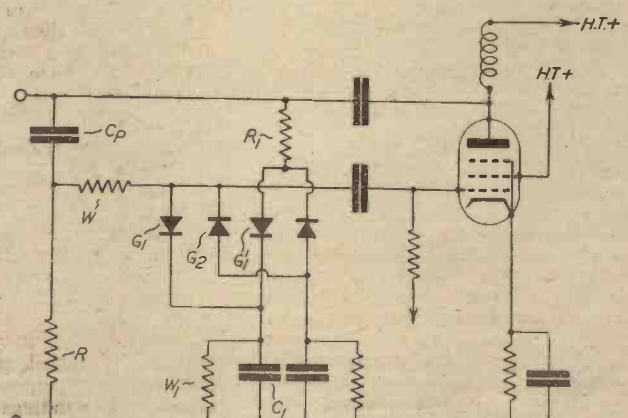


Fig. 4.—Another scheme which produces the same result as Fig. 1.

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.

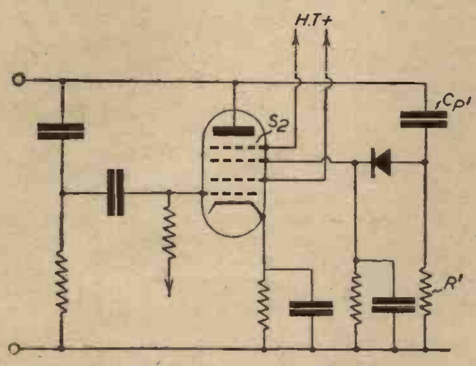


Fig. 5.—Rectified voltage is applied here to the 4th grid.

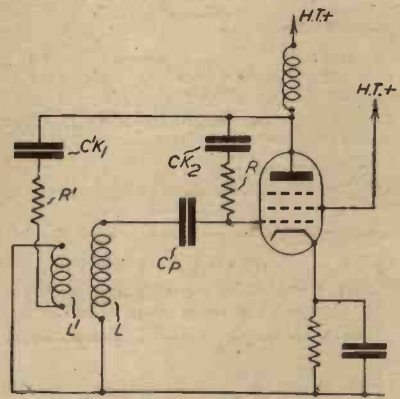


Fig. 6.—Another scheme which is ideal for the medium-waveband.

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.

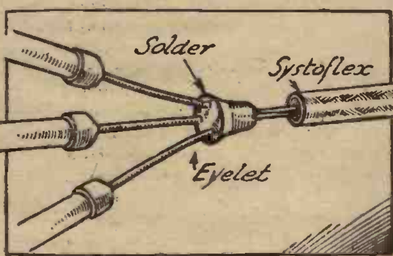
Recital by Famous Blind Organist

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.

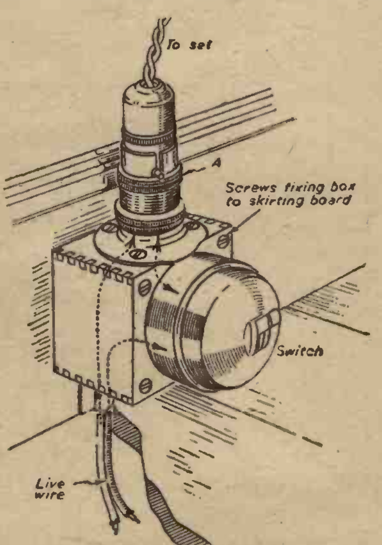
connecting wire being slipped into the other end.

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



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

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SPECIAL NOTICE

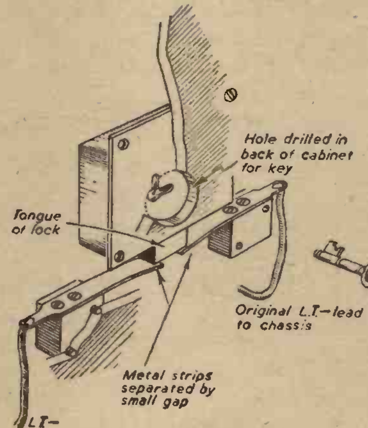
All hints must be accompanied by the coupon cut from page iii of Cover.

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 Simple Lock Switch

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

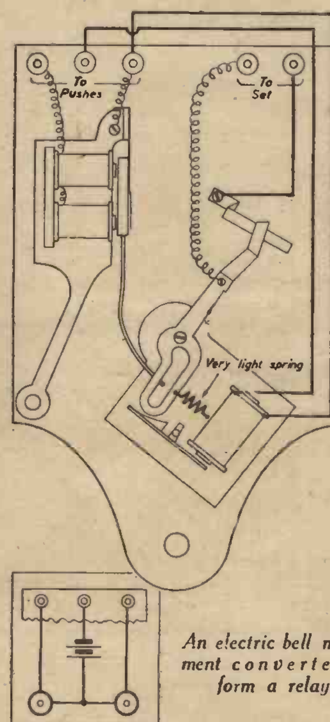


A novel lock switch

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 and Unusual Type of Rece

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.

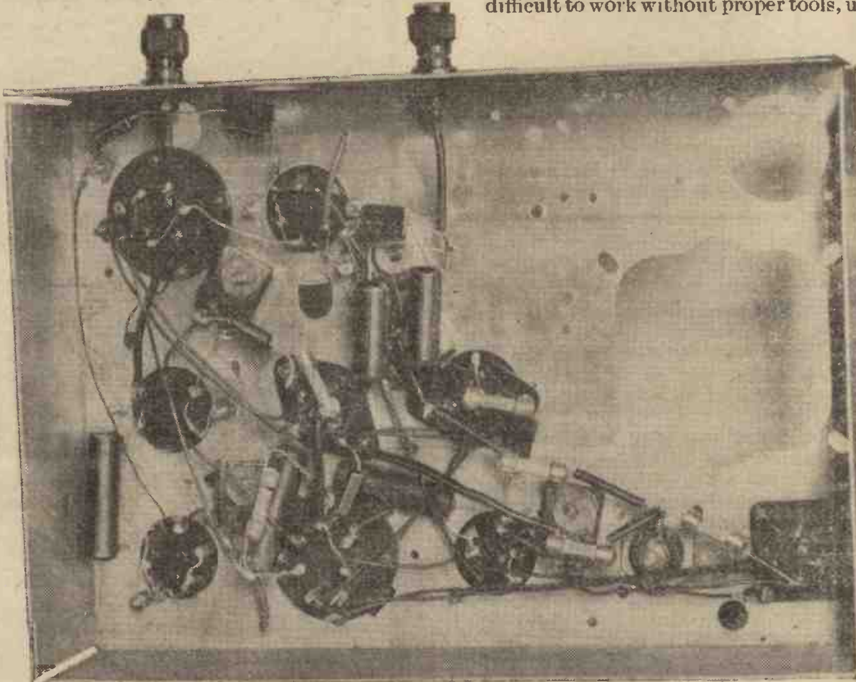


Fig. 6.—Underside view of the chassis showing components and wiring.

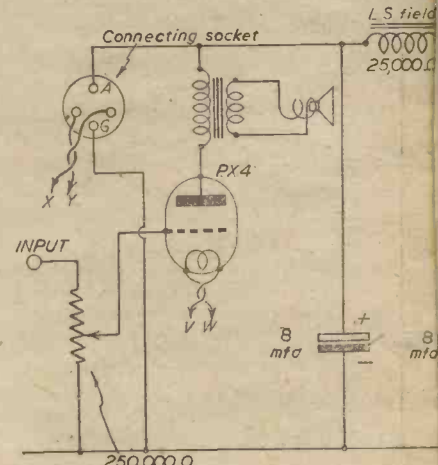


Fig. 5.—Alternative amplifier and

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

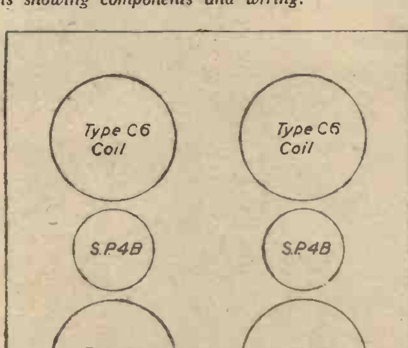


Fig. 3.—Suggested chassis layout for those who wish to use a new chassis.

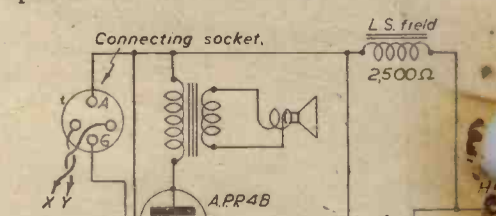


Fig. 4.—Mains section and Power Amplifier for use Receiver.

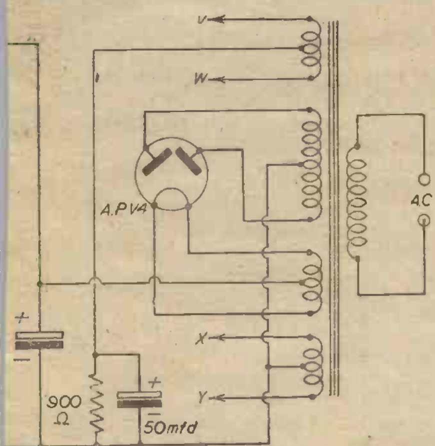
Y RECEIVER

l 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.



mains 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.

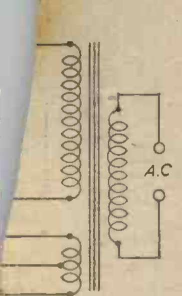
It should be noted that as the SP4B valves have their control grids brought out to the top cap, it is necessary to bring the leads from terminal 1 of the C.6 coils up through the chassis. Similarly, the top red leads of the C.7 coils have to be taken down through the chassis for connection to the SP4B 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.



with 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.

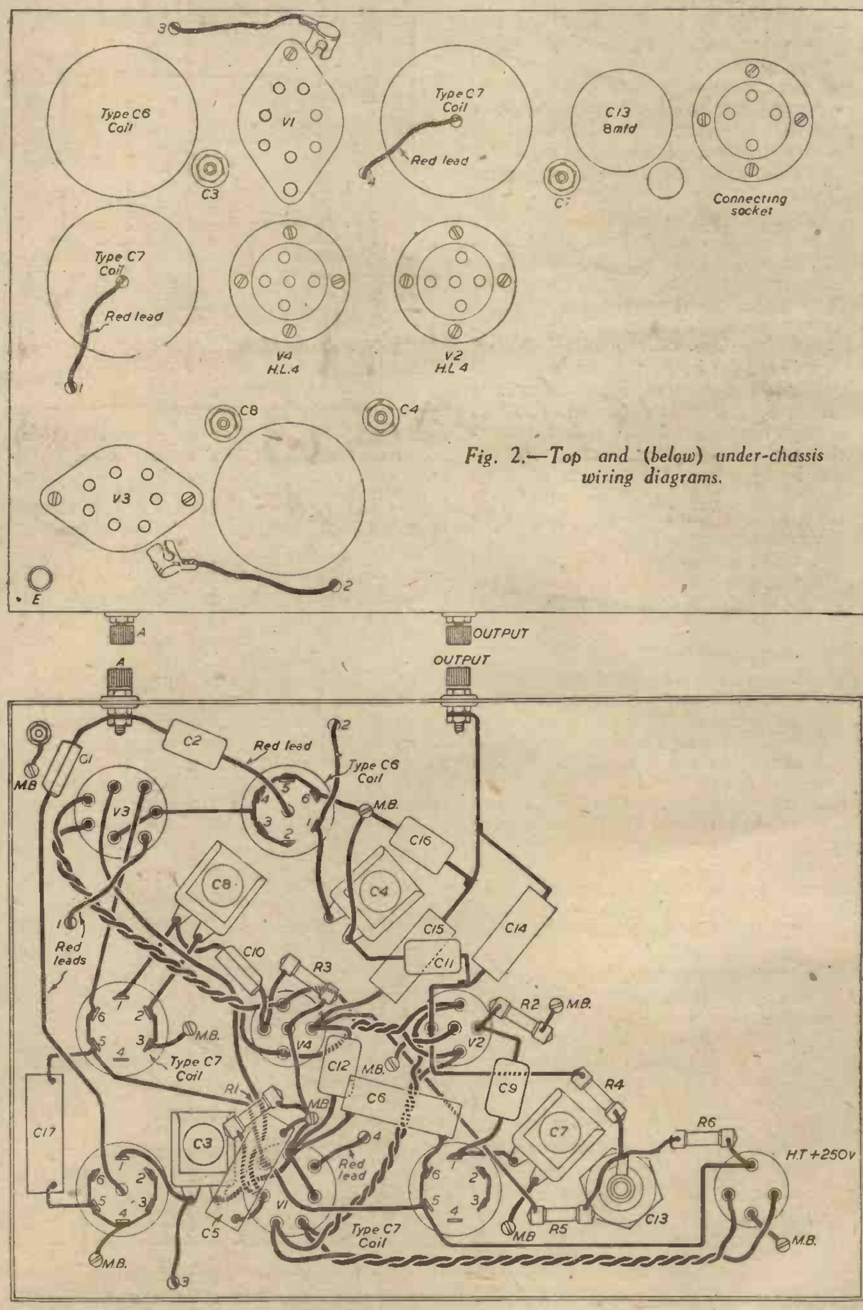


Fig. 2.—Top and (below) under-chassis wiring diagrams.

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

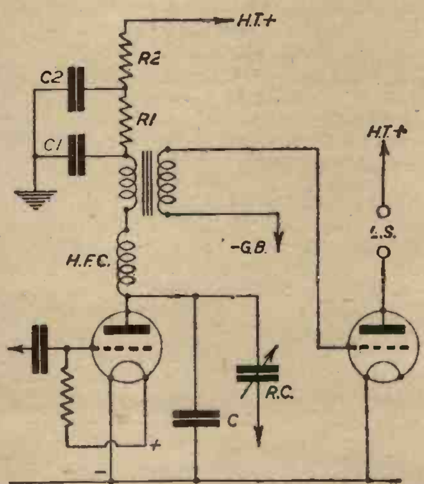


Fig. 4.—Double-decoupling added to the anode circuit of the original detector stage.

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

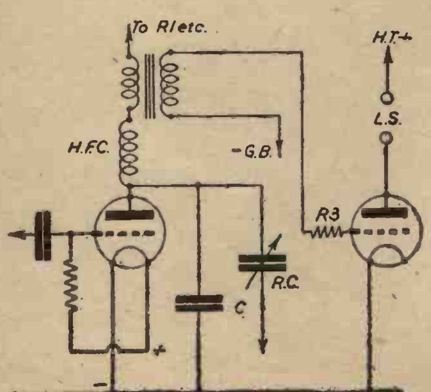


Fig. 5.—Showing the position of the grid H.F. stopper resistance R3 in a transformer-coupled stage.

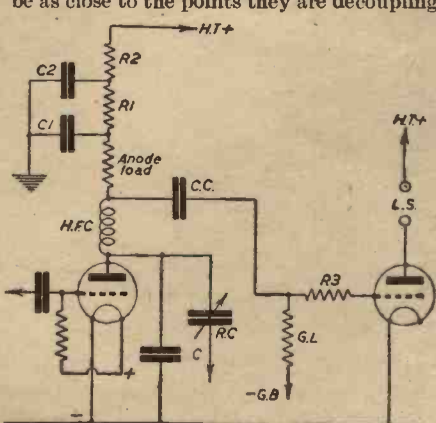


Fig. 6.—With resistance-capacity coupling, care must be taken to see that R3 is wired in the correct position relative to the G.L.

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

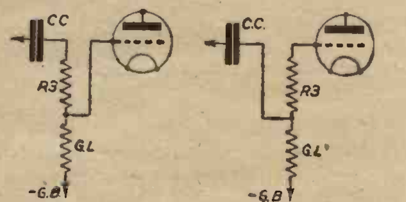


Fig. 7.—Shows the actual network formed by R3 and G.L. The method shown on right is correct.

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."

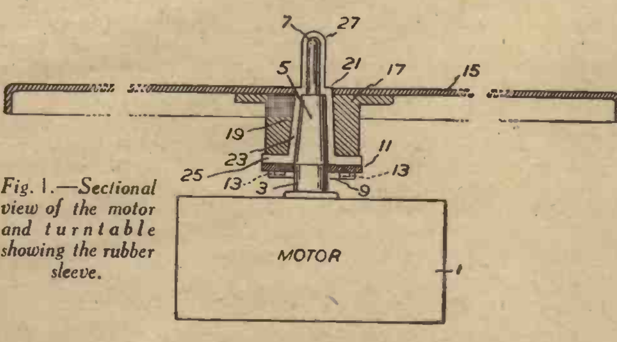
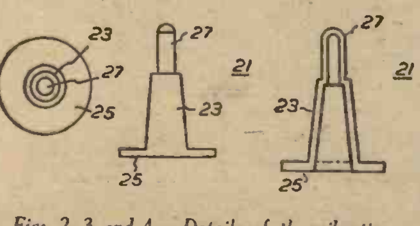


Fig. 1.—Sectional view of the motor and turntable showing the rubber sleeve.

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: $a = side^2$; 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 $=\frac{1}{3}(8\sqrt{\frac{S^2}{4}+v^2}-s)$;

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 $=\frac{\text{circ. of base}\times\text{slant length}}{2}+$ base; contents=area of base $\times\frac{1}{3}$ vertical height.

Frustum of cone: surface= $(C+c)\times\frac{1}{2}$ 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 $=\pi d$ (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 $3\frac{1}{7}\times$ length.
Capacity $=3\frac{1}{7}\times$ 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

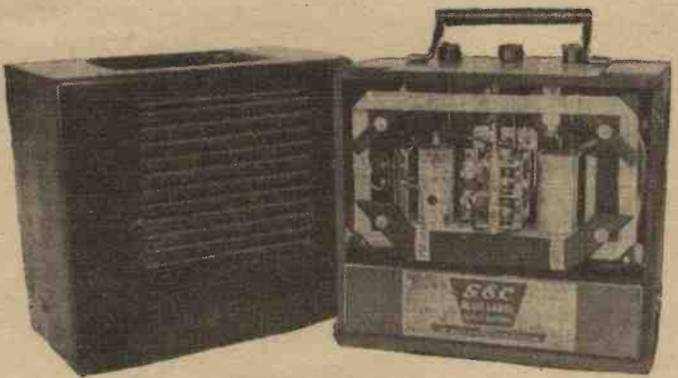
One ft. lb.	1 lb. raised 1 foot high.
One BTU	1,055 joules.
One BTU	778.8 ft. lbs.
1 watt	10 ergs per second.
1 watt	23.731 foot poundals per second.
1 watt	0.7376 ft. lb. per second.
1 watt	0.001341 h.p.
One HP hour	0.746 kW. hour.
One HP hour	1,980,000 ft. lbs.
One HP hour	2.545 BTU's.
One kwH. (kilowatt 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 7¾ins. 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.

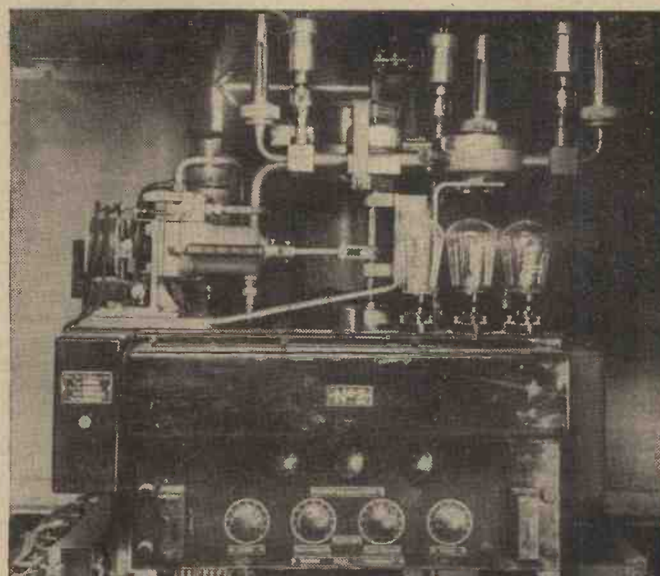
IN an endeavour to provide a satisfactory form of remote control which can be usefully applied, for example, to the remote tuning of a radio receiver, many schemes have been tried, and one of the latest to be disclosed makes use of the fundamental operating characteristics of a photo-electric cell which 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 electromagnetic 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).

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.

The "Rapid Two"

SIR,—Recently I reconstructed, for standby 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 headphones. A speaker works very well on the other six, but I was unable to identify the long-wave stations. In my opinion a wavetrap 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).

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, Linningley, Nr. Doncaster, Yorks.

Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS

	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	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

	Date of Issue.	No. of Blueprint.
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

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.

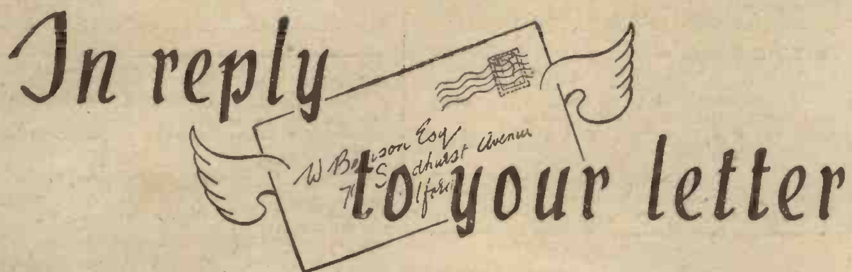
Issues of Practical Wireless ...	**4d.**	**Post Paid**
Amateur Wireless	**4d.**	**" "**
Wireless Magazine	**1/3**	**" "**

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.

	Date of Issue.	No. of Blueprint.
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



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 $\frac{1}{C2}=\frac{1}{C1+C}$. 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.

RECEIVERS AND COMPONENTS

BARGAINS in radiograms and receivers, new and used, £1 to £75. Part or complete exchanges. 2½d. stamp for complete lists.—Stewart and Roberts, Amersham.

5/- BARGAIN PARCEL comprising Speaker Cabinet, 2 Drilled Chassis, condensers, resistances and many other useful components. Worth £2. Limited number. Postage 1/-.—Bakers Selhurst Radio, 75, Sussex Road, South Croydon.

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.

SHORT-WAVE EQUIPMENT

"H.A.C." one-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Road, S.W.8.

TECHNICAL PUBLICATIONS

R.S.G.B. AMATEUR RADIO HANDBOOK, 300 pages, 3s., by post.—16, Ashridge Gardens, London, N.13.

TUITION

PRACTICAL Postal Courses, radio television, test equipment design, trade-test coaching for R.A.F. posts, I.P.R.E. and I.W.T. exams.; booklet free.—Secretary, I.P.R.E., 3, Shirley Road, London, W.4.

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

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HOW MUCH HIGH TENSION?— See Page 219

A NEWNES PUBLICATION

Edited by F. J. CAMM

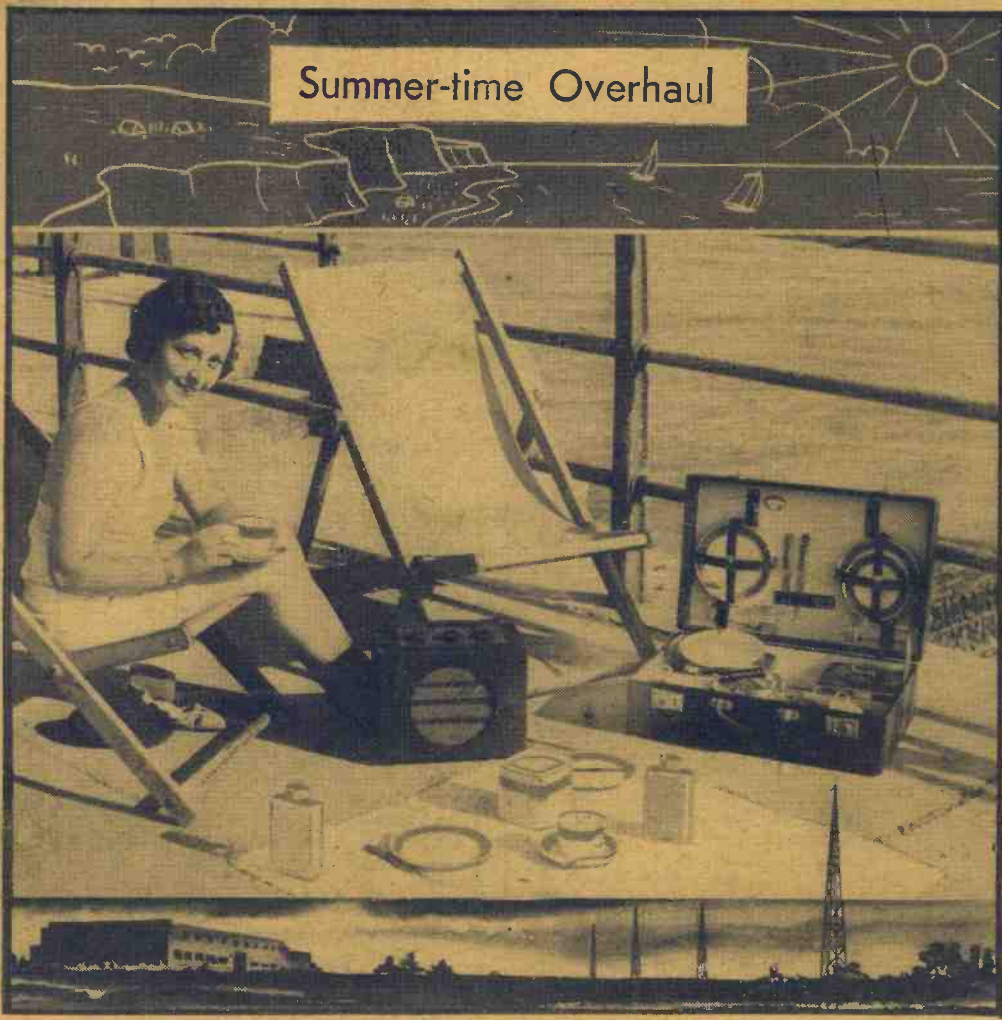
Vol. 16. No. 401.

Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

May 25th, 1940.

Contents



NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 113.

FORCE

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

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

ENERGY

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

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

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

No. 114.

POWER

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

ELECTRICAL EQUATIONS

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

No. 115.

HEAT

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

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

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

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

TIME

1 sidereal second=0.99727 second (mean solar).

1 second (mean solar)=1.002738 sidereal second.

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

No. 116.

ENGLISH WEIGHTS & MEASURES

LONG MEASURE

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

AREA (Square Measure)

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

MEASURES OF VOLUME AND CAPACITY (Cubic Measure)

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

No. 117.

MEASURE OF CAPACITY (Liquid or Dry Measure)

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

Wine Measure

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

Ale and Beer Measure

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

No. 118.

Avoirdupois Weight

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

Apothecaries Weight

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

Apothecaries' Fluid Measure

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

Diamond and Pearl Weight

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

Paper Measure

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

Troy Weight

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

(See also page 223.)

Practical Wireless and PRACTICAL TELEVISION

EDITED BY F. J. CAMM

EVERY WEDNESDAY
Vol. XVI. No. 401. May 25th, 1940.

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

ROUND THE WORLD OF WIRELESS

Your Copy of the RADIO TRAINING MANUAL

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

Summer-time Conditions

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

Midlands v. Wales in Darts

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

Rugby League Commentary

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

Double Bill Programme

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

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

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

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

Flanagan and Allen

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

"Melody and Co."

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

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

THE AMATEURS' ACTIVITIES

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

By L. O. SPARKS

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

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

Theoretical Knowledge

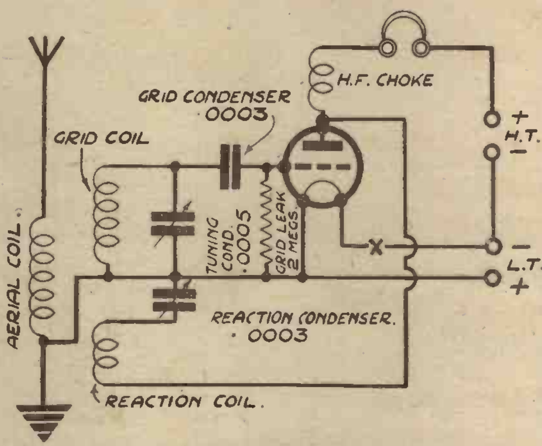
A theoretical knowledge is undoubtedly essential and forms a valuable asset. Without it, the amateur's path will not be too easy, and what is even more important he will not be able to obtain the maximum interest from his hobby. The point to be stressed, however, is that the knowledge of theoretical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

Aerials

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

Experimental Subjects

Here are a few of the items which lend themselves to interesting experimental work. Location, i.e., effect of surrounding objects; whether any screening is produced by these, or does the proximity of trees, overhead wires or houses have any absorption effect on the signals. The height of the horizontal portion of the aerial; its effect



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

on signal strength and interference. The best proportion between lead-in and horizontal portion; screened and unscreened down-leads; directional effects; where possible, try the aerial in different compass directions and note the effect on stations over all compass points. Various types of aerial; single or twin down-leads; effect of gauge of wire used, and any variation of efficiency with relation to insulation of aerial at points of suspension in all weathers.

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

Inductance

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

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

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

Circuits

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

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

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

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

Log Books

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

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

Testing Equipment

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

Alternating Current Circuits

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

By FRANK PRESTON

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

It is not possible to cover the matter

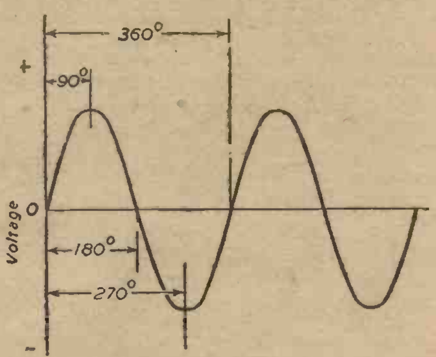


Fig. 1.—A typical sine curve representing an alternating voltage.

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

The Nature of A.C.

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

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

Direction of Current Flow

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

Continued rotation causes that side of the loop which was travelling downward to rise, and that which was rising to fall. Thus, the induced current flows in the opposite direction. Apart from the direction of current flow, the sequence of events is exactly as before. Thus, by the time the loop has made a complete circle, the current (and voltage) has varied from maximum

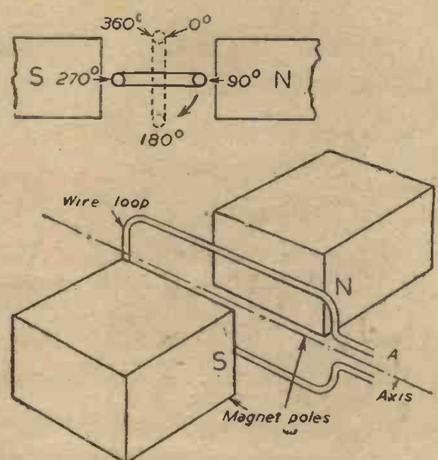


Fig. 2.—Diagram to illustrate the principles of an A.C. generator. The inset illustrates the angular positions of the loop corresponding with the points marked in Fig. 1.

positive to maximum negative and has passed through zero. That should help to make the so-called sine curve more readily understandable.

Why the Name?

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

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

The R.M.S. Value

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

Resistance to A.C.

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

As often stated in these pages, the reactance of a condenser is $1/2\pi fC$, where π is the standard 3.14, f is the frequency in cycles per second, and C is the capacity in

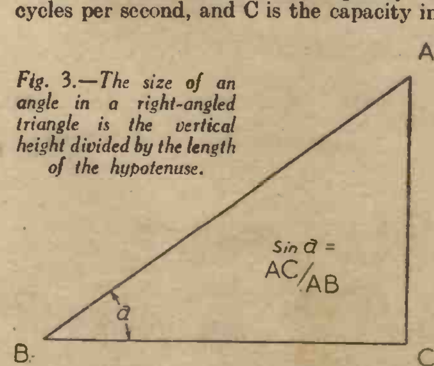


Fig. 3.—The size of an angle in a right-angled triangle is the vertical height divided by the length of the hypotenuse.

farads. If reactance is substituted for resistance in Ohm's Law it is possible to calculate the current flowing in an A.C. circuit containing a condenser from the formula: I=E/X, where E is the voltage and X the reactance.

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

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

(Continued on next page)

ALTERNATING CURRENT CIRCUITS

(Continued from previous page)

Series Reactances

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

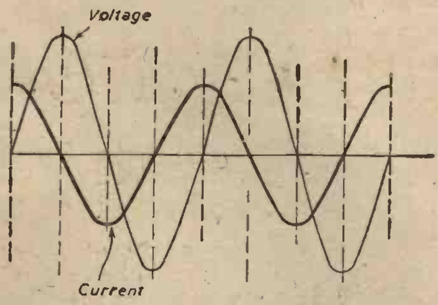


Fig. 4.—In an A.C. circuit containing a series capacity, the current "leads" the voltage by 90°.

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

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

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

A SIMPLE U.S.W. CIRCUIT

And Notes on Tuned Radio-frequency Working

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

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

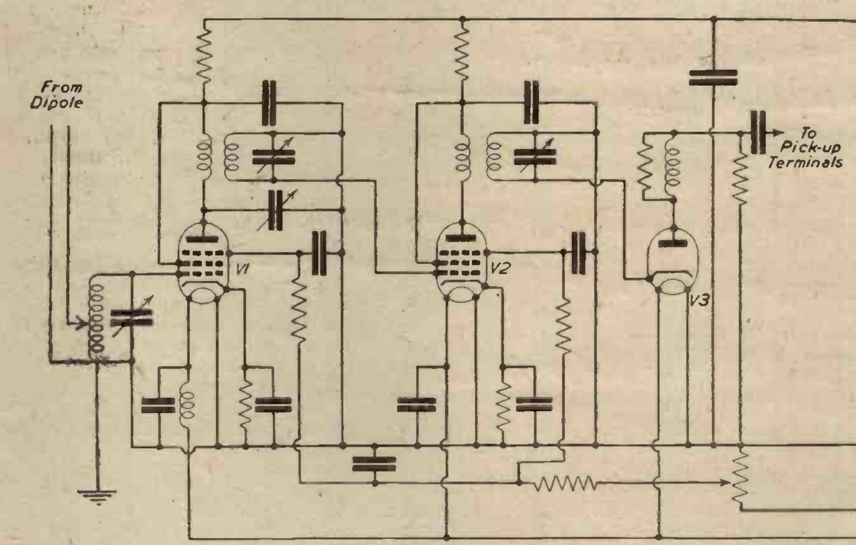
T.R.F. Working

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

Gain Control

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

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



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

Is Full-wave Detection Impossible?

An Interesting Analysis on this Important Subject

By D'ARCY FORD

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

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

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

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

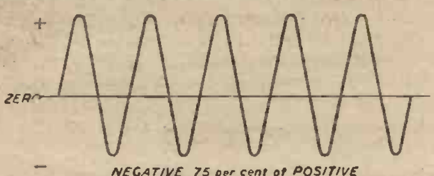


Fig. 3.—This curve shows the waveform with 75 per cent. negative amplitude.

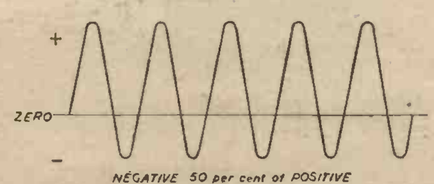


Fig. 4.—In this diagram the waveform shows the negative half-cycle 50 per cent. of the positive.

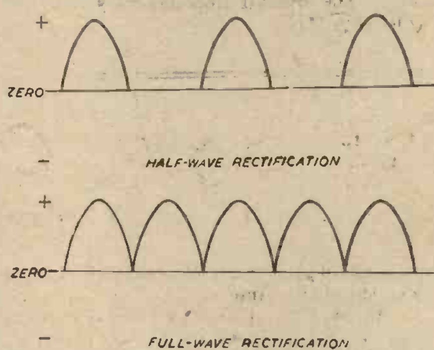
Radio Frequencies

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

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

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

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



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

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

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

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

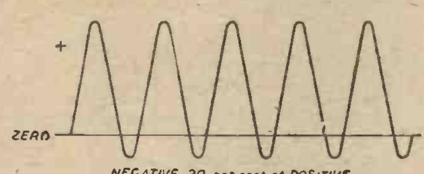


Fig. 5.—In this waveform the negative amplitude is only 20 per cent. of the positive.

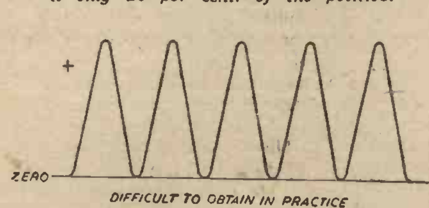


Fig. 6.—A zero negative potential is indicated by the waveform in this diagram.

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

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

Modulated Wave

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

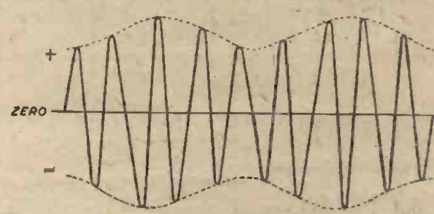


Fig. 7.—This shows the waveform of a modulated wave in accordance with accepted theory.

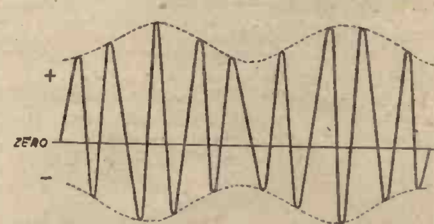


Fig. 8.—This shows the output from a detector by a method of detection which displaces the zero voltage line so that the negative amplitude of the output is 50 per cent. of the positive (refer to Fig. 4).

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

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

(Continued on page 220).

Obtaining Maximum Efficiency from a Class AB Amplifier

An Interesting Resistance-coupled Push-pull Amplifier Circuit

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

The circuit of the amplifier is shown in Fig. 1, and it will be seen to consist of two pentode valves (type 6F6) in the output stage driven by a double-triode (type 6N7) phase inverter. The amplifier is below that value of anode current lying midway between that corresponding to zero grid voltage, and grid voltage corresponding to anode current cut-off. This is indicated at 68 in Fig. 2. The operating condition established is such that one valve will be cut off before the other valve reaches zero grid voltage, and the amplifier may thus operate Class AB. The operation is prevented from extending beyond Class AB by the fact that the grids are resistance-capacity coupled and include relatively high resistance elements in circuit, which prevent drawing grid current. It is, therefore, a problem to obtain maximum power output without drawing grid current, and for this reason the load line 65 of the push-pull operated valves is caused to pass through the $E_g = O$ curve at the knee 66 of the curve, thereby permitting maximum power output to be developed without grid current. Therefore, resistance-capacity coupling may be used, as shown in Fig. 1, between the driver stage and the output stage. This is advantageous in providing phase inversion between the usual diode detector and the output power amplifier of a radio receiver.

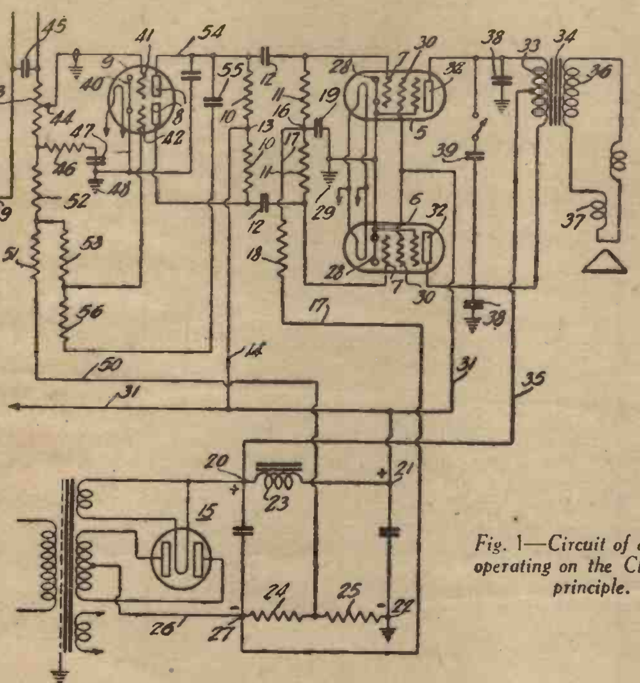


Fig. 1—Circuit of amplifier operating on the Class AB principle.

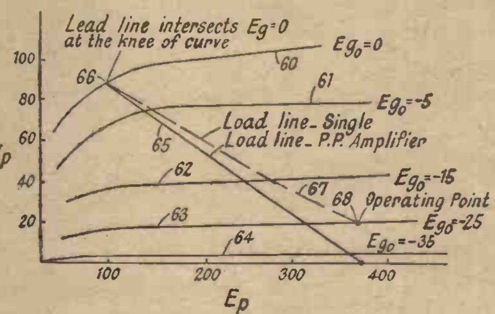


Fig. 2.—Plotting of the load line for different working voltages

resistance-coupled, which precludes the driving of the output valves into grid current. The anode resistors for the phase inverter may be 100,000 ohms with coupling capacitors of 0.01 mfd. and grid resistors of 270,000 ohms. The bias for the push-pull output stage is obtained from the two resistors in series in the H.T. negative lead.

Load Impedance

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

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

The load line for a single valve is indicated at 67, and the operating point 68 thereon is so chosen that the valves are biased initially, in the absence of signals, close to anode current cut-off, i.e., considerably

Maximum Power Output

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

ON YOUR WAVELENGTH

By Thermion

The Length of Receiving Aerials

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

The Woman Announcer

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

Price Control of Radio

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

Ganged Inductances

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

Happy Landing

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

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

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

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

B.B.C. Symphony Concerts at Bristol

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

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

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

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

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

The Home Front in France

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

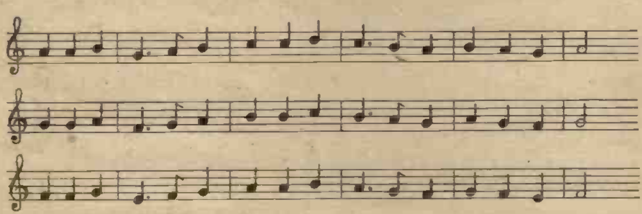
Comment, Chat and Criticism

Musical History—1

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

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

A B C



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

First System of Notation

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

Early Musical Instruments

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

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

The Tonic Sol-fa

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

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

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

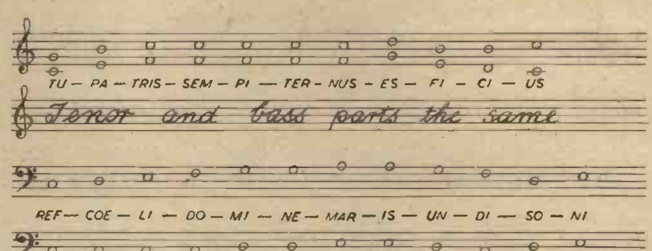
Hebrew music, probably derived from the Egyptian, was largely Eastern in character. The Old Testament is full of proof that the Jews were, musically, far in advance of the Greeks, or any previous civilisation. Sir W. H. Hadow says: "It is not too much to say that the Old Testament is saturated with a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

Recorded Notes

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

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

D E



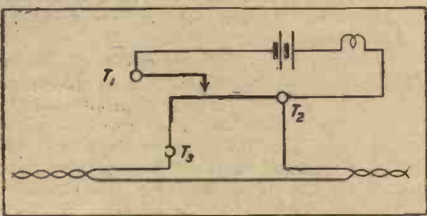
Two examples of early musical notation taken from Burney's History.

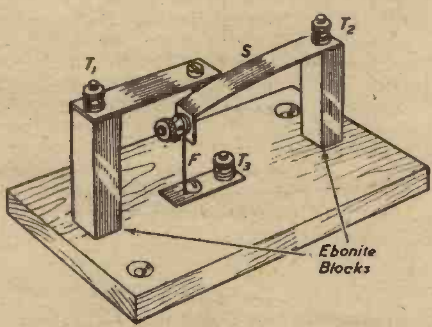
Mention should be made of the earliest examples extant of part singing as we know the term to-day; a piece of music containing the elements of harmony, melody, time and rhythm as now universally practised. It is the celebrated "Reading," "Rota," or "Round" "Summer is icumen in, lhude sing cuccu," written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

Practical Hints

An Automatic Emergency Light

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





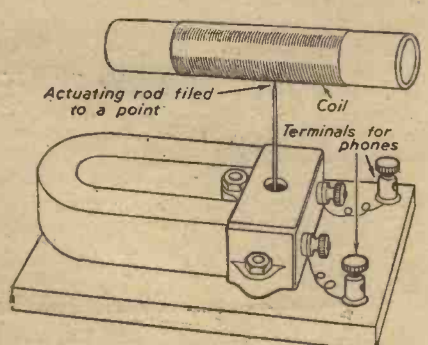
A novel switching arrangement for emergency lighting.

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

Counting Coil Windings

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

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



An improvised counter for fine coil windings.

THAT DODGE OF YOURS!

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

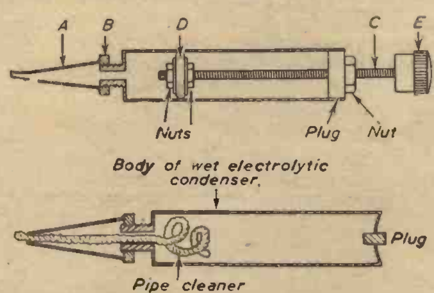
SPECIAL NOTICE

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

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

A Flux Gun and Switch Cleaner

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

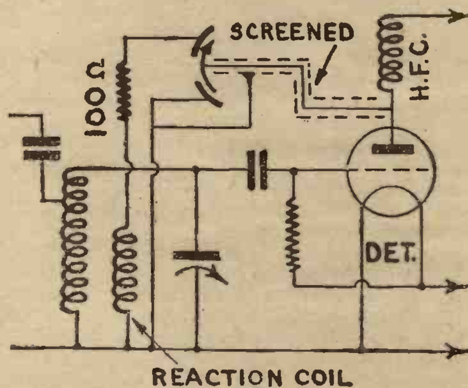


This handy flux gun and switch cleaner were contrived from old condenser cases.

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

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

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

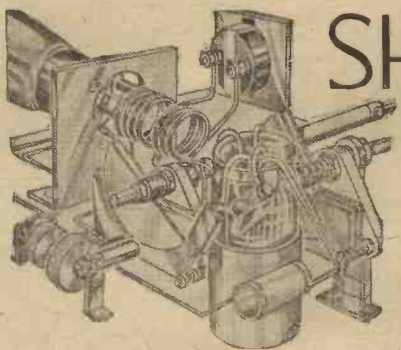


Circuit diagram showing how a reaction difficulty was overcome.

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

Smoother Reaction

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



SHORT-WAVE SECTION

USING A SHORT-WAVE CONVERTER

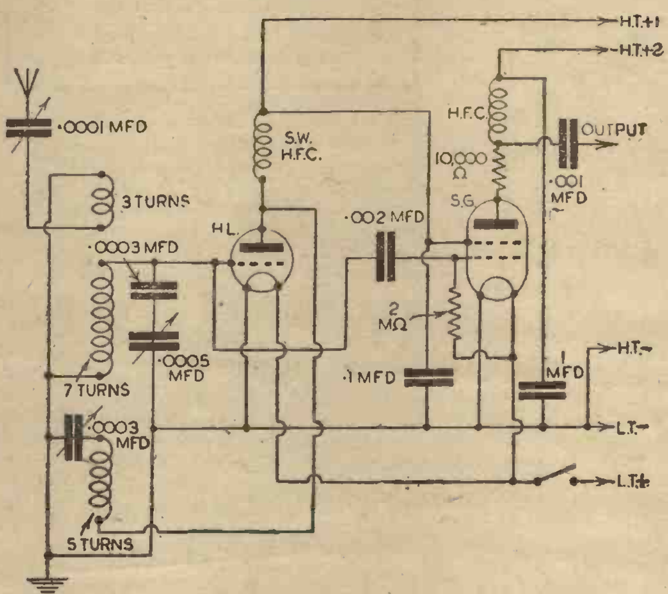
How to Ensure Maximum Results from a Converter-receiver Combination.—By W. J. DELANEY.

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

Battery Connections

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

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



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

Double Tuning

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

Tuning Range

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

HOW MUCH HIGH TENSION?

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

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

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

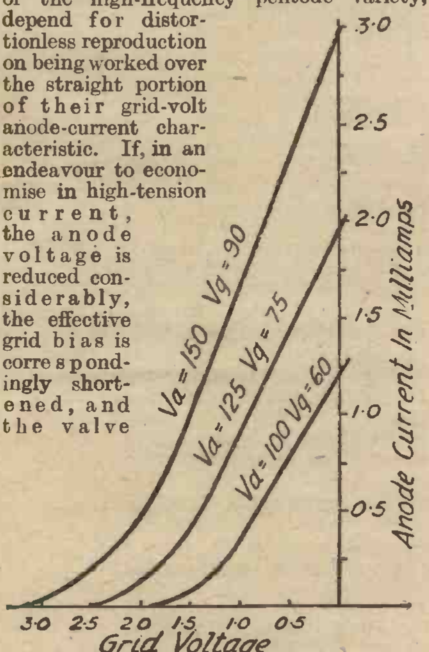


Fig. 1.—A family of static characteristic curves for a screen-grid valve.

Affecting Over-all Performance

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

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

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

Best Detector Conditions

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

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

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

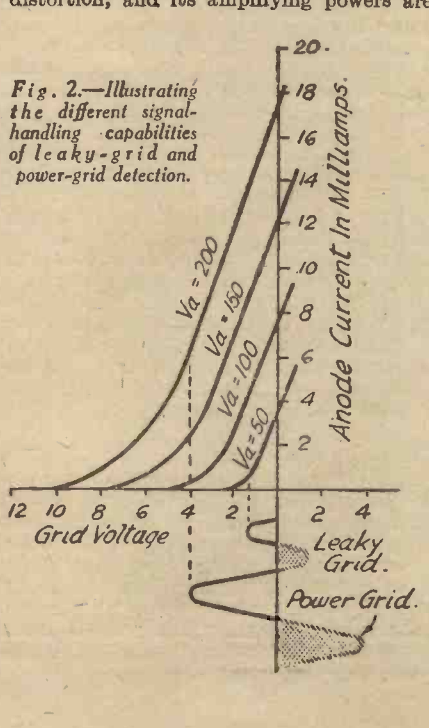


Fig. 2 illustrates the effect of power-grid detection when compared with the ordinary leaky-grid system, the difference in signal-handling capabilities and in anode-current consumption being illustrated very clearly.

It is, however, in connection with the output stage that the ill effects of parsimony in high-tension supply are perhaps most noticeable. It should be borne in mind that in the output stage is generated the actual power required for driving the loudspeaker.

In all other stages the only effect required is to produce in the anode circuit of the valve as large an alternating current as possible; the power question does not enter into the matter, and the consumption of anode current is merely incidental and perhaps unfortunate. But the output valve must provide a considerable amount of alternating power, as represented by the product of alternating voltage developed across the "load" in the anode circuit (speaker or output transformer) and the alternating portion of the anode current.

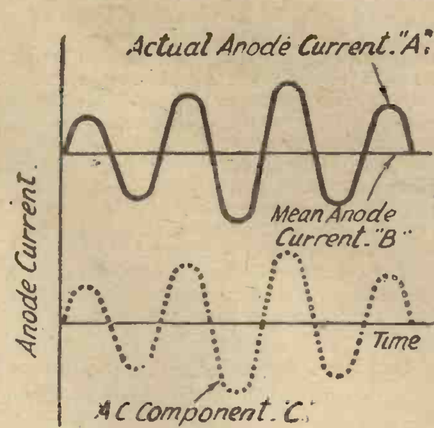


Fig. 3.—The steady or mean output current with the alternating component superimposed.

Insensitive Large Speakers

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

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

If, therefore, a really large output is

HOW MUCH HIGH TENSION?

(Continued from previous page)

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

Question of Cost

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

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

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

Battery Types

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

IS FULL-WAVE DETECTION IMPOSSIBLE?

(Continued from page 213).

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

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

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

The British Long-Distance Listeners' Club

Disappointing News

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

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

DX Contest

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

An Interesting Point

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

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

Diversity Receivers

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

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

Station Equipment

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

With the Services

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

Contacts Required

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

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

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

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

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

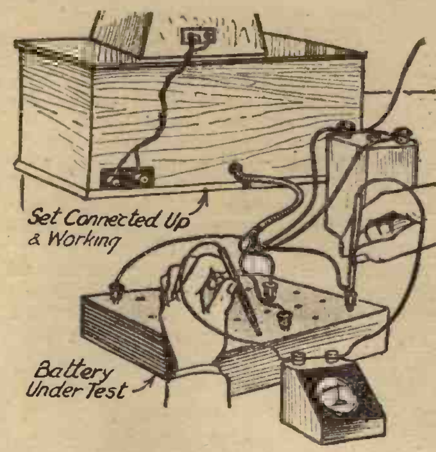
Redditch: Member 6565, of 43, Batchley Road, Redditch, Worcs.

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

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

Summer-time Overhaul

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



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

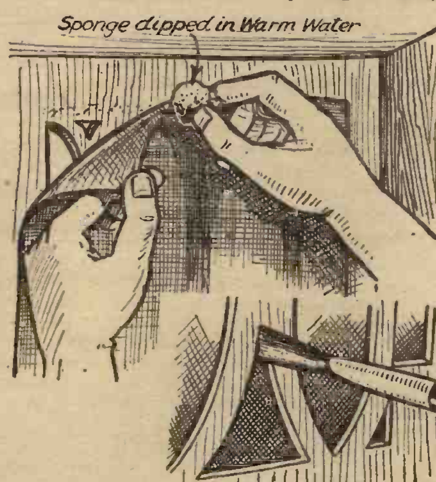
WINTER time is the station hunter's paradise, but in the summer time he is confronted with conditions for distant reception entirely different from those ruling in the cold-weather period. During the winter, foreigners roll in one after the other with monotonous regularity and even the modest one-valver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

Compensating for Weak Signals

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

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

Remove the receiver and the loudspeaker from the cabinet and any other gadgets which may have been fixed to it. If the material which covers the fret looks dirty, take this out and have it washed, or if a change in design is required, fit a new piece. The easiest way to remove the material if it is wanted again is to damp where it is glued (round the edges) with warm water. The glue will soften and the material may be gently pulled away. If the material is not required again, it can be torn out carefully and the excess glue and odd ends removed with a scraper. When everything is clear, go over the inside of the cabinet and all the interstices of the fret with a small, stiff brush and remove all traces of dust that could not be removed when the silk was in. Go over the outside with a rag doped with a good furniture polish and regain some of the original finish. If any hinges or locks are fitted to the cabinet, these should be cleaned up and treated to a spot of oil. Many broken hinges are the result of not looking after this small point.



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

Spring-cleaning the Receiver

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

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

(Continued on next page)

SUMMER-TIME OVERHAUL

(Continued from previous page)

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

Attending to the Batteries

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

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

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

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

Aerial and Earth

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

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

NEW SERIES

RADIO ENGINEER'S POCKET BOOK

No. 119.

HORSE-POWER

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

Horse Power of an Electric Motor

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

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

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

where P=Mean effective steam pressure in lb. per sq. in.
L = Length of stroke in feet.
A = Area of piston in sq. in.
N = Number of revolutions per minute.

For a double-acting engine the formula is:

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

Horse Power of Petrol Engine:

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

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

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

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

No. 120.

Wire and Sheet-metal Gauges—4

Number of Gauge	Lancashire Steel Wire Letter Gauge in.	Lancashire Steel Wire Letter Gauge mm.	London or Old English in.	London or Old English mm.	Morse Steel Wire Gauge for Drills in.	Morse Steel Wire Gauge for Drills mm.	Music Wire Gauge, English in.	Music Wire Gauge, English mm.	Music Wire Gauge, Washburn & Moen in.	Music Wire Gauge, Washburn & Moen mm.
13	N .302	7.67	.095	2.413	.185	4.697	.027	0.685	.031	0.787
14	M .295	7.48	.083	2.108	.182	4.620	.028	0.711	.032	0.812
15	L .290	7.36	.072	1.828	.180	4.57	.031	0.787	.034	0.863
16	K .281	7.13	.065	1.65	.177	4.487	.0314	0.797	.036	0.914
17	J .277	7.02	.058	1.473	.173	4.335	.034	0.863	.037	0.939
18	I .272	6.90	.049	1.244	.169	4.288	.035	0.889	.039	0.990
19	H .266	6.75	.040	1.016	.166	4.212	.039	0.990	.041	1.011
20	G .261	6.62	.035	0.889	.161	4.085	.041	1.041	.043	1.092
21	F .257	6.5	.031	0.787	.159	4.038	.046	1.168	.046	1.168
22	E .250	6.35	.029	0.736	.157	3.987	.049	1.244	.048	1.219
23	D .246	6.24	.027	0.685	.154	3.911	—	—	.051	1.295
24	C .242	6.14	.025	0.635	.152	3.860	—	—	.055	1.397
25	B .238	6.04	.023	0.584	.149	3.778	—	—	.058	1.473
26	A .234	5.94	.020	0.508	.147	3.727	—	—	.062	1.574
27	—	—	.018	0.457	.144	3.651	—	—	.065	1.651
28	—	—	.016	0.406	.140	3.55	—	—	.072	1.828
29	—	—	.015	0.381	.136	3.452	—	—	.076	1.930
30	—	—	.013	0.330	.128	3.243	—	—	.080	2.03
31	—	—	.012	0.304	.120	3.04	—	—	—	—
32	—	—	.011	0.279	.116	2.942	—	—	—	—
33	—	—	.010	0.254	.113	2.866	—	—	—	—
34	—	—	.0095	0.241	.111	2.815	—	—	—	—
35	—	—	.009	0.228	.110	2.79	—	—	—	—
36	—	—	.0075	0.19	.106	2.692	—	—	—	—

No. 121.

Resistance Values for Decoupling and Voltage Dropping

VOLTAGE DROPPED

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

1 watt 2 watt 3 watt

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

No. 122.

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

VOLTAGE DROPPED

Current mA	70	80	90	100	125	150	175	200	
1	70,000	80,000	90,000	100,000	125,000	150,000	175,000	200,000	
2	35,000	40,000	45,000	50,000	62,500	75,000	87,500	100,000	
3	25,000	30,000	30,000	30,000	40,000	50,000	50,000	75,000	1 *watt*
4	17,500	20,000	25,000	25,000	30,000	40,000	40,000	50,000	
5	15,000	17,500	20,000	20.000	25,000	30,000	40,000	40,000	
10	7,000	9,000	9,000	10,000	12,000	15,000	17,500	20,000	2 *watt*
15	5,000	5,000	6,000	7,000	9.000	10,000	12,000	15,000	3 *watt*
20	5,000	5.000	5,000	5,000	7,000	9,000	9,000	10,000	4 *watt*
25	2,500	2,500	5,000	5,000	5,000	5,000	7,000	8,000	5 *watt*
30	2,500	2,500	2,500	5,000	5,000	5,000	7,000	7,000	6 *watt*
40	2,000	2,000	2,500	2.500	2,500	5,000	5,000	5,000	8 *watt*
50	1.500	1,500	2,000	2.000	2,500	2,500	2,500	5,000	10 *watt*

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

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

Notes from the Test Bench

Output Measurements

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

Identifying Leads

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

"Britain and the Mediterranean"

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

Open to Discussion

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

A Good S.W. Log

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

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

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

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

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

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

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

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

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

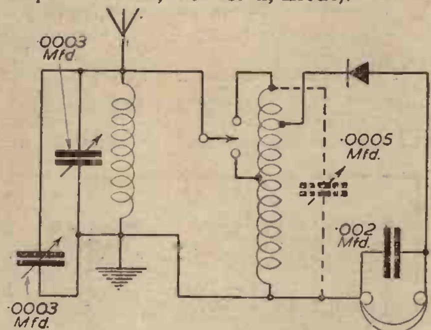
Novel Circuit for a Crystal Set

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

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

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

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



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

An Efficient Three-valve Circuit

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

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

Prize Problems

PROBLEM No. 401.

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

Solution to Problem No. 400.

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

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

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

"Dead Spots"

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

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

A 14mc's Log from Wandsworth

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

1. 66ft. indoor, N.W.-S.E.-S.W.-W.-E.
2. 45ft. E.-W. under the eaves of the roof.
and 3. 16ft. V-beam directed on Asia (N.E.).

Fone and C.W.:

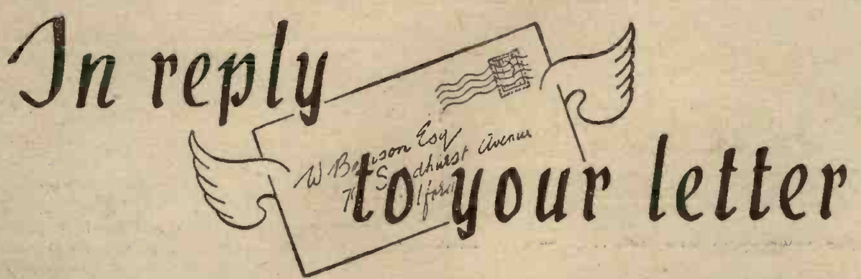
AC4MI, CE1AR, 1AS, 3CZ; CO2GY, 2LY, 2OY, 5BA, 6OM, 7CS, 7CX, 8MP; CX2CO, D6AWY, EA7A, 9BA; EK1AF, ES1E, 4G, 5C, 5D, 6E; HA1I, 2P, 3B, 6K, 7N, 8B, 8S, 8T; HH2HB, HI1P, 3N, 5RC; I1KTG, 7AA; K6NYD, 6PLZ, LU4KO, 5CK; LY1BE, 1DD, 1G, 1J, 1MB; LZ1ID, OK3ID, 3ZN; OQ5BF, PY1GJ, 1ME, 2CK, 2ET, 2MI, 5AD; TG5JG, 9BA, U3BM, 3BX, 3DS, 5YH, 8IL, 9MJ; UE2GB, 3KP, 3KQ; UK3AH, W1ADM, BCX, ISB, IKU, JA, JFG, KJJ, LPY, OR; W2AD, BCK, PBC, CRB, ECR, HFM, IXY, LBK, LLB, MTC; W3BNC, EOZ, EQZ, FAM, HFD, HGN; W4ARW, DCQ, FUT; W5AKZ, BEK, SMO, W6BGW, ITH, MRB, MYO, NJV, PCV; W7ACD, EKA, GMV, HIA (Oreg.); W8ACY, BYR, CRA, CUO, JSU, LA, NJP, PMP, RHP; W9AKI, DAY, ELK, NDA, TI; YU7AY, 7LX; YV1AQ, 1AV, 4AE, and 5ABE.

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

Correspondents Wanted

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

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



Superhet Design

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

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

Direct-coupled Amplifier

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

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

U.S.W. Tuning

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

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

RULES

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

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

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

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

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

H.F. By-passing

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

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

Making Astatic Choke

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

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

Weak Output

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

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

REPLIES IN BRIEF

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The coupon on page 228 must be attached to every query

Practical Wireless
BLUEPRINT SERVICE

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

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

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

PRACTICAL WIRELESS

	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.3.37	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
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Wilson Tone Master (1/-)	*June* '36	WM406
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LATEST PATENT NEWS

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NEW PATENTS

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

Latest Patent Applications.

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

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

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

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

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

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

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

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

Specifications Published.

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

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

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

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

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

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

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

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

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

Push-button Receiver Refinements

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

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

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

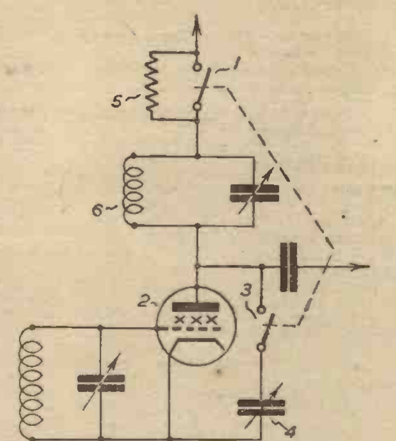

Diagram showing how the circuit switching is carried out.

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

CORRECTION

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

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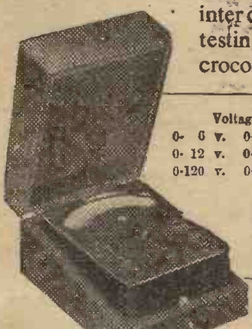

Voltage		Current
0- 6 v.	0-240 v.	0- 6 m/amps.
0- 12 v.	0-300 v.	0- 30 m/amps.
0-120 v.	0-600 v.	0-120 m/amps.

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0-1,200,000 ohms.
0-3 megohms.

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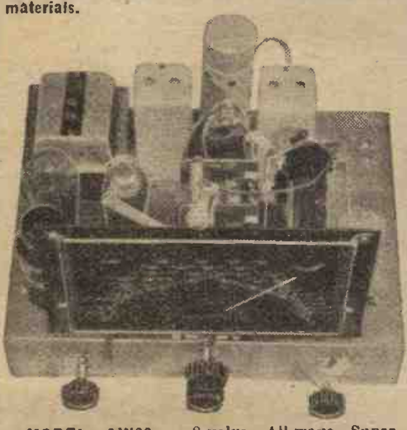
ARMSTRONG

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



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