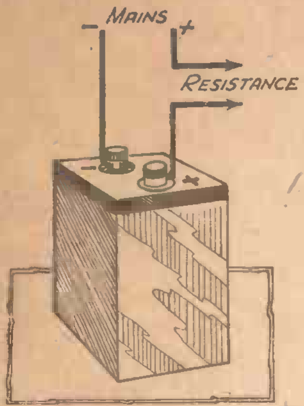
Presented with PRACTICAL WIRELESS, dated December 17th, 1932.

"PRACTICAL WIRELESS" DATA SHEET No. 1

Accumulator Charging



Charging from D.C. Mains.

The simple method of joining an accumulator to D.C. mains for charging purposes. The positive lead from the mains must be broken, and a suitable resistance inserted in this lead. A carbon or metal-filament lamp forms a very good resistance, and the table at the side shows the current passed by the different values of lamp. Of course, any form of resistance may be employed provided it regulates the current to a suitable value. An ammeter may be used to adjust this, and the charging rate should not exceed that which is given on the label of the accumulator.

Notes on Carbon Filament Lamps.—Carbon filament lamps are used for charging purposes chiefly because they take almost four times as much current per candle-power as do metal lamps.
The table shows the current allowed by one lamp of the candle-power indicated on the various voltages shown.
If the lamps available are only stamped in watts they consume, to find how many such lamps are required multiply the voltage of supply by the charging current required. This will give the total watts required.

Current in Amperes per Lamp.	Voltage of Supply.				
	25	50	100–200	200–250	
¼	—	—	8 c.p.	16 c.p.	At 4 watts per c.p.
½	—	8 c.p.	16 c.p.	32 c.p.	
1	6 c.p.	16 c.p.	32 c.p.	60 c.p.	
2	12 c.p.	32 c.p.	60 c.p.	100 c.p.	

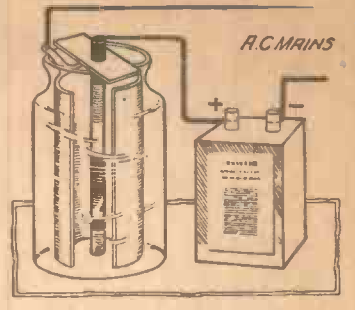
EXAMPLE 1.—Suppose the battery has to be charged at 10 amperes and the voltage of supply = 250.
Total watts required = 250 × 10 = 2,500.
Divide this value by the wattage of the lamps available to get the number required. Thus the number of 60-watt lamps required

$= \frac{2{,}500}{60} = 42$ approx.; 100-watt lamps = 25, etc.

EXAMPLE 2.—To find the current which a certain number and value of lamps will allow to flow.
Four lamps of 60 watts each are available and the town supply is 250 volts.

$$\text{Current flowing} = \frac{\text{Number of lamps} \times \text{wattage of each.}}{\text{Voltage of supply.}}$$

$$= \frac{4 \times 60}{250} = \frac{240}{250} = .96 \text{ amperes.}$$



A Half-wave Chemical Rectifier.

With A.C. mains the current must first be rectified. This illustration shows a simple half-wave rectifier consisting of a jar containing two electrodes and an electrolyte. The electrodes are composed of lead and aluminium the former being in the form of a flat sheet bent to form practically a cylinder. The aluminium should be in the form of a rod. The jar is filled with ammonium phosphate, in the proportion of 2½ lb. of salts to one gallon of water. To limit the charging rate lamps may be used as described for D.C. mains. Weak ammonia should be added from time to time to the solution to neutralise the electrolyte.

CURRENT-CARRYING CAPACITY OF LAMPS.

CARBON-FILAMENT LAMPS.

Candle-power.	Voltage.	Current passed.
8	110	.254
16	110	.509
32	110	1.018
8	220	.127
16	220	.209
32	220	.509

Neutralising Spilled Acid.—If electrolyte is spilled, it should be immediately treated with a neutralising solution such as sodium carbonate (soda) and water, or ammonia and water.

CURRENT-CARRYING CAPACITY OF LAMPS.

METAL-FILAMENT LAMPS

Candle-power.	Voltage.	Current passed.
8	110	.09
16	110	.18
32	110	.36
8	220	.049
16	220	.09
32	220	.18

TABLE OF ACID AND WATER PROPORTIONS USING ACID OF 1.840 SPECIFIC GRAVITY.

Required Specific Gravity at 70° F.	Water.	Acid, 1.840 Specific Gravity.
	Parts by Volume.	Parts by Volume.
1.400	14	10
1.350	18	10
1.300	21	10
1.250	27	10
1.225	29	10

ACID OF 1.400 SPECIFIC GRAVITY.

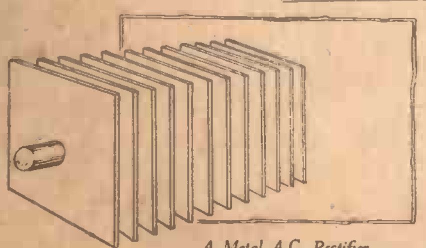
Required Specific Gravity at 70° F.	Water.	Acid, 1.400 Specific Gravity.
	Parts by Volume.	Parts by Volume.
1.300	4.5	10
1.280	5.5	10
1.275	6.25	10
1.265	6.4	10
1.255	6.65	10
1.250	6.75	10

Another method of rectifying A.C. current is to employ a metal rectifier. This form of rectification is used principally for trickle charging. A small transformer is joined to the mains giving a step down suitable for the rectifier. The output may then be adjusted by suitable resistances to suit the accumulator, either 2, 4, or 6 volt.

ACID TEMPERATURE CORRECTION TABLE.

Condition of Cells.	Actual Hydrometer readings at temperatures shown below to give 1.280 at 60° F.						
	40°F.	50°F.	60°F.	70°F.	80°F.	90°F.	100°F.
Fully charged	1.288	1.284	1.280	1.276	1.272	1.268	1.264
Half discharged	1.207	1.204	1.200	1.196	1.193	1.189	1.186
Fully discharged	1.115	1.113	1.110	1.107	1.104	1.101	1.098

A more efficient method of using the chemical rectifier shown above. Four of the jars are joined as shown, and this results in full-wave rectification. The jars are joined in pairs in series, and then connected back to back. The accumulator is joined between the two pairs.

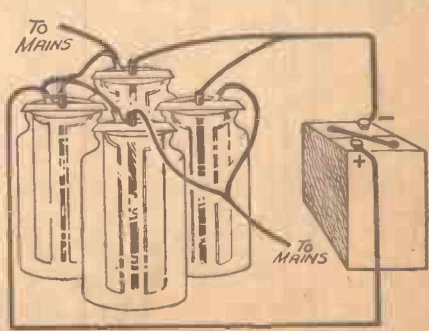


A Metal A.C. Rectifier.

The Charging Rate.—The maximum safe charging rate of an accumulator is approximately one-tenth of its actual capacity. For instance, the charging rate of a 60 ampere-hour cell would be 6 amps. Any excess would cause heating and disintegration of the plates.

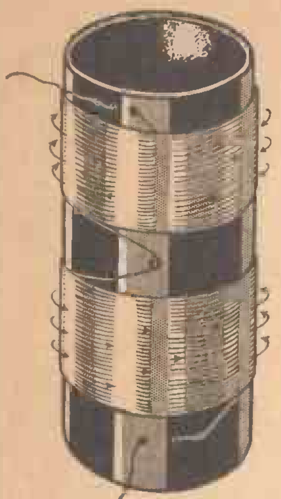
Use glass, china, earthenware, or lead-lined vessels.

Pour the acid carefully into the water—not the water into the acid, as this may cause spluttering and possible personal injury.



A Full-wave Chemical Rectifier.

"PRACTICAL WIRELESS" DATA SHEET No. 2



An Astatic Coil

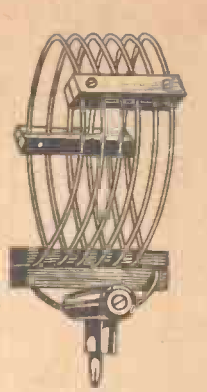
COILS AND COIL WINDING

FINDING THE INDUCTANCE OF A COIL.

Tuning coils are stated to have a certain Inductance. The Unit of Inductance is the "Henry," and 1 henry is the value of inductance which will cause a change of current of 1 amp. in 1 second upon the application of 1 volt. In wireless practice the tuning coils never have a value approaching a henry and therefore a smaller value is chosen and this is one-millionth part of a henry, or, in other words, a "microhenry." The formula for finding the inductance of a tuning coil (which has no metallic core) is:—

$$\text{Inductance} = \frac{4\pi A.N.^2}{l} \times 10^{9} \text{ henries}$$

where A = sectional area of the coil in sq. cms.
N = number of turns.
l = length of the coil in cms.



A Typical Short-Wave Coil

ASTATIC COILS.

An Astatic Coil is a coil wound in two sections, with each section in opposition. This method of winding is known as "Astatic," and the purpose of it is to reduce the size of the external field. The fields of each section neutralise each other and so it is possible to arrange two of these coils in fairly close proximity with employing metal screens. A small screw or other stud is inserted in the coil former at the central point, and when one half of the coil has been wound the wire is taken round the stud and the remainder of the winding concluded in the opposite direction.

SHORT-WAVE COILS.

Coils for the short wavelengths need the minimum of dielectric and therefore it is usual to use air-spaced coils for this purpose. The coil illustrated is a good example of a short wave coil, in which the wire is of bare copper having a large cross-section (16 or 18 S.W.G.). This wire should be wound round a former slightly smaller in diameter than is required in the finished coil and the turns should be wound side by side. When the required number of turns has been laid on the wire is cut and released. It will spring out to the necessary size and the turns will automatically space themselves. Small strips of ebonite may be screwed or tied to keep the turns from shifting. The mounts for these coils should also be designed with a minimum of dielectic material.

TURNS PER INCH

S.W.G.	Enamel.	Turns per inch. S.S.C.	D.S.C.	S.S.C.	D.S.C.	S.W.G
16	15	14	14	14	13	16
17	17	16	16	15	14	17
18	20	20	19	18	17	18
19	23	23	23	21	20	19
20	26	26	25	23	21	20
21	29	29	28	26	23	21
22	33	33	31	29	26	22
23	38	38	36	33	29	23
24	42	42	40	35	31	24
25	46	46	43	38	33	25
26	50	50	47	41	35	26
27	55	55	51	44	37	27
28	61	60	56	48	40	28
29	66	65	60	51	42	29
30	73	72	67	54	44	30
31	77	76	70	56	46	31
32	83	81	75	63	50	32
33	88	87	80	66	52	33
34	98	93	85	70	54	34
35	106	101	91	80	61	35
36	116	110	102	86	64	36
37	128	120	110	92	67	37
38	143	133	121	100	71	38
39	168	149	134	109	75	39
40	180	159	142	114	78	40

MEDIUM WAVE COILS.—Inductance 200 microhenries.

Gauge of Wire.	No. of turns.	Diameter of former.	Length of winding
30 D.S.C.	102	1.25"	1.52"
30 D.S.C.	82	1.5"	1.22"
30 D.S.C.	68	1.75"	1.01"
30 D.S.C.	59	2.0"	0.88"
28 D.S.C.	57	2.25"	1.01"
28 D.S.C.	51	2.5"	0.91"
26 D.S.C.	45	3.0"	0.95"

LONG WAVE COILS.—Inductance 2,100 microhenries.

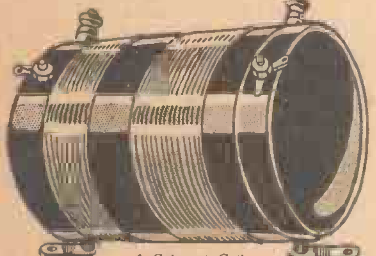
Gauge of Wire.	Diameter of former.	No. of slots.	Turns per slot
36 enam.	1.0"	5	80
36 enam.	1.5"	3	81
36 D.S.C.	2.0"	3	65

DUAL-RANGE COILS.

A modern coil wound to cover two wave-bands, and known as a "Dual-Range coil." The coil for the normal, or medium wave-band is wound in solenoid form on the upper part of the former, whilst the wire for the long wave winding is arranged in slots in the lower portion. The wire in the slots is simply piled up anyhow, as many as 90 turns sometimes being included in each slot. In the commonest form of dual-range coil the long-wave winding is short-circuited by a simple switch when using the normal winding. Tappings may be included for the aerial circuit, but these necessitate complicated switching devices.

SOLENOID COILS

The simplest type of coil, known as the "Solenoid" is shown below. This consists of a cylindrical former with the wire wound on in the form of cotton on a cotton-reel. The most efficient winding has a diameter greater than the length. The principal defect of this type of coil is its large external field which necessitates a large baseboard in order that no metallic bodies or other coil windings may be brought within the field.



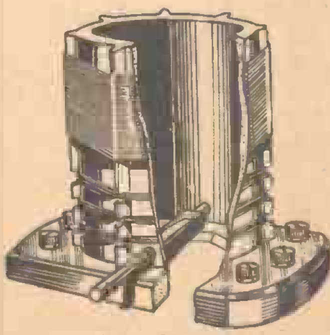
A Solenoid Coil

FINDING THE WAVELENGTH COVERED BY A COIL.

The wavelengths to which a given coil will tune are determined by its inductance and the tuning condenser used with it. The minimum wavelength will be that of the coil alone (roughly) and the maximum wavelength will be that of the complete closed circuit, that is, the coil with the maximum capacity of the condenser in parallel. The formula fo finding the wavelength of a closed circuit is:—

$$1.885\sqrt{(\text{Capacity} \times \text{Inductance})}$$

where the capacity is in micro-microfarads and the inductance in microhenries. If the capacity is expressed in microfarads, then the first figure in the above formula becomes simply 1,885. It must be borne in mind that the addition of an aerial and earth to a coil affects its range.

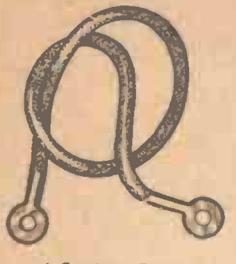


A Dual-Range Coil

Presented with PRACTICAL WIRELESS, dated December 31st, 1932.

"PRACTICAL WIRELESS" DATA SHEET No. 3

RESISTANCES



A Spaghetti Resistance

A resistance of the flexible type, known popularly as a "Spaghetti" resistance. This consists of a core of asbestos string, round which is wound the resistance wire. The ends of this winding are clamped, soldered or welded to the connecting lugs, and the winding covered with insulated sleeving. When joining these in circuit care must be taken that the connecting lugs are not pulled away from the resistance wire.

FINDING RESISTANCE VALUES.

$$\text{Resistance in Ohms} = \frac{\text{Voltage}}{\text{Current in Amps.}}$$

Where the current is in milliamps, this should be expressed as the decimal fraction of an amp.

Example:—Resistance required to drop 50 volts at 5 mA.

$$\frac{50}{.005} = 10{,}000 \text{ Ohms.}$$

GRID BIAS RESISTANCES.

For automatically biasing the grid of L.F. valves the resistance must be capable of carrying the total anode current of the valve which is biased. The value of the resistance can be found from the formula given on this sheet. The current will be the anode current of the valve, and the voltage will be the value of the grid bias required.

Example:—L.F. valve with 150 Volts H.T. requires Grid Bias of 10 volts, at which value the normal Anode Current is 5 milliamps.

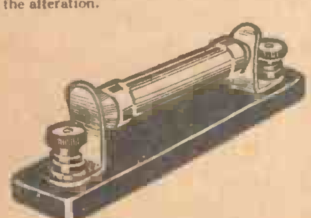
$$\therefore \frac{10}{.005} = 2{,}000 \text{ Ohms.}$$

COUPLING RESISTANCES.

Resistances employed for Resistance Capacity Coupling must be capable of carrying the anode current of the valve and should be roughly three times the value of the impedance of the valve. The resistance employed as the grid leak of the R.C.C. stage should also be chosen in conjunction with the anode resistance and the coupling condenser. The table on this sheet gives the complete data for a number of different R.C.C. Units.

A resistance of the cartridge type. This consists of resistance wire wound on a glass, porcelain, ebonite or asbestos former, and the ends soldered to metal caps. In some cases the wire is left uncovered, and in others the whole resistance is enclosed in a casing. Some forms of resistance are now composed of a moulded material and are consequently non-inductive. This type of resistance, however, will not have the same current carrying capacity as the wire wound resistance.

When handling this type of resistance care should be taken not to drop it or otherwise subject it to severe blows, as in some types of resistance the manufacturing process leaves a brittle component which is fairly easily broken. Precautions should also be taken not to expose them to undue heat as the values may be altered with no visual indication of the alteration.



A cartridge resistance.

DECOUPLING RESISTANCE AND CONDENSER VALUES.

Anode Current m.A.	VOLTS DROP. 20 Res.	20 Cond.	40 Res.	40 Cond.	60 Res.	60 Cond.	100 Res.	100 Cond.	200 Res.	200 Cond.
1	20,000	2	40,000	1	60,000	1	100,000	1	200,000	1
2	10,000	4	20,000	2	30,000	2	50,000	1	100,000	1
3			15,000	3	20,000	2	30,000	2	70,000	1
4			10,000	4	15,000	3	25,000	2	50,000	1
5					12,000	3	20,000	2	40,000	1
6					10,000	4	15,000	3	35,000	1
8							12,000	3	25,000	2
10							10,000	4	20,000	2

Correct to nearest values obtainable. The resistances used must be capable of standing the current flowing. Condensers must be capable of standing the voltage.

R.C.C. DATA
(Resistance Capacity Coupling).

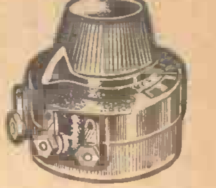
Anode Resistance.	Grid Leak.	Condenser
Ohms.	Meg.	Mfd.
250,000	1	0.006
200,000	1	0.006
100,000	0.5	0.01
75,000	0.5	0.01
50,000	0.25	0.02
30,000	0.2	0.03
25,000	0.1	0.05
20,000	0.1	0.05
15,000	0.05	0.1
10,000	0.05	0.1

Values Correct to Nearest Values Listed by Makers.

When employing Resistance Capacity Coupling it is essential to incorporate a High frequency filter in the anode circuit of the Detector valve in order to ensure that no frequencies of this order pass to the grid of the following valve. This demands that the condenser must be of the mica variety, and it is also advisable to incorporate a resistance in the grid circuit of the L.F. or following valve to prevent this H.F component from affecting the frequency response. The value of this resistance should not be greater than 100,000 ohms. An H.F. choke may be used, if desired, in place of this resistance.

RESISTANCE WIRE.

Size. S.W.G.	Size. Inch.	Eureka Resistance Wire. Resistance. per 1,000 yds. at 15.6° C. (60° F.)	Carrying Capacity for rise in Temp. of 100° C. (212° F)
		Ohms.	Amps.
16	0.064	209.4	6.0
18	0.048	371.8	4.3
19	0.040	535.6	3.7
20	0.036	661.3	3.0
21	0.032	837.2	2.8
22	0.028	1,093.0	2.2
23	0.024	1,487.0	1.8
24	0.022	1,770.0	1.5
25	0.020	2,142.0	1.25
26	0.018	2,645.0	1.0
27	0.0164	3,186.0	0.9
28	0.0148	3,914.0	0.76
29	0.0136	4,634.0	0.68
30	0.0124	5,575.0	0.59
31	0.0116	6,370.0	0.52
32	0.0108	7,350.0	0.47
33	0.010	8,571.0	0.42
34	0.0092	10,128.0	0.37
35	0.0084	12,149.0	0.33
36	0.0076	14,840.0	0.28
37	0.0068	18,536.0	0.26
38	0.006	23,808.0	0.19
39	0.0052	31,696.0	0.16
40	0.0048	37,184.0	0.15
41	0.0044	44,268.0	0.14
42	0.004	53,564.0	0.13
43	0.0036	66,136.0	0.11
44	0.0032	83,664.0	0.10
45	0.0028	108,648.0	0.08
46	0.0024	148,764.0	0.07
47	0.002	214,284.0	0.05



Variable resistances.

The most popular form of variable resistance. This is almost invariably provided with three terminals so that it may also be used as a potentiometer. The modern forms of this component are now made in a tapered or "logarithmic" form so that for some purposes a straight line variation of voltage is obtained.

A circular form of resistance where the wire is wound round a flat strip and the strip then bent to form practically a circle. The resistances wound in this form are made adjustable by having a rotating arm rubbing against the edge of the strip. By joining the two ends to two terminals, and the moving arm to a further terminal, a potentiometer is obtained.

DECOUPLING RESISTANCES.

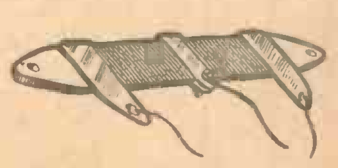
Resistances used for decoupling purposes should be chosen so that an excessive voltage is not wasted. In addition the decoupling condenser must be chosen in conjunction with the value of the resistance. The undermentioned table gives the value of decoupling resistance and condenser for different anode currents, according to the amount of voltage which may be spared.

RESISTANCE VALUES.

Current in mA	Approximate value of resistance in Ohms. To drop 25 volts.	To drop 50 volts.	To drop 100 volts.
1	25,000	50,000	100,000
2	12,500	25,000	50,000
3	8,000	16,000	30,000
4	6,000	12,000	25,000
5	5,000	10,000	20,000
10	2,500	5,000	10,000
20	1,250	2,500	5,000
25	1,000	2,000	4,000
30	800	1,500	3,500
40	600	1,200	2,500
50	500	1,000	2,000

A strip resistance. This consists of the same arrangement as shown above, with the exception that the former upon which the wire is wound is much thicker and is left in a flat condition. The ends of the wire are attached to metal lugs which are usually drilled to facilitate mounting or soldering connections. To enable adjustments of value to be obtained a small clip may be fastened round the wire with a connection taken from the clamping nut.

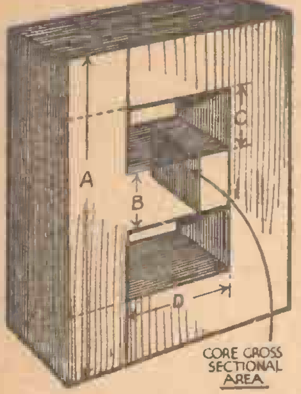
This type of resistance will carry much heavier currents than the other types illustrated on this sheet, owing to the large surface exposed to the air. Consequently, it is most suitable for use in mains receivers or in other places where heavy currents have to be carried. Where very fine wire is employed care should be taken that the wire is not broken, due to a knock from a screw-driver or other instrument which is employed in constructing the receiver.



A strip resistance.

"PRACTICAL WIRELESS" DATA SHEET No. 4

Mains Transformers



The assembled core of a Mains Transformer.

FINDING THE NUMBER OF TURNS.

The formula for ascertaining the number of turns of wire for Mains Transformers is :—

$$\frac{V}{T} = \frac{A\,B\,n}{3.49 \times 10^6}$$

where $\frac{V}{T}$ = Volts per turn in both the Primary and Secondary.

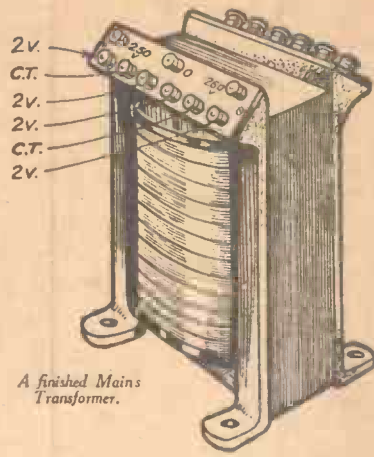
A = Cross sectional area of the core in sq. ins.

B = Flux in the core in lines per sq. cm.

n = Frequency of the supply in cycles per second.

The usual flux density varies between 6,000 and 8,000 lines.

The method of building up the laminations for the core of a mains transformer. The principal dimensions are referred to in the tables. The central bar is the most important part of the assembly, as it is principally upon the cross-sectional area of this that the number of turns of wire depends. The size of the winding area also enters into the calculations, but by purchasing standard sizes of stampings the calculations are greatly facilitated.



A finished Mains Transformer.

How to assemble the completed transformer, with a strip of ebonite to carry the various terminals. It is safest to take all the secondary windings to one strip situated on one side of the transformer, and the primary (or mains input) terminals to a strip on the opposite side. This prevents accidentally touching or shorting the mains. The feet and supports, as well as clamping bolts, should be of brass and not steel. If found more convenient aluminium may be used.

FINDING THE RATING.

The total rating of a mains transformer is obtained by adding together the wattage of each separate winding and then adding 20 per cent. to the resultant figure. The cost of operating a mains receiver can therefore be easily worked out.

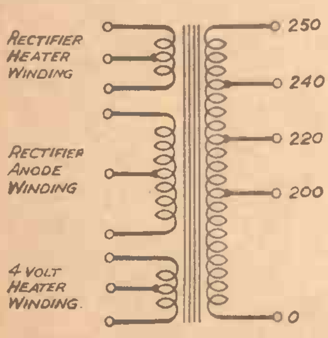
CORE PROPORTIONS.

Size of Stalley Stampings.	Dimensions (ins.)				Number of Stampings	Watts (approx.)	Turns per volt.
	A.	B.	C.	D.			
5	$3\frac{1}{8}$	$\frac{5}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$	6 doz.	25	15
4	$3\frac{9}{16}$	$\frac{15}{16}$	$1\frac{5}{8}$	$2\frac{5}{16}$	6 doz.	50	8
4 A	$3\frac{9}{16}$	$\frac{15}{16}$	$1\frac{5}{8}$	$1\frac{1}{2}$	6 doz.	40	8
30	$3\frac{9}{16}$	$\frac{15}{16}$	$1\frac{5}{8}$	$1\frac{1}{4}$	6 doz.	40	8
30 A	$3\frac{9}{16}$	$\frac{13}{16}$	$1\frac{5}{8}$	$\frac{13}{16}$	6 doz.	35	8
28	5	$1\frac{1}{4}$	$2\frac{1}{2}$	3	6 doz.	100	6
29	$6\frac{3}{4}$	2	$2\frac{3}{4}$	$4\frac{1}{2}$	6 doz.	250	4

TESTING.

Before connecting a home-made mains transformer in circuit all windings should be tested for breaks, short-circuits and insulation. A high voltage dry battery may be used, in conjunction with a meter, and there should be no readings between different windings, nor from windings to core.

Theoretical circuit of a small mains transformer, showing how the primary winding is tapped to suit mains inputs of different values, and the manner in which all heater windings are centre-tapped. The Rectifier valve heater winding forms the positive lead of the H.T. supply, and the centre tap of the Anode winding is the negative lead. Where it is preferred the remaining heater windings may be provided with an adjustable centre tap by means of an external potentiometer instead of the wired point.



Circuit of a Mains Transformer.

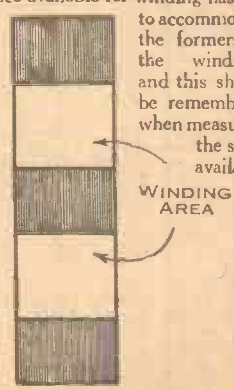
WIRE FOR TRANSFORMERS.

In the table below the number of turns per sq. in. makes no allowance for the end cheeks of the winding bobbins. This must therefore be taken into consideration. The Safe Current should also be regarded as the absolute maximum value, and if possible the next largest size of wire should be employed, especially for heater windings where large currents are to be handled. When using enamelled wire care must be exercised that the covering does not crack during winding. This wire takes up less room but greater care must be taken in the winding.

WIRE DATA.

Standard Wire Gauge.	Safe Current (amps.)	Turns per sq. inch.		Yards per Pound.	
		Enamelled.	D.C.C.	Enamelled.	D.C.C.
18	4.7	392	297	46.9	45.4
20	4.0	685	472	83.3	79.4
24	1.5	1,770	977	221	203
28	0.7	3,760	1,630	488	422
30	0.5	5,370	1,990	694	587
32	0.4	6,890	2,550	915	755
34	0.25	9,610	3,020	1,202	1,024
36	0.18	13,500	4,100	1,840	1,477
38	0.1	20,400	5,100	2,810	2,287
40	0.07	32,500	—	4,576	—
42	0.05	44,300	—	6,576	—

Section through the core showing the winding area in which all the windings have to be disposed. It is most efficient to arrange the windings on bobbins placed side by side as indicated, with heater windings disposed between the input and H.T. windings. This forms a screen and helps to prevent induced hum. This illustration should be studied in conjunction with the diagram in the upper left-hand corner of this sheet. The actual space available for winding has also to accommodate the formers of the windings, and this should be remembered when measuring the space available.



Section through core.

Presented with PRACTICAL WIRELESS, dated January 14th, 1933.

"PRACTICAL WIRELESS" DATASHEET No. 5

WIRE GAUGES AND CORRESPONDING DATA.

S.W.G.	Diameter in Inches.	Yards per Lb.	Weight in Lb. per 1,000 Yds.	Lb. per Ohm.	Resistance in Ohms. per Yard.	Resistance in Ohms. per Lb.	Turns per Inch. Enamel Covered.	Turns per Inch. Single Silk Covered	Turns per Inch. Double Silk Covered	Turns per Inch. Single Cotton Covered	Turns per Inch. Double Cotton Covered.	Calculated Sectional Area. Sq. in.	Calculated Sectional Area. Sq. m/m.	Current Rating at 1,000 per sq. in.
10	.128	6.67	148.8	83.3	.001868	.0120		7.64	7.55	7.35	7.04	.012868	8.3019	12.868
11	.116	8.16	122.2	50.0	.002275	.0200		8.41	8.30	8.06	7.69	.010568	6.8183	10.568
12	.104	10.23	98.22	35.7	.002831	.0280		9.35	9.22	8.93	8.48	.008495	5.4805	8.495
13	.092	13.00	76.86	18.1	.003617	.0550		10.5	10.4	10.0	9.43	.006648	4.2888	6.648
14	.080	17.16	58.12	12.2	.004784	.0820		12.1	11.8	11.4	10.6	.005027	3.2429	5.027
15	.072	21.23	47.08	7.14	.005904	.1400	↓	13.3	13.1	12.5	11.6	.004072	2.6268	4.072
16	.064	26.86	37.20	4.95	.007478	.2021	15.0	14.9	14.6	14.1	13.2	.003217	2.0755	3.217
17	.056	35.00	28.48	2.38	.009762	.3423	17.1	16.9	16.5	15.9	14.7	.002463	1.5890	2.463
18	.048	47.66	20.92	1.56	.01328	.6351	19.8	20.0	19.4	18.5	17.2	.0018096	1.1675	1.8096
19	.040	68.66	14.53	.757	.01913	1.315	23.7	23.8	23.0	21.7	20.0	.0012566	.8107	1.2566
20	.036	85.00	11.77	.497	.02362	2.012	26.1	26.3	25.3	23.8	21.7	.0010179	.6567	1.0179
21	.032	107.6	9.299	.309	.02990	3.221	29.4	29.4	28.2	26.3	23.8	.0008042	.5189	.8042
22	.028	140.6	7.120	.181	.03905	5.498	33.3	33.3	31.8	29.4	26.3	.0006158	.3973	.6158
23	.024	191.6	5.231	.098	.05313	10.14	38.8	38.5	36.4	33.3	29.4	.0004524	.2919	.4524
24	.022	228.3	4.395	.069	.06324	14.38	42.1	42.1	40.0	35.7	31.3	.0003801	.2453	.3801
25	.020	275.3	3.632	.0471	.07653	21.08	46.0	46.0	43.5	38.5	33.3	.0003142	.2027	.3142
26	.018	340.0	2.942	.0309	.09448	32.21	50.6	50.6	47.6	41.7	35.7	.0002545	.16417	.2545
27	.0164	410.0	2.442	.0215	.01138	46.55	55.9	55.1	51.6	44.6	37.9	.0002112	.13628	.2112
28	.0148	503.0	1.989	.0141	.1398	70.12	61.4	60.4	56.2	48.1	40.2	.00017203	.11099	.1720
29	.0136	596.6	1.680	.0101	.1655	98.65	66.2	65.2	60.2	51.0	42.4	.00014527	.09372	.1453
30	.0124	716.6	1.396	.0069	.1991	142.75	73.3	72.0	67.1	54.4	44.7	.00012076	.07791	.1208
31	.0116	820.0	1.222	.0054	.2275	185.80	77.8	76.3	70.9	56.8	46.3	.00010568	.06818	.1057
32	.0108	943.3	1.059	.0040	.2625	248.20	83.0	81.3	75.2	63.3	50.5	.00009161	.05910	.0916
33	.0100	1100	.9081	.0029	.3061	337.50	88.9	87.0	80.0	66.7	52.6	.00007854	.05067	.0785
34	.0092	1300	.7686	.0023	.3617	471.00	98.0	93.4	85.5	70.4	54.9	.00006648	.04289	.0665
35	.0084	1556	.6408	.0014	.4338	676.50	106	101	91.8	80.6	61.0	.00005542	.03575	.0554
36	.0076	1903	.5246	.00098	.5300	1009	116	110	102	86.2	64.1	.00004536	.02927	.0454
37	.0068	2380	.4199	.00064	.6620	1574	128	120	110	92.6	67.6	.00003632	.02343	.0363
38	.0060	3056	.3269	.000385	.8503	2598	143	133	121	100	71.4	.00002827	.018241	.0283
39	.0052	4066	.2456	.000217	1.132	4645	168	149	134	109	75.8	.00002124	.013701	.0212
40	.0048	4766	.2092	.000156	1.328	6360	180	159	142	114	78.1	.000018096	.011675	.0181
41	.0044	5700	.1758	.000112	1.581	9020	194	169	150	↑	↑	.000012566	.008107	.0126
42	.0040	6866	.1453	.000076	1.913	13150	211	191	167			.000010179	.006567	.0101
43	.0036	7500	.1177	.000050	2.362	20120	230	206	179			.000008042	.005189	.0080
44	.0032	10766	.0930	.000030	2.989	32210	253	225	192			.000006158	.003973	.0062
45	.0028	14066	.0712	.000015	3.904	54980	282	247	208			.000004524	.002919	.0045
												.000003142	.002027	.0031
												.000002011	.0012972	.0020
												.0000011310	.0007297	.0011
												.0000007854	.0005067	.0008

RESISTANCE WIRE DATA.

S.W.G.	Eureka. Resistance per yd.	Eureka. Yards per lb.	Eureka. Current Capacity. (Amps.)	German Silver. Resistance. per yd.	German Silver. Yards per lb.	German Silver. Current Capacity. (Amps.)
18	.37	48	4.3	.117	51	3.6
20	.66	85	3.0	.315	90	3.5
22	1.10	140	2.2	.520	147	2.0
24	1.77	227	1.5	.844	238	1.2
26	2.65	340	1.0	1.26	349	.65
28	3.91	502	.76	1.85	527	.4
30	5.58	714	.59	2.65	750	.29
32	7.35	943	.47	3.50	984	.25
34	10.43	1300	.37	4.82	1360	.19
36	14.84	1905	.28	7.06	2000	.095
38	23.81	3060	.19	11.33	3295	.076
40	37.18	4761	.15	17.70	4920	.065

CURRENT-CARRYING CAPACITY OF WIRES.

S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)
10	19.305	19	1.8855	28	.258	37	.0545
11	15.855	20	1.527	29	.218	38	.0425
12	12.7425	21	1.206	30	.1812	39	.0318
13	9.872	22	.9237	31	.1586	40	.0272
14	7.5405	23	.6786	32	.1374	41	.0228
15	6.108	24	.5702	33	.1178	42	.0189
16	4.8255	25	.4703	34	.0998	43	.0153
17	3.6945	26	.3818	35	.0831	44	.012
18	2.715	27	.3168	36	.0681	45	.0093

NOTE : S.W.G.= Standard Wire Gauge. B.W.G.= Birmingham Wire Gauge.

Presented with PRACTICAL WIRELESS, dated January 21st, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 6

CHOKES : H.F. and L.F.

Fig. 1—A High Frequency Choke

The purpose of a choke is to prevent the passage of certain frequencies. For H.F. purposes a high inductance value is necessary, with a minimum of capacity. No core is employed in H.F. chokes. For L.F. purposes a very much greater inductance is required, and preferably a low D.C. resistance. An iron core is employed to increase the inductance value and avoid the use of too much wire with its consequent high D.C. resistance.

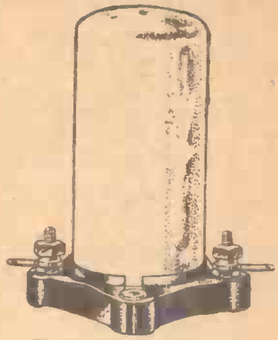


Fig. 2—A Screened H.F. Choke.

The standard form of construction of an H.F. choke. The former is made of ebonite and should preferably be of the ribbed or similar type so that the resultant winding is air-spaced. One terminal should be provided on the base, and the other tapped into the top of the former. By distributing the winding in sections the self-capacity is reduced. A choke of this description has a fairly extensive field, and should, therefore, not be mounted close to tuning coils or similar inductances.

INDUCTANCE.
The inductance of a choke will depend, of course, upon the amount of wire which is employed. The method of winding will affect this, and, therefore, no tables or other details can be given. The following, however, is the data for a simple H.F. choke, having an inductance of about 200,000 microhenries. Half an ounce of No. 38 gauge double-silk-covered wire, wound on a half-inch diameter former, and separated into four sections of 300 turns each.

OUTPUT FILTER CIRCUIT.
For an Output Filter circuit following a Pentode valve, the choke should be provided with a number of tappings in order that the loud speaker in use may be matched to the impedance of the valve. Therefore, the choke bobbin should be divided into four sections, with tappings taken at one half, two-thirds and three-quarters of the total winding. This will then provide ratios of 1 : 1, 2 : 1, 3 : 1 and 4 : 1.

L.F. CHOKE CONSTRUCTION.
The normal construction of an L.F. choke. It consists of a core of stampings in the same manner as a transformer, with the winding carried on a former. The winding may be wound as one continuous coil, or be split up into several sections as in an H.F. choke. If this form of construction is adopted, tappings may be brought out from each section to provide a tapped output choke for use in filter circuits.

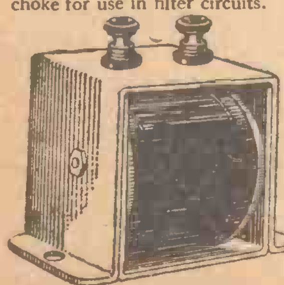


Fig. 3—A Low Frequency Choke.

A similar type of choke to Fig. 1, but mounted in a copper or aluminium box to reduce the troubles caused by the external field. This type of construction requires more care, as the proximity of the metal casing alters the value of the inductance. This type of choke is essential for stability in S.G. circuits. For this latter type of circuit it is useful to provide a screened lead from the top of the casing for attachment to the anode terminal on top of the valve.

L.F. CHOKE DETAILS.
For L.F. chokes, the Stalloy Stampings mentioned on Data Sheet No. 4 may be employed. Again, no actual data relative to inductance can be tabulated, as the value will vary according to the thickness of the core, the winding area available, and the quantity of wire which is accommodated in the bobbin. This latter factor will depend, of course, upon the gauge of the wire employed. However, as a guide, six dozen No. 30A stampings, with a three-quarter inch spool, will comfortably take four ounces of No. 38-gauge enamelled wire, and this will have an inductance of roughly 30 henries at a current of 30 milliamps. With the same size stampings, and thicker wire, more current could be carried, but the inductance value would be correspondingly reduced. Thinner wire, on the other hand, would enable the inductance to be increased, but the maximum safe current would be decreased.

REDUCING FIELD OF H.F. CHOKE.
Another method of reducing the external field of an H.F. choke. In this pattern two formers are provided and the total winding is distributed between the two formers. In addition, the direction of winding on the formers is reversed, so that the field of one coil neutralises the field of the other and so avoids the necessity of screening.

PRACTICAL VALUES FOR H.F. CHOKES.

Purpose.	Inductance.	Self-capacity.	D.C. Resist.
Coupling for S.G. valves	200,000 to 500,000	1 to 3 m.m.F.	200 to 500
Standard H.F. coupling	100,000 to 200,000	2 to 4 m.m.F.	300 to 800
Ordinary reaction ..	50,000 to 200,000	1 to 3 m.m.F.	200 to 700

PRACTICAL VALUES FOR L.F. CHOKES.

Purpose.	Inductance.	D.C. Resistance.	Current.
L.F. coupling ..	15 to 20 henries	500 to 800	15 to 30 m/A
Power grid coupling	100 to 300 ,,	1,000 to 2,000	5 to 10 m/A
General purpose	20 to 30 ,,	300 to 500	30 to 60 m/A
Output filter ..	20 to 60 ,,	200 to 500	20 to 60 m/A
Pentode output ..	30 to 60 ,,	500 to 1,000	20 to 60 m/A
Mains smoothing	30 to 60 ..	200 to 500	20 to 80 m/A

MAKING A FORMER FOR H.F. CHOKES.

A former-wound choke necessitates a slotted former, and this is, of course, easily turned up on a lathe. Where a lathe is not obtainable the following method may be adopted for making the type of former required. The centre consists of a piece of ebonite or wooden rod about three-eighths on an inch in diameter, and the slots may be improvised by using ebonite tubing, with an internal diameter of three-eighths of an inch. This should be of the type having a wall at least a quarter of an inch thick, and it should be cut into pieces just over a quarter of an inch wide. These rings should be slipped over the rod and fixed in position with either Chatterton's Compound or a small rivet. The result will be a slotted former just as effective as a turned rod. An alternative method would be to build up the rings with strips of paper, adhesive tape, or similar material, winding it over and over until the desired thickness has been obtained. With either method it is desirable that the inner rod should be of ebonite.

SHORT-WAVE CHOKE.

For short-wave reception quite a small choke is required, and a very efficient component may be made by winding from 60 to 150 turns of wire (gauge from 38 to 46 S.W.G.) on an ebonite or similar tube having an overall diameter of one inch.

Fig. 4—A Binocular H.F. Choke.

Presented with PRACTICAL WIRELESS, dated January 28th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 7

CONDENSERS

The above illustration shows the method of building up a fixed condenser. It will be noticed that the electrodes (or plates) are separated by insulating material, and that the ends of the plates are brought out alternately to provide means for connection. All the plates on each side are joined together.

INDUCTIVE AND NON-INDUCTIVE CONDENSERS.

Condensers of the Mansbridge type (that is, those consisting of a length of prepared paper and tinfoil wrapped in a coil) possess inductance, and are not, therefore, advisable for H.F. by-pass or L.F. coupling purposes. It is, therefore essential that such condensers should be of the non-inductive type. The Mansbridge condenser is rendered non-inductive by having connections made to the ends after wrapping, or by being wound back upon itself. The case containing such a condenser bears the letters N.I. or the words Non-Inductive in full. This type of condenser may be obtained in all values from .005 to 2 mfd. The other type of non-inductive condenser is the mica, but this naturally is more expensive than the paper condenser.

CHOOSING A CONDENSER.

Condensers are obtainable in a variety of shapes, and with moulded or metal cases. For the majority of purposes the moulded case is to be preferred, although in an all-metal chassis type of receiver the metal casing may be earthed. The small types of fixed condenser should never be mounted flat on a metal baseboard, as there may be a risk of losses due to the capacity of the condenser with the earthed screen. For Mains smoothing the Electrolytic type of condenser is to be preferred as this may be obtained in a larger capacity, and gives greater smoothing. This type of condenser consists of an aluminium case (which is the negative electrode) and a central metal rod which forms the positive electrode. Surrounding this rod is an aqueous solution, which, upon the application of direct current to the two electrodes causes an insulating film to form on the electrode and so provides a high-class condenser.

DIELECTRIC STRENGTHS IN VOLTS PER MILLIMETRE.

Substance.	Strength.	Substance.	Strength.
Presspahn	5,000	Paraffin wax	12,000
Glass ..	8,000	Ebonite	30,000
Porcelain ..	10,000	Micanite ..	40,000
Empire cloth	10,000		

A condenser consists of two or more electrodes (generally known as "plates") separated by a dielectric—see below. The property of a condenser is to "store" electricity, and the holding power of the condenser is known as its capacity. The Unit of capacity is the Farad, but this is too large to be convenient for wireless practice, and the useful unit is therefore made smaller and is actually one millionth of a farad. This measure is known as a Microfarad (μF). For a large number of condensers in a wireless receiver very small capacities are required, and these are expressed as decimal proportions of a microfarad.

CAPACITY OF FLAT FIXED CONDENSERS.

$$C = .225 \frac{nKA}{t} \mu\mu F$$

A = Area of overlap of one plate (in inches).
n = Number of dielectrics.
t = Thickness of dielectric.
K = Dielectric constant. (See table)

$$C = \frac{.0885\,A\,K\,N}{1{,}000{,}000\,D}$$

Where A is in square centimetres
D is in centimetres.

AREA OF EFFECTIVE OVERLAP FOR FIXED CONDENSERS.

Capacity.	Thickness of Mica employed (ins.) .001	.0015	.002	.003
.0001	.075	.11	.15	.25
.0002	.15	.23	.3	.45
.0003	.23	.34	.45	.68
.0004	.3	.45	.6	.9
.0005	.38	.56	.75	1.13
.001	.75	1.13	1.5	2.25
.002	1.5	2.25	3.0	4.5
.003	2.25	3.38	4.5	6.75
.004	3.0	4.5	6.0	9.0
.005	3.75	5.62	7.5	11.25

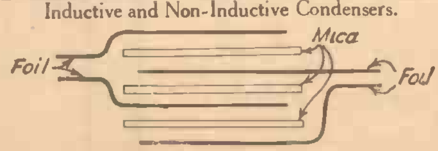
To use the above table, find the capacity required, then under the column bearing the measure corresponding to the thickness of the dielectric employed you may read off the total area of the dielectric required. This may be used in one piece or divided amongst a number of smaller pieces. The electrodes of the condenser will be one more in number than the number of dielectrics.

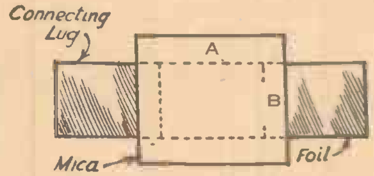
Example: Required, a condenser of .001 capacity, using mica .002 in. thick. 1.5 ins. is the total area required, and this may be made up by two pieces with .75 in. overlap, in which case three plates would be required.

PRINCIPAL VALUES OF CONDENSERS IN A WIRELESS RECEIVER.

Use.	Value in Microfarads.
Series aerial tuning ..	.00005 to .0003
Aerial tuning	.0003 or .0005
Secondary tuning ..	.0005
H.F. coupling	.0001 to .001
H.F. by-pass	.1
Tuned anode	.0003 or .0005
H.F. transformer tuning	.0005
Leaky grid detector ..	.0002 or .0003
Power grid detector ..	.0001
Detector anode by-pass	.0001 to .0003
R.C. coupling	.001 to .1
Parallel-fed transformer	.05 to 2.0
De-coupling for H.F. purposes	.1 to 1.0
De-coupling on L.F. side	1 or 2

Inductive and Non-Inductive Condensers.





The method of calculating the capacity of a condenser is typified in the above diagram. It will be seen that a certain proportion of each pair of plates overlaps, and this is known as the "effective" surface. The area of this surface should be ascertained —by multiplying A by B—and this should be employed in conjunction with the formula for capacity given in the centre column.

TESTING A CONDENSER.

A condenser may be tested by connecting it to a source of high voltage. After leaving it in contact for a short time, disconnect the leads, taking care not to touch the terminals. After the lapse of half an hour, join a wire across the two terminals, and a spark should be obtained. The larger the capacity of the condenser the larger the spark, and the better the insulation of the condenser, the longer will it hold the charge. Where small condensers have to be tested, and the resultant spark will be small, a number of such condensers may be joined in parallel and the test then carried out.

PROPORTIONS OF FIXED CONDENSERS, USING COPPER FOIL AND MICA 0.002 in. THICK.

C in Microfarad.	Dimension of Plate in Inches.	No. of Plates.
.001	¾ × ½	5
.002	1 × ½	7
.003	1 × ¾	7
.00015	¼ × ½	3
.0005	½ × ½	4
.0006	1 × 1	2
.0008	½ × ½	6

The illustration at the foot of the centre column shows how to make a small fixed condenser. A strip of ebonite is provided for the base, and two terminal holes are drilled at the ends. The assembly of plates and dielectric is built up as shown above, and the plates are provided with holes to fit over the terminals. On top of the complete assembly another small ebonite plate is clamped to press the condenser into contact and exclude air from between plates and dielectric.

DIELECTRIC CONSTANTS.

Air ..	1	Paraffin, liquid	2
Castor oil	5	,, wax	2
Ebonite ..	2.75	Shellac ..	3
Glass ..	5-10	Sulphur	4
Mica ..	6	Wood, waxed	5
Paper, waxed	2		

"PRACTICAL WIRELESS" DATA SHEET No. 8

BATTERY ELIMINATORS

THE FUNCTION OF AN ELIMINATOR.

The purpose of a battery eliminator is to provide the working voltages of a receiver from the electric lighting mains. As these voltages must be Direct Current, a process of rectification is essential when using alternating current mains. With both types of mains a smoothing circuit must be employed to smooth out the ripples. The exception to these statements is the supply for the heaters of Indirectly Heated A.C. valves where ordinary A.C. at 4 volts is employed.

METAL RECTIFICATION.

Metal rectifiers may be employed instead of valves for rectification purposes, and these may be joined up to provide half-wave rectification or full-wave rectification. For half-wave rectification the metal rectifier is joined in series with the positive lead from the transformer secondary to the choke. For full-wave rectification two half-wave rectifiers are joined in series, the ends being H.T. + and H.T. –. One end of the secondary of the transformer is joined to the junction of the two rectifiers, and the other end of the secondary is joined to the centre of two 4-mfd. condensers which are joined across H.T. + and H.T. –. This method is known as the "Voltage doubling" principle.

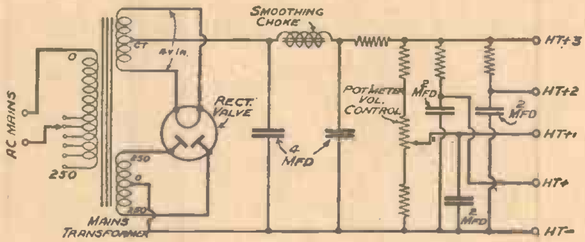
RESISTANCE VALUES FOR VOLTAGE DROPPING.

The value of resistances required to dispose of surplus voltages may easily be ascertained by an application

(Continued opposite.)

REMOVING HUM.

Sometimes when using a battery eliminator loud hum is noticed when the receiver is tuned to a powerful station. This is known as "modulation hum" and may be remedied by the following means: Two condensers with a capacity of .1 mfd. are joined together, and the junction point is taken to earth. The remaining two terminals are then connected to the two A.C. mains input leads. Another method employed with full-wave rectifying valves, is to join the two condensers across the two anodes of the valve, and to earth the junction.

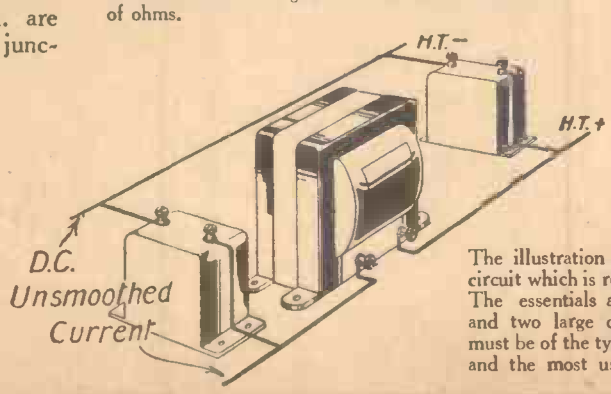


A.C. BATTERY ELIMINATOR.

The above diagram shows a typical A.C. mains battery eliminator, and illustrates the method of inserting voltage dropping resistances in conjunction with by-pass condensers. The tapping marked H.T. 1 is provided with an adjustable voltage by means of a potentiometer across the total output of the unit. In addition to the secondary windings shown on the mains transformer, separate secondaries may be provided to deliver 4 volts at 1 or more amps. for supplying the heaters of indirectly heated valves.

Voltage to be dropped.	Current flowing.	Resistance required.
10 volts	1	10,000 ohms.
20 ,,	2	10,000 ,,
30 ,,	5	6,000 ,,
40 ,,	8	5,000 ,,
50 ,,	5	10,000 ,,
100 ,,	5	20,000 ,,
150 ,,	10	15,000 ,,
200 ,,	5	40,000 ,,

It will be seen from this table that the values are definitely relative, and that the current (in milliamps) divided into the volts gives the resistance in thousands of ohms.



AUTOMATIC EXCITATION OF FIELD WINDING.

Where a moving-coil loud-speaker with a mains field is employed this may be used in place of the smoothing choke of an eliminator. It should be of the type designed to work from D.C. supplies and taking a current of 20 to 40 milliamps. In view of the voltage drop which would be occasioned by this method, the output from the rectifier should be correspondingly larger than is required at the H.T. end of the eliminator.

(Continued from 1st column.)

of Ohms Law. The resistance required (in Ohms) is obtained by dividing the number of volts to be disposed of, by the current flowing in amps. (One milliamp is .001 of an amp.). The table given on the left shows some common values of resistance, and other values may be obtained by adjustment of the table, or by employing the above formula.

AUTOMATIC GRID BIAS.

Automatic grid bias may be provided from the eliminator, by inserting in the H.T. negative lead a suitable voltage dropping resistance. The total anode current from the receiver passes through this resistance, and results in a voltage drop worked out by the method given on this sheet. This resistance may be tapped to provide various values of bias for a number of valves.

The illustration to the left shows the smoothing circuit which is required in every type of eliminator. The essentials are a high inductance L.F. choke and two large capacity fixed condensers. These must be of the type made to withstand high voltages, and the most useful value is 4 mfds.

Presented with PRACTICAL WIRELESS, dated February 18th, 1933

"PRACTICAL WIRELESS" DATA SHEET No. 9

SCREWS AND SCREW THREADS

The principal Thread used in wireless engineering is the B.A. (British Association). The standard engineering thread is the Whitworth. In addition to these two threads there are the B.S.F. (British Standard Fine Screw Thread) and the U.S.S. (United States Standard Thread).

BRITISH ASSOCIATION STANDARD THREAD.

B.A. Number	Diameter		Pitch		Depth of Thread, Inches	Radius, Inches	Double Depth of Thread Inches
	Millimetres	Inches	Millimetres	Inches			
0 ..	6.0	.2362	1.0	.0394	.0236	.0072	.0472
1 ..	5.3	.2087	.90	.0354	.0212	.0064	.0425
2 ..	4.7	.1850	.81	.0319	.0191	.0058	.0383
3 ..	4.1	.1614	.73	.0287	.0172	.0052	.0345
4 ..	3.6	.1417	.66	.0260	.0156	.0047	.0312
5 ..	3.2	.1260	.59	.0232	.0139	.0042	.0279
6 ..	2.8	.1102	.53	.0209	.0125	.0038	.0250
7 ..	2.5	.0984	.48	.0189	.0113	.0034	.0227
8 ..	2.2	.0866	.43	.0169	.0101	.0031	.0203
9 ..	1.9	.0748	.39	.0154	.0092	.0028	.0184
10 ..	1.7	.0669	.35	.0138	.0083	.0025	.0165
11 ..	1.5	.0591	.31	.0122	.0073	.0022	.0146
12 ..	1.3	.0511	.28	.0110	.0066	.0020	.0132
13 ..	1.2	.0472	.25	.0098	.0059	.0018	.0118
14 ..	1.0	.0394	.23	.0091	.0055	.0016	.0109
15 ..	.90	.0354	.21	.0083	.0050	.0015	.0099
16 ..	.79	.0311	.19	.0075	.0045	.0014	.0090
17 ..	.70	.0276	.17	.0067	.0040	.0012	.0080
18 ..	.62	.0244	.15	.0059	.0035	.0011	.0071
19 ..	.54	.0213	.14	.0055	.0033	.0010	.0066
20 ..	.48	.0189	.12	.0047	.0028	.0009	.0057
21 ..	.42	.0165	.11	.0043	.0026	.0008	.0052
22 ..	.37	.0146	.098	.0039	.0023	.0007	.0046
23 ..	.33	.0130	.089	.0035	.0021	.0006	.0042
24 ..	.29	.0114	.080	.0031	.0019	.0006	.0038
25 ..	.25	.0098	.072	.0028	.0017	.0005	.0034

NUMBER OF THREADS PER INCH CORRESPONDING TO A GIVEN DIAMETER.
BRITISH STANDARD FINE SCREW THREAD.

Diameter	Threads per inch	Diameter at Root of Thread
1/4	26	.2007
5/16	22	.2543
3/8	20	.3110
7/16	18	.3664
1/2	16	.4200
9/16	16	.4825
5/8	14	.5335
11/16	14	.5960
3/4	12	.6433
13/16	12	.7058
7/8	11	.7586
15/16	11	.8311
1	10	.8720

STANDARD WOOD SCREWS.

All measurements are in fractions of an inch.

No. of Screw Gauge	Diameter	Neck of Screw	Diameter of Head	Depth of Head	Slot	
					Width	Depth
0	.05784	1/16	7/64	1/32	1/64	1/64
1	.07100	5/64	9/64	3/64	1/64	1/32
2	.08416	5/64	11/64	3/64	1/64	1/32
3	.09732	3/32	3/16	3/64	1/64	1/32
4	.11048	7/64	7/32	1/16	1/32	1/32
5	.12364	1/8	15/64	1/16	1/32	1/32
6	.13680	9/64	17/64	5/64	1/32	3/64
7	.14996	5/32	19/64	5/64	1/32	3/64
8	.16312	5/32	21/64	3/32	3/64	3/64
9	.17628	11/64	23/64	3/32	3/64	3/64
10	.18944	3/16	3/8	7/64	3/64	1/16
11	.20260	13/64	13/32	7/64	3/64	1/16
12	.21576	7/32	7/16	1/8	3/64	1/16
13	.22892	15/64	29/64	1/8	1/16	1/16
14	.24208	1/4	31/64	9/64	1/16	1/16
15	.25524	1/4	33/64	9/64	1/16	1/16
16	.26840	17/64	17/32	5/32	1/16	3/64
17	.28156	9/32	9/16	5/32	1/16	5/64
18	.29472	19/64	19/32	11/64	5/64	5/64
19	.30788	5/16	39/64	11/64	5/64	5/64
20	.32104	21/64	21/32	11/64	5/64	5/64
21	.33420	21/64	43/64	3/16	5/64	3/32
22	.34736	11/32	11/16	3/16	3/32	3/32
23	.36052	23/64	23/32	13/64	3/32	3/32
24	.37368	3/8	3/4	13/64	3/32	3/32

WHITWORTH STANDARD THREADS.

(Showing Relation between Nearest British Standard Fine)

Formula

$$p = \text{pitch} = \frac{1}{\text{No. threads per inch}}$$

$$d = \text{depth} = p \times .64033$$

$$r = \text{radius} = p \times .1373$$

Diameter inches	Threads per inch		Outside Diameter inches	Pitch Diameter inches	Root Diameter inches	Tap Drill Size
	Whitworth Std.	British Std. Fine				
1/16	60	—	.0625	.0518	.0412	56
3/32	48	—	.0938	.0804	.0671	49
1/8	40	—	.1250	.1090	.0930	40
5/32	32	—	.1563	.1362	.1162	31
3/16	24	—	.1875	.1608	.1341	28
7/32	24	—	.2188	.1921	.1654	18
1/4	20	—	.2500	.2180	.1860	11
1/4	..	26	.2500	.2254	.2001	5
9/32	..	26	.2813	.2566	.2321	B
5/16	18	..	.3125	.2769	.2414	D
5/16	..	22	.3125	.2834	.2543	G
3/8	16	..	.3750	.3350	.2950	N
3/8	..	20	.3750	.3430	.3110	O
7/16	14	..	.4375	.3918	.3460	S
7/16	..	18	.4375	.4019	.3665	3/8
1/2	12	..	.5000	.4466	.3933	X
1/2	..	16	.5000	.4600	.4200	7/16
9/16	12	..	.5625	.5091	.4558	15/32
9/16	..	16	.5625	.5225	.4825	1/2
5/8	11	..	.6250	.5668	.5086	33/64
5/8	..	14	.6250	.5793	.5336	35/64
11/16	11	..	.6875	.6293	.5711	37/64
11/16	..	14	.6875	.6418	.5961	39/64
3/4	10	..	.7500	.6860	.6219	[illegible]
3/4	..	12	.7500	.6966	.6434	[illegible]
13/16	10	..	.8125	.7485	.6844	[illegible]
13/16	..	12	.8125	.7591	.7059	[illegible]
7/8	9	..	.8750	.8039	.7327	[illegible]
7/8	..	11	.8750	.8168	.7586	[illegible]
15/16	9	..	.9375	.8664	.7952	[illegible]
1	8	..	1.0000	.9200	.8399	[illegible]
1	..	10	1.0000	.9360	.8720	[illegible]

Presented with PRACTICAL WIRELESS dated February 25th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 10

BATTERY-OPERATED VALVES

SCREEN GRID VALVES. 2-VOLT.

Impedance.	Amplification.	Fil. Current.	Anode Volts.	S.G. Volts.	Anode Current.	Price.	Type.	Maker.
727,000	800	.15	150	60	2.0	16/6	S215A	Mazda
455,000	500	.15	150	60	1.5	16/6	215SG	Mazda
357,000	500	.18	150	75	2.0	16/6	SS218SG	Six-Sixty
334,000	700	.15	150	60	1.0	16/6	S215B	Mazda
330,000	500	.18	150	90	3.0	16/6	PM12A	Mullard
300,000	330	.15	150	80	2.5	16/6	215SG	Cossor
300,000	330	.15	150	80	2.5	12/6	BY6	Eta
300,000	180	.15	150	80	2.0	16/6	S215	Mar. & Os.
200,000	350	.2	150	75	3.0	16/6	S22	Mar. & Os.
200,000	320	.2	150	80	3.1	16/6	220SG	Cossor
200,000	220	.1	150	70	2.5	16/6	S21	Mar. & Os.
190,000	200	.15	150	75	3.0	16/6	SS215SG	Six-Sixty
180,000	200	.15	150	75	4.5	16/6	PM12	Mullard
4-VOLT.								
230,000	200	.075	150	75	2.75	20/-	PM14	Mullard
220,000	190	.075	150	75	2.5	20/-	4075SG	Six-Sixty
200,000	200	.1	150	80	4.0	20/-	S410	Mar. & Os.
200,000	200	.1	150	80	4.1	20/-	410SG	Cossor
6-VOLT.								
210,000	190	.075	150	75	4.5	20/-	6075SG	Six-Sixty
200,000	210	.1	150	80	5.0	20/-	S610	Mar. & Os.
200,000	200	.1	150	80	4.1	20/-	610SG	Cossor
200,000	200	.075	150	75	3.5	20/-	PM16	Mullard
VARIABLE-MU S. G. VALVES, 2-VOLT.								
350,000	700	.15	150	60	2.8	16/6	S215VM	Mazda
110,000	—	.2	150	80	5.0	16/6	220VSG	Cossor
—	—	.1	150	70	3.5	16/6	VS2	Mar. & Os.
—	—	.15	150	90	5.5	16/6	PM12V	Mullard
—	—	.15	150	90	3.5	16/6	215VSG	Six-Sixty

ORDINARY VALVES. 2-VOLT.

Impedance.	Amp.	Fil. Current.	Anode Volts.	Mutual Conductance	Price.	Type.	Maker.
59,000	47	.1	150	.8	7/-	H210	Mazda
50,000	40	.1	150	.8	7/-	210RC	Cossor
50,000	35	.1	150	.7	7/-	H210	Mar. & Os.
45,400	50	.1	150	1.1	7/-	210RC	Six-Sixty
45,000	50	.1	150	1.1	7/-	H2	Mazda
41,600	50	.1	150	1.2	7/-	PM1A	Mullard
35,000	35	.1	150	1	7/-	H2	Mar. & Os.
25,000	19	.1	150	.75	7/-	210HF	Six-Sixty
23,000	20	.1	150	.87	7/-	HL210	Mar. & Os.
22,000	24	.1	150	1.1	7/-	210HL	Cossor
22,500	18	.1	150	.8	7/-	PM1HF	Mullard
21,000	32	.1	150	1.5	7/-	HL2	Mazda
20,000	28	.1	150	1.4	7/-	PM1HL	Mullard
20,000	26	.1	150	1.3	7/-	210HL	Six-Sixty
20,000	20	.11	150	1	5/6	BY2020	Eta
18,500	26	.1	150	1.4	7/-	HL210	Mazda
18,000	27	.1	150	1.5	7/-	HL2	Mar. & Os.
15,800	24	.1	150	1.5	7/-	210HF	Cossor
13,000	15	.1	150	1.15	7/-	210DET	Cossor
12,500	10.6	.1	150	.85	7/-	210LF	Six-Sixty
12,000	18	.1	150	1.5	7/-	PM2DX	Mullard
12,000	11	.1	150	.92	7/-	L210	Mar. & Os.
12,000	11	.1	150	.9	7/-	PM1LF	Mullard
10,000	19	.1	150	1.9	7/-	L2	Mazda
10,000	18	.1	150	1.8	7/-	210D	Six-Sixty
10,000	12	.11	150	1.2	5/6	BY1210	Eta
4,800	7.2	.2	150	1.5	8/9	220P	Six-Sixty
4,400	7.5	.2	150	1.7	8/9	PM2	Mullard
4,000	16	.2	150	4	8/9	220PA	Cossor
4,000	13	.2	150	3.2	7/6	BW1304	Eta
4,000	9	.15	150	2.25	8/9	215P	Cossor
4,000	8	.2	150	2.0	8/9	220P	Cossor
4,000	6	.2	150	1.5	8/-	BX604	Eta
3,900	15	.2	150	3.85	8/9	LP2	Mar. & Os.
3,700	13	.2	150	3.5	8/9	220PA	Six-Sixty
3,700	12.5	.2	150	3.4	8/9	P220	Mazda
3,600	12.5	.2	150	3.5	8/9	PM2A	Mullard
2,150	7.5	.2	150	3.5	12/-	P2	Mar. & Os.
2,150	6.5	.2	150	3	13/6	PM254	Mullard
2,060	7	.2	150	3.4	12/-	220SP	Six-Sixty
2,000	7	.2	150	3.5	12/-	PM202	Mullard
1,900	7	.4	150	3.7	12/-	PM252	Mullard
1,900	7	.4	150	3.7	12/-	P240	Mazda
1,900	6.6	.4	150	3.5	12/-	240SP	Six-Sixty
1,900	6.5	.32	150	3.4	8/-	BW602	Eta
1,850	6.5	.2	150	3.5	12/-	P220A	Mazda
1,500	4.5	.3	150	3.0	12/-	230XP	Cossor

ORDINARY VALVES. 4-VOLT.

Impedance.	Amp.	Fil. Current.	Anode Volts.	Mutual Conductance	Price.	Type.	Maker.
58,000	37	.075	150	.64	8/6	4075RC	Six-Sixty
55,000	38	.075	150	.66	8/6	PM3A	Mullard
50,000	40	.1	150	.8	8/6	410RC	Cossor
20,800	25	.1	150	1.2	8/6	HL410	Mar. & Os.
20,000	22	.1	150	1.1	8/6	410HF	Cossor
13,000	14	.075	150	1.05	8/6	PM3	Mullard
12,500	13.5	.075	150	1.1	8/6	4075HF	Six-Sixty
10,000	17	.1	150	1.7	8/6	410LF	Cossor
8,500	15	.1	150	1.77	8/6	L410	Mar. & Os.
7,500	15	.1	150	2.0	8/6	PM4DX	Mullard
7,250	14.5	.1	150	2.0	8/6	410D	Six-Sixty
5,000	7.5	.1	150	1.5	10/6	P410	Mar. & Os.
4,100	7.8	.1	150	1.9	10/6	410P	Six-Sixty
4,000	8	.1	150	2.0	10/6	PM4	Mullard
4,000	8	.1	150	2.0	10/6	410P	Cossor
2,150	6.5	.2	150	3.0	13/6	420SP	Six-Sixty
2,080	5	.15	150	2.4	13/6	P415	Mar. & Os.
2,000	7	.25	150	3.5	13/6	425XP	Cossor
1,950	3.5	.25	150	1.8	13/6	P425	Mazda
1,500	4.5	.15	150	3.0	13/6	415XP	Cossor
1,200	4.8	.6	150	4.0	17/6	4XP	Cossor
6-VOLT.							
66,000	40	.1	150	.6	8/6	H610	Mazda
58,000	42	.075	150	.7	8/6	6075RC	Six-Sixty
50,000	40	.1	150	.8	8/6	610RC	Cossor
49,000	40	.075	150	.85	8/6	PM5B	Mullard
30,000	30	.1	150	1	8/6	HL610	Mar. & Os.
20,000	27	.8	400	1.35	25/-	680HF	Cossor
20,000	26	.075	150	1.3	8/6	PM5D	Mullard
20,000	22	.1	150	1.1	8/6	HL610	Mazda
20,000	20	.1	150	1	8/6	610HF	Cossor
15,200	17	.075	150	1.1	8/6	6075HF	Six-Sixty
14,700	17.5	.075	150	1.2	8/6	PM5X	Mullard
9,250	18.5	.1	150	2	8/6	610D	Six-Sixty
9,000	18	.1	150	2	8/6	PM6D	Mullard
7,500	15	.1	150	2	8/6	L610	Mar. & Os.
7,500	15	.1	150	2	8/6	610LF	Cossor
6,000	5.5	.8	400	.92	25/-	680P	Cossor
3,500	8	.1	150	2.28	10/6	610P	Cossor
3,500	8	.1	150	2.3	10/6	P610	Mar. & Os.
3,550	8	.1	150	2.25	10/6	PM6	Mullard
3,400	7.8	.1	150	2.3	10/6	610P	Six-Sixty
2,750	3	.8	400	1.1	25/-	680XP	Cossor
2,500	7	.25	200	2.8	13/6	625P	Cossor
2,400	6	.25	250	2.5	13/6	P625	Mar. & Os.
2,000	5	.1	150	2.5	13/6	610XP	Cossor
1,850	6	.25	250	3.25	13/6	PM256	Mullard
1,780	5.8	.25	150	3.25	13/6	625SP	Six-Sixty
1,600	3.7	.25	200	2.3	13/6	P625A	Mar. & Os.
1,500	3.9	.25	150	2.6	13/6	625SPA	Six-Sixty
1,400	3.6	.25	200	2.6	13/6	PM256A	Mullard
1,400	3.2	1.6	400	2.3	30/-	620T	Cossor
1,300	3.5	.5	200	2.7	18/-	P650	Mazda
1,000	2.25	4.5	500	2.5	105/-	620T	Cossor

PENTODES. 2-VOLT.

Impedance.	Amp.	Fil. Current.	Anode Volts.	Mutual Conductance	Price.	Type.	Maker.
—	—	.2	150	2.5	17/6	220PT	Cossor
—	—	.2	150	2.5	17/6	220HPT	Cossor
—	—	.3	150	1.8	17/6	230HPT	Cossor
—	—	.3	150	2.0	17/6	230PT	Cossor
—	—	.2	150	2.5	17/6	PT2	Cossor
—	—	.2	150	2.5	17/6	PT2	Mar. & Os.
—	—	.2	150	2.5	17/6	Pen220	Mazda
—	—	.2	150	2.5	17/6	Pen220A	Mazda
—	—	.3	150	1.3	17/6	PM22	Mullard
—	—	.2	150	2.5	17/6	PM22A	Mullard
—	—	.3	150	1.25	17/6	230PP	Six-Sixty
—	—	.2	150	2.5	17/6	220Pen	Six-Sixty
4-VOLT							
—	—	.1	150	2.5	17/6	410PT	Cossor
—	—	.15	150	2	17/6	415PT	Cossor
—	—	.25	200	2	17/6	PT425	Mar. & Os.
—	—	.25	200	2.4	17/6	Pen425	Mazda
—	—	.15	150	1.75	17/6	PM24	Mullard
—	—	.275	300	2	20/-	PM24A	Mullard
—	—	.15	150	2.2	17/6	415PP	Six-Sixty
6-VOLT							
—	—	.15	150	2	17/6	615PT	Cossor
—	—	.25	250	1.85	20/-	PT625	Mar. & Os.
—	—	.17	150	2	17/6	PM26	Mullard
—	—	.17	150	1.9	17/6	617PP	Six-Sixty

Presented with PRACTICAL WIRELESS, dated March 4th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 11

MAINS OPERATED VALVES

A. C. (4-VOLT) VALVES

SCREEN GRID

Impedance.	Amplification Factor.	Heater Current	Anode Volts.	S.G. Volts.	Anode Current.	Price.	Type No.	Makers.
1 megohm	1,000	1	200	110	1.0	19/–	4SG.AC	Six-Sixty
*909,000	1,000	1	200	75	1.5	19/–	S4V	Mullard
800,000	1,000	1	200	100	1.0	15/6	DW6	Eta
*600,000	3,000	1	200	80	5.0	19/–	AC/S2	Mazda
*570,000	1,700	1	200	60	4.4	19/–	AC/SG	Mazda
*500,000	1,000	1	200	100	2.1	19/–	MSG-HA	Cossor
*500,000	550	1	200	60	2.5	19/–	MS4	Mar. & Os.
*400,000	1,000	1	200	80	.8	19/–	41MSG	Cossor
*350,000	1,120	1	200	80	3.4	19/–	MS4B	Mar. & Os.
*210,000	750	1	200	110	5	19/–	S4VB	Mullard
*200,000	750	1	200	100	5.2	19/–	MSG-LA	Cossor
200,000	600	1	200	80	5	15/6	DW7	Eta
* —	1,000	1	200	110	3	19/–	S4VA	Mullard
—	1,000	1	200	110	3.0	19/–	4XSG.AC	Six-Sixty
—	—	1	200	110	5	19/–	4YSG.AC	Six-Sixty
* —	—	1	200	150	9.0	20/–	MS-Pen-A	Cossor

VARIABLE Mu VALVES

Impedance.	Amplification Factor.	Heater Current	Anode Volts.	S.G. Volts.	Anode Current.	Price.	Type No.	Makers.
*545,000	600	1	200	75	5.8	19/–	AC/S1VM	Mazda
*465,000	1,400	1	200	60	6	19/–	AC/SGVM	Mazda
200,000	400	1	250	100	7	15/6	DW8	Eta
*200,000	—	1	200	100	7.8	19/–	MVSG	Cossor
* —	—	1	200	100	7	19/–	VM4V	Mullard
—	—	1	200	110	—	19/–	4MM.AC	Six-Sixty
* —	—	1	200	70	—	19/–	VMS4	Mar. & Os.
* —	—	1	200	110	6	19/-	MM4V	Mullard

GENERAL TYPES

Impedance.	Amplification Factor.	Heater Current.	Anode Volts.	Mutual Conductance.	Price.	Type No.	Makers.
*34,000	75	1	200	2.2	13/6	904V	Mullard
*18,000	72	1	200	4	13/6	41MH	Cossor
*12,000	36	1	200	3	13/6	354V	Mullard
*11,700	35	1	200	3	13/6	AC/HL	Mazda
*11,500	75	1	200	6.5	13/6	AC2/HL	Mazda
*11,500	52	1	200	4.5	13/6	41MHL	Cossor
*11,100	40	1	200	3.6	13/6	MH4	Mar. & Os.
* 8,000	20	1	200	2.5	13/6	MHL4	Mar. & Os.
* 4,850	16	1	200	3.3	15/–	164V	Mullard
* 3,000	12	1	200	4	15/–	104V	Mullard
* 2,860	12	1	200	4.2	15/–	ML4	Mar. & Os.
2,850	10	1	200	3.5	16/–	AC104	Mullard
* 2,650	10	1	200	3.75	15/–	AC/P	Mazda
* 2,500	18.7	1	200	7.5	15/–	41MP	Cossor
2,000	6	1	200	3	16/–	ACO64	Mullard
* 1,500	11.2	1	200	7.5	17/6	41MXP	Cossor
1,500	9	2	400	6	25/–	PP5/400	Mazda
* 1,460	5.4	1	200	3.7	17/6	AC/P1	Mazda
1,390	9	2	400	6.5	25/–	DO/24	Mullard
* 1,250	5	1	200	4	17/6	O54V	Mullard
1,150	4	1	200	3.5	17/6	ACO44	Mullard
1,000	6.5	1	250	6.5	17/6	PP3/250	Mazda
830	5	1	250	6	17/6	PX4	Mar. & Os.

PENTODES

Voltage.	Current.	Impedance.	Amplification Factor.	Mutual Conductance.	Anode Volts.	Price.	Type No.	Makers.
*16	.25	30,000	90	3	200	20/–	DPT	Mar. & Os.
*35	.1	—	—	2.5	250	20/–	DC2/PEN	Mazda
* 8	.5	—	—	3.5	250	20/–	DC/PEN	Mazda

PENTODES

Impedance.	Amplification Factor.	Heater Current	Anode Volts.	Mutual Conductance.	Price.	Type No.	Makers.
—	—	1	250	3	20/–	PT41	Cossor
—	—	1	400	2.25	22/6	PT41B	Cossor
* —	—	1	250	4	20/–	MP/PEN	Cossor
* —	—	1	250	3	20/–	MPT4	Mar. & Os.
—	—	1	200	2.2	20/–	PT4	Mar. & Os.
—	—	2	400	4	45/–	PT25	Mar. & Os.
* —	—	1	250	2.5	20/–	AC/PEN	Mazda
—	—	1	250	3	20/–	PM24M	Mullard
—	—	1	400	2.1	22/6	PM24B	Mullard
—	—	1	400	3	22/6	PM24C	Mullard
—	—	1	250	3	20/–	Pen4V	Mullard
—	—	2	500	4	45/–	PM24D	Mullard

RECTIFYING VALVES

Heater. Voltage.	Heater. Current.	Anodes.	Output Current.	Price.	Type No.	Makers.
4	1	250–250	60 mA	12/6	506BU	Cossor
4	1	250–250	60 mA	12/6	U10	Mar. & Os.
4	1	250–250	60 mA	12/6	UU2	Mazda
4	2	250–250	60 mA	12/6	UU60/250	Mazda
4	1	250–250	60 mA	12/6	DW2	Mullard
4	2.5	350–350	120 mA	15/–	442BU	Cossor
4	2.5	350–350	120 mA	15/–	U12	Mar. & Os.
4	2.5	350–350	120 mA	15/–	UU120/350	Mazda
4	2	350–350	120 mA	15/–	DW3	Mullard
4	2.5	500–500	120 mA	20/–	460BU	Cossor
4	2.5	500–500	120 mA	20/–	U14	Mar. & Os.
4	2.5	500–500	120 mA	20/–	UU120/500	Mazda
4	3	500–500	120 mA	20/–	DW4	Mullard
4	3	1,000 (half wave)	250 mA	25/–	GU1	Mar. & Os.

D. C. VALVES

SCREEN GRID

Voltage.	Current.	Impedance.	Amplification Factor.	Anode Volts.	S.G. Volts.	Price.	Type No.	Makers.
*20	.1	600,000	1,200	200	60	19/–	DC2/SG	Mazda
*16	.25	500,000	550	200	70	19/–	DS	Mar. & Os.
* 6	.5	360,000	1,000	200	60	19/–	DC/SG	Mazda
*16	.25	350,000	1,120	200	80	19/–	DSB	Mar. & Os.
*16	.25	Variable Mu		200	80	19/–	VDS	Mar. & Os.
*20	.1	Variable Mu		200	80	19/	DC2/SGVM	Mazda

ORDINARY

Voltage	Current.	Impedance.	Amplification Factor.	Mutual Conductance.	Anode Volts.	Price.	Type No.	Makers.
*6	.5	13,000	35	2.7	200	13/6	DC/HL	Mazda
*25	.1	11,700	35	3	200	13/6	DC3/HL	Mazda
*16	.25	10,800	40	3.7	200	13/6	DH	Mar. & Os.
*16	.25	2,660	12	4.5	200	15/–	DL	Mar. & Os.
*35	.1	2,650	10	3.75	200	15/–	DC2/P	Mazda
* 8	.5	2,220	10	4.5	200	15/–	DC/P	Mazda

SPECIAL BATTERY VALVES

Impedance.	Amp.	Fil. Current.	Anode Volts.	Slope.	Purpose.	Price.	Type.	Makers.
27,000	5.1	.1	100	.19	Double-Grid	20/–	210DG	Cossor
3,750	4.5	.2	100	1.2	Double-Grid	20/–	DG2	Marconi
3,750	4.5	.2	100	1.2	Double-Grid	20/–	DG2	Osram
—	—	.1	80	.8	Double-Grid	20/–	PM1DG	Mullard
—	—	.1	80	.8	Double-Grid	20/–	210DG	Six-Sixty

* These valves are of the Indirectly Heated Type.

Presented with PRACTICAL WIRELESS, dated March 11th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 12

HANDY FORMULÆ

AMPLIFICATION.

Of a tuned circuit .. $= \dfrac{\omega L}{r}$

Where r = equivalent series resistance.

CAPACITY.

Capacity of a condenser :

(a) With parallel plates $C = \dfrac{Ak}{11.31 \times 10^6 \times d}$ mfd.

(b) Spherical plates $C = r/9 = 10^5$ mfds.

Capacity of a horizontal aerial :

$$C = l \div \left(4.144 \times 10^6 \log_{10} \frac{4h}{d}\right) \text{ mfd.}$$

where l = length in cms.
d = diameter in cms.
h = height above earth in cms.
A = total area in cms. of one plate.
r = radius in cms.

Capacities in series $C = \dfrac{C_1 \times C_2}{C_1 + C_2}$.

Capacities in parallel $C = C_1 + C_2$.

FREQUENCY.

$$f = \frac{\sqrt{10^6 \times 10^6}}{2\pi\sqrt{LC}}$$

INDUCTANCE.

Inductance of a straight wire $L = 2l \left(\log_e \left(\dfrac{2l}{r}\right) - 1\right)$ cms.

Inductance of a solenoid $L = 4r^2 a^2 N^2 b^2$.

Inductance in series (with no mutual inductance)
$L = L_1 + L_2$.

Inductances in parallel (with no mutual inductance)

$$L = \frac{L_1 \times L_2}{L_1 + L_2}$$

L = Inductance in cms.
N = Turns per cm.
b = Overall breadth of coil in cms.
r = radius of wire in cms

IMPEDANCE.

In a circuit with Resistance, Inductance and Capacity in series.

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} = \sqrt{R^2 + X^2}$$

OHM'S LAW.

$I = \dfrac{E}{R}$ $E = I \times R$ $R = \dfrac{E}{I}$

For A.C. circuits $I = \dfrac{E}{2\pi f L}$

REACTANCE.

Of a coil .. .. $X = 2\pi f L$

Of a condenser .. $X = \dfrac{1}{2\pi f C}$

Net reactance .. $X = X_L - X_C$

At resonance .. $f = \dfrac{1}{2\pi\sqrt{LC}}$

RESISTANCE.

$R = \dfrac{E}{I}$

Of a tuned circuit .. .. $R = \dfrac{L}{C \times r}$

Where r = equivalent series resistance.

Resistances in series $R1 + R2$

Resistances in parallel $\dfrac{R1 \times R2}{R1 + R2}$

WATTAGE DISSIPATION.

$I^2R = EI$

WAVELENGTH.

Wavelength (in metres) $= \dfrac{\text{Velocity}}{\text{Frequency}}$

Of a tuned circuit — $\lambda = 1885\sqrt{LC}$

Where L = microhenrys.
C = microfarads.
$\lambda \times f = 300{,}000{,}000$

To convert Wavelengths (in metres) to Frequency (in kilocycles), divide 300,000 by the Wavelength.

To convert Frequency (in kilocycles) to Wavelength (in metres), divide 300,000 by the Frequency.

VALVE FORMULÆ

AMPLIFICATION FACTOR.

$$\mu = \frac{\text{Change in anode volts}}{\text{Change in grid volts}}$$

IMPEDANCE. (This is actually A.C. resistance)

$$Ro = \frac{\text{Change in anode volts}}{\text{Change in anode current}}$$

MUTUAL CONDUCTANCE.

$$= \frac{\text{Change in anode current}}{\text{Change in grid volts}}$$

TABLE OF SYMBOLS USED IN WIRELESS AND ELECTRICAL FORMULÆ

Amplification	A
„ factor	μ (Mu)
Ampere (unit of current)	A
Current (R.M.S. value)	I
„ (instantaneous)	i
Capacity	C
Energy	W
E.M.F. (voltage—R.M.S. value)	E
E.M.F. (instantaneous)	e
Farad (unit of capacity)	F
Henry (unit of inductance)	H
Impedance	Z
Inductance	L
Mutual inductance	M
Ohm (unit of resistance)	Ω
Power	P
Resistance	R
Reactance	X
Wavelength	λ
2πf	ω

"PRACTICAL WIRELESS" DATA SHEET No. 13

TERMINALS, FUSES, ETC.

TERMINAL SIZES

Terminal shanks are practically all 4 B.A. The older form of slotted shank supplied by Belling-Lee is 2 B.A. These sizes are clearance dimensions.

TERMINAL TYPES

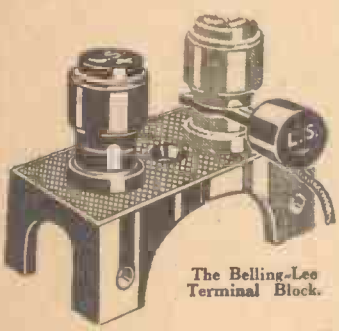
Terminals are obtainable in many sizes and patterns, but the markings set out below are those which are standardised by the majority of terminal manufacturers. The Belling-Lee terminals are manufactured in four sizes, Types B, M, R and Q. Types B. R and Q have ebonite heads, whilst Type R is of metal. Types B and M also have non-rotatable heads so that the name is always easily read.

Eelex terminals are manufactured with non-rotatable indicating heads, and with socket centres so that plugs may be inserted. In addition, the Treble Duty terminal has removable indicating plates which are held in place on the head. The shank is slotted to accommodate connecting wires.

The Eelex Treble Duty Plug.

TERMINAL BLOCKS

Terminals are usually attached to a strip of ebonite fixed to the rear of a baseboard, but to simplify this method of construction, special terminal mounting blocks are manufactured by Belling-Lee, Ward & Goldstone, Telsen, etc. The Belling-Lee accommodates two terminals of any type, whilst the Ward & Goldstone accommodates only one terminal. The Telsen is complete with two terminals, one red and one black.

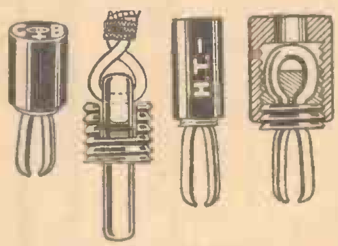


The Belling-Lee Terminal Block.

STANDARD TERMINAL INDICATIONS

Aerial	Aerial 1	Aerial 2
Aerial 3	Earth	Pick-up
L.S.+	L.S. –	Phones+
Phones –	L.T.+	L.T. –
H.T.+	H.T.+1	H.T.+2
H.T.+3	H.T.+4	H.T. –
Grid+	Grid –	Grid –1
Grid –2	Grid –3	Screen
Input+	Input –	Output+
Output –	+	–
Mains+	Mains –	A.C. Mains
L.T.A.C.		

And in addition, plain red or black.



Various Types of Wander Plugs.

TERMINAL MOUNTING STRIPS

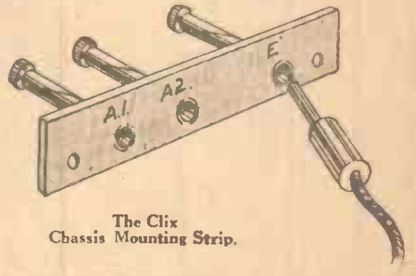
In place of the customary terminal block or strip, special paxolin strips are obtainable from Clix, in which resilient sockets are fixed. These are appropriately engraved and accommodate the solid type of plug. This is an improvement on the terminal with screw top, as it enables rapid connection to be made. Messrs. Bulgin also manufacture a small ebonite terminal block with two terminals fitted.

FUSES

H.T. – is invariably joined to L.T. –, and it is advisable always to make this connection by means of a fuse. The leads to the valve-holders are then taken from the L.T. – side of the fuse-holder. Fuse-holders are manufactured by Telsen and Bulgin and accommodate small lamp fuses of the flashlamp bulb type. They are obtainable in various ratings and the choice should be made in the following manner. Add together the total filament current consumption of each individual valve, and choose a fuse which will blow at a value slightly lower than this total. Microfuses are also obtainable, and these consist of a thin gold film and not a lamp type. They are also obtainable in various ratings. (Note: .2 amp. is 200 milliamps.)

BATTERY CORDS

To obviate the necessity of joining battery leads to terminals, special multi-way battery cords are obtainable. Those manufactured by Messrs. Belling-Lee are fitted with two spades for connecting to the accumulator, whilst the remaining cords are provided with wander plugs. These may be obtained in lengths of 30 in. or 54 in. and are made up in 5-way, 6-way, 7-way, 8-way, 9-way and 10-way cables. The leads are intended for G.B. and H.T. tappings, but obviously the plugs may be altered to suit individual requirements. Messrs. Bulgin, Ward & Goldstone and Harbro also manufacture multi-way battery cords similar in type to those above mentioned. Messrs. Bulgin do not supply spades or plugs with their cords so that these may be made up to suit particular demands.



The Clix Chassis Mounting Strip.

Presented with PRACTICAL WIRELESS, dated March 25th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 14

LOUD SPEAKERS

Loud speakers are divided into two classes: Moving-iron and Moving-coil. But no matter what type of loud speaker is employed it is essential that it should match the valve if the maximum undistorted power output is required. With normal three-electrode valves, the loud-speaker load, or as it is more correctly called, the "optimum valve load," should be roughly twice the normal impedance of the valve. A moving-coil loud speaker (and some types of electrostatic loud speaker) remains constant in impedance throughout the normal frequency range, but moving-iron speakers vary in impedance with the frequency. It is, therefore, usual to take the impedance of this type of speaker at 256 cycles. To enable the matching to be carried out it is necessary to use a transformer, and the ratio of this may be obtained from the adjoined formula. Where two or more valves are connected *in parallel* in the output stage, the load is proportionately less. For instance, two valves in parallel would require a load half that of either valve used separately. Where two valves are connected *in push-pull* in the output stage, the load required is just double that of either valve.

$$\text{Transformer Ratio} = \sqrt{\frac{\text{Optimum Valve Load}}{\text{Loud Speaker Impedance.}}}$$

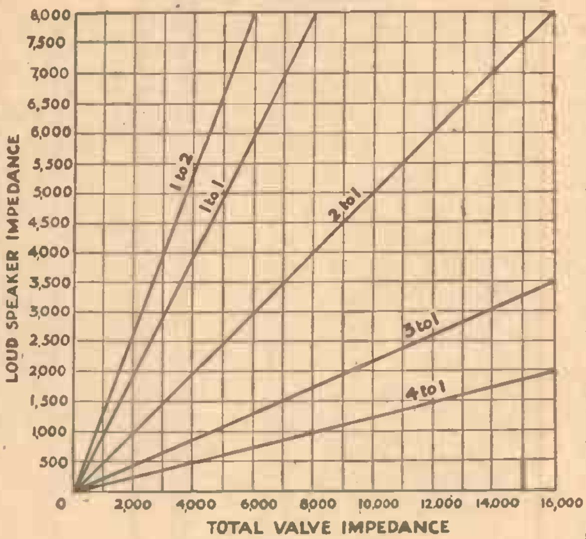
MOVING-IRON LOUD SPEAKERS.

Moving-iron loud speakers may consist of a simple reed movement, a balanced armature, or an inductor-dynamic arrangement. The former is the simplest, but owing to its inertia fails to deal with the lower frequencies in the musical range. The balanced armature possesses slightly more freedom and, therefore, gives better response at the lower frequencies, whilst the inductor-dynamic is especially designed to respond well down in the musical scale. It is not, however, very good at the higher musical frequencies. Owing to the fact that the impedance of moving-iron loud speakers varies with the frequency, it is inadvisable to employ this type of speaker with a pentode valve. Great care should be taken with these speakers to see that the reed does not get bent out of alignment, and the cone washer employed for attaching the diaphragm should be kept well tightened. The material of which the diaphragm is made will affect the response, and, generally speaking, this should be of thin material with felt rings between the cone washers and the diaphragm at both back and front.

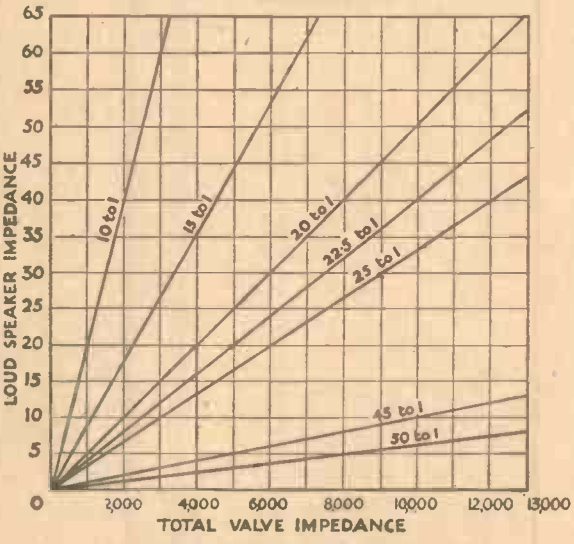
DIAPHRAGMS.

With all types of loud speaker, the material from which the diaphragm is made will affect its response. The effects are especially noticeable with the moving-coil type of loud speaker. A very good all-round material is No. 2 sheet Bristol Board. This should be formed into a cone with right-angled sides, and the edge turned back at an angle for a distance of not more than a quarter of an inch. This turned-back edge should be cemented to *thin* leather, and this should not be stretched when attaching it to the clamping ring or other device to which it may require to be affixed. The speech coil should be of the minimum weight, and it should, therefore be wound on a very thin paper cylinder, and doped with collodion. A very good material to use for this purpose is Durofix. The resistance of the speech coil should be from 5 to 50 ohms, and the matching carried out by means of a transformer as pointed out in the first section above. The angle of the cone will affect its response, and for general results in the home, a right-angled cone will be found best. It should not be made less than a right-angle owing to the risk of focussing. Generally speaking, a light, thin diaphragm will give brilliancy, whilst a heavy dead material will result in a deep tone.

HIGH RESISTANCE



LOW RESISTANCE

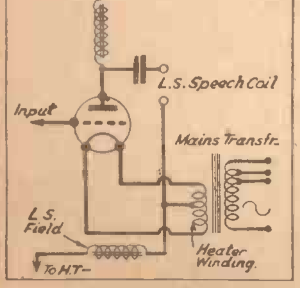


MOVING-COIL LOUD SPEAKERS

Moving-coil loud speakers are divided into two classes, those having a permanent magnet and those possessing an energised field. In the former the magnet may take on any shape, but it requires no method of energising, and owing to modern methods of manufacture it is sufficiently permanent in its magnetism to outlast the design of the speaker. The other type has a large winding round the pole-piece, and this requires the application of a direct current in order to produce the magnetic field. The required voltage may vary from 10 volts in some designs to 200 volts in others. The type of speaker which requires a high voltage usually has a field winding with a resistance of from 2,000 ohms to 10,000 ohms, and, therefore, in the lower values it may be employed as a smoothing choke in a mains eliminator. For this purpose the eliminator should be designed to give an output of 350 volts at 100 mA or so, and the drop through the field will give a dissipation of from 3 to 10 watts, according to the resistance of the field. The voltage drop will permit of the full 200 or 250 volts being applied to the receiver. Care must be taken in handling this type of speaker so as not to introduce hum by induction, and with all types of moving-coil speaker the diaphragm should be handled carefully so as not to upset the centralising device.

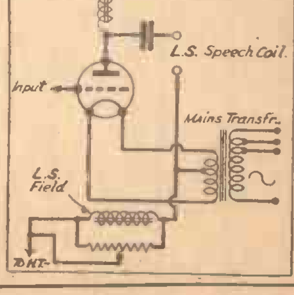
BAFFLES.

Practically all types of loud speaker necessitate a baffle, which prevents the sound waves from one side from passing round to the other side and so neutralising the effect of very low notes. The baffle should be as thick as conveniently possible—not less than three-eighths of an inch. The hole in it should be of the same size as the mouth of the diaphragm—not smaller. The speaker should be securely fixed to the baffle to prevent rattle, and it is also a good plan to glue large odd-shaped pieces of wood to the inside of the baffle at various positions to break up unwanted resonances. In cases where the baffle is built in the form of a cabinet, resonance may be removed by packing the corners with non-resonant material such as wool, kapok, etc. The size of the baffle will govern the reproduction of the bass notes, and the following details will assist in the choice of the correct size for particular individual requirements. For the reproduction of a 200-cycle note, the baffle should be 18 inches wide. For 100 cycles, 2 ft. 9 ins.; for 60 cycles 4 ft. 6 ins., and for 30 cycles at least 9 ft. must be provided. Where undue emphasis is given to the bass notes, a reduction in strength may be obtained by removing the loud speaker to a distance of about one inch behind the baffle. In other words, a slight air space between the front of the diaphragm and the rear surface of the baffle will assist in reducing the low note response.



TRANSFORMER RATIOS AND FIELD BIASING.

The two graphs above have been designed on the assumption that the optimum load required for the valve is double the A.C. impedance of the valve. As pointed out above, however, this does not hold good for Pentodes, Valves in Parallel and Valves in Push-Pull. To ascertain the ratio of transformer, find the point of intersection of the lines, corresponding to the valve resistance and speaker impedance. The nearest line running from the lower left-hand corner will then give the transformer ratio required. Where the field of the speaker is of the energised type having a D.C. resistance of 2,000 to 5,000 ohms, it may be employed for biasing the output valve. The illustration on the left shows the method of connection. The total anode current of the output valve passes through the field, and therefore the bias obtained may be worked out by multiplying the resistance of the field (in ohms) by the anode current (expressed as a decimal fraction of an amp.). If this results in an excessive voltage, a reduction may be obtained by joining a high-resistance potentiometer (of the order of 50,000 ohms) across the field, and connecting the arm, as well as one end, to H.T.—as shown on the right. The slider should be adjusted until the anode current, as shown by a milliammeter, is of the correct value. The manufacturer's instructions should, of course, be carried out in all cases.



Presented with PRACTICAL WIRELESS, dated April 1st, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 15

EUROPEAN BROADCASTING STATIONS

(BRITISH) STATIONS ARE IN HEAVY TYPE, thus: **DAVENTRY NATIONAL**)

Frequency in Kc/s.	Wave-length in Metres.	Station.	Country.	Power in Kw.
155.0	1935.0	Kaunas (Kovno)	Lithuania	7.00
160.0	1875.0	Huizen (Exchanges wavelengths with Hilversum every 3 months)	Holland	8.50
167.0	1796.0	Lahti	Finland	40.00
174.0	1725.0	Radio Paris, C.F.R.	France	75.00
183.5	1635.0	Zeesen (Königswusterhausen)	Germany	60.00
187.5	1600.0	Irkoutsk, RV14	Russia	10.00
193.0	1554.4	**Daventry National**	England	30.00
195.0	1538.0	Ankara (Angora)	Turkey	7.00
202.5	1481.0	Moscow, RV1 (Old Komintern)	Russia	100.00
207.5	1446.0	Eiffel Tower, FL, Paris	France	13.00
212.5	1412.0	Warsaw 1	Poland	120.00
217.5	1380.0	Novosibirsk, RV6	Russia	100.00
222.2	1350.0	Tunis-Kasbah	Tunisia	0.50
222.5	1348.0	Motala (Relays Stockholm)	Sweden	30.00
230.0	1304.0	Moscow, WZSPS (Trade Union)	Russia	100.00
238.0	1260.0	Baku, RV8	Russia	10.00
244.0	1229.5	Boden (Relays Stockholm)	Sweden	0.60
250.0	1200.0	Stamboul	Turkey	5.00
250.0	1200.0	Reykjavik	Iceland	21.00
256.0	1170.0	Tashkent, RV11	Russia	25.00
260.0	1154.0	Kalundborg (Relays Copenhagen)	Denmark	7.50
268.5	1117.0	Moscow, Popoff RV58	Russia	40.00
271.5	1105.0	Minsk Koloditschi, RV10	Russia	35.00
277.0	1083.0	Oslo	Norway	60 00
280.0	1071.0	Tiflis, RV7	Russia	10.00
290.0	1035.0	Kiev, RV9	Russia	36.00
300.0	1000.0	Leningrad, Kolpino RV53	Russia	100.00
320.0	938.0	Kharkov, RV4	Russia	20.00
340.0	882.0	Saratov, RV3	Russia	20.00
353.4	849.0	Rostov-on-Don, RV12	Russia	4.00
357.0	840.0	Budapest	Hungary	18.50
363.6	825.0	Sverdlovsk, RV5	Russia	50.00
385.0	779.0	Petrozavodsk, RV29	Russia	10.00
389.0	770.0	Ostersund (Relays Stockholm)	Sweden	0.60
395.0	760.0	Geneva (Relays Sottens)	Switzerland	1.30
416.6	720.0	Moscow, RV2 (Experimental)	Russia	20.00
434.6	690.0	Oulu (Uleaborg)	Finland	1.50
441.2	680.0	Lausanne (Relays Sottens)	Switzerland	0.60
521.5	575.0	Samara, RV16	Russia	1.20
522.0	574.7	Ljubljana	Yugoslavia	2.50
527.0	569.3	Freiburg-im-Breisgau (Relay Station)	Germany	0.25
528.0	568.1	Grenoble	France	2.00
530.0	566.0	Hanover (Relays Hamburg)	Germany	0.25
533.0	563.0	Wilno (Relay Station)	Poland	16.00
536.0	560.0	Augsburg (Relays Munich)	Germany	0.25
536.0	560.0	Hamar (Relays Oslo)	Norway	0.70
536.0	560.0	Kaiserslauten (Relays Munich)	Germany	1.50
537.0	558.6	Tampere (Relays Helsinki)	Finland	1.00
545.0	550.0	Budapest No. 1 Lakihegy	Hungary	18.50
554.0	542.0	Palermo	Italy	3.00
554.0	542.0	Sundsvall (Relays Stockholm)	Sweden	10.00
563.0	533.0	Munich	Germany	1.50
571.0	525.0	Riga	Latvia	15.00
580.0	517.0	Vienna (Rosenhügel)	Austria	15.00
589.0	509.0	Brussels No. 1, Velthem (French Programme)	Belgium	15.00
589.0	509.0	Astrakhan, RV35	Russia	10.00
598.0	501.7	Nijni Novgorod, RV42	Russia	10.00
599.0	500.8	Florence, 1F1 (Relays Turin)	Italy	20.00
608.0	493.4	Trondheim	Norway	1.20
614.0	488.6	Prague, No. 1	Czechoslovakia	120.00
617.0	486.2	Oufa, RV22	Russia	10.00
625.0	480.0	**North Regional (Manchester)**	England	50.00
625.0	480.0	Ivanovo-Voznesenk, RV33	Russia	10.00
635.0	472.4	Langenberg	Germany	60.00
644.0	465.8	Lyons la Doua, PTT	France	1.50
653.0	459.4	Beromünster (Schweizerischer Landessender)	Switzerland	60.00
662.0	453.2	San Sebastian, EAJ8	Spain	0.60
662.0	453.2	Salamanca, EAJ22	Spain	1.00
662.0	453.2	Pori	Finland	1.00
662.0	453.2	Danzig (Relays Heilsberg)	Austria	0.50
662.0	453.2	Klagenfurt (Relays Vienna)	Austria	0.50
662.0	453.2	Porsgrund (Relays Oslo)	Norway	0.70
662.0	453.2	Tromsö	Norway	0.10
662.0	453.2	Bodö	Norway	0.50
662.0	453.2	Upsala (Relays Stockholm)	Sweden	0.15
666.7	450.4	Odessa, RV13	Russia	10.00
671.0	447.1	Ecole Supérieure, PTT, Paris	France	7.00
671.0	447.1	Aalesund	Norway	0.35
671.0	447.1	Rjukan	Norway	0.15
671.0	447.1	Notodden (Relays Oslo)	Norway	0.08
680.0	441.2	Rome, IRO	Italy	50.00
689.0	435.4	Stockholm, SASA	Sweden	55.00
698.0	430.0	Belgrade	Yugoslavia	2.50
707.0	424.3	Madrid, EAJ7 (Union Radio) (After 7.0 p.m.)	Spain	2.00
707.0	424.3	Madrid, EAJ2 (Radio Espana) (Up to 7.0 p.m.)	Spain	1.30
707.0	424.3	Moscow, Imini Stalina	Russia	100.00
716.0	419.0	Berlin, No. 1, Witzleben	Germany	1 50
720.5	416.4	Rabat	Morocco	5.00
725.0	413.0	Athlone	Irish Free State	60.00
734.0	408.7	Katowitz	Poland	16.00
743.0	403.8	Sottens (Radio Suisse Romande)	Switzerland	25.00
752.0	398.9	**Midland Regional**	England	25.00
761.0	394.2	Bucharest	Roumania	12.00
770.0	389.6	Leipzig	Germany	120.00
770.0	389.6	Archangel, RV36	Russia	10.00
779.0	385.1	Toulouse (Radiophonie du Midi)	France	8.00
779.0	385.1	Stalino, RV26	Russia	10.00
788.0	381.0	Lwow (Lemburg)	Poland	16.00
797.0	376.4	**Scottish Regional (Falkirk)**	Scotland	50.00
806.0	372.2	Hamburg	Germany	1.50
810.5	370.1	Radio, L.L., Paris	France	0.80
815.0	368.1	Seville, EAJ5 (Union Radio)	Spain	1.00
815.0	368.1	Bolzano	Italy	1.00
815.0	368.1	Helsinki (Relays Lahti)	Finland	10.00
815.0	368.1	Kharkov, RV20	Russia	10.00
816.0	367.6	Fredriksstad (Relays Oslo)	Norway	0.70
824.0	364.1	Bergen	Norway	1 00
825.0	363.6	Algiers	Algeria	13.00
832.0	360.6	Mühlacker (Stuttgart)	Germany	60.00
843.0	355.9	**London Regional (Brookmans Park)**	England	50.00
852.0	352.1	Graz (Relays Vienna)	Austria	7.00
860.0	348.8	Barcelona, EAJ1	Spain	7.60
860.0	348.8	Leningrad, RV70	Russia	10.00
869.0	345.2	Strasbourg, PTT	France	11.50
878.0	341.7	Brno (Brunn)	Czechoslovakia	35.00
887.0	338.2	Brussels II, Velthem (Flemish Programme)	Belgium	15.00
896.0	335.0	Cadiz	Spain	5.00
897.0	334.4	Poznan	Poland	1.90
905.0	331.5	Milan (Relays Turin)	Italy	50.00
914.0	328.2	Poste Parisien	France	60.00
923.0	325.0	Breslau	Germany	60.00
932.0	321.9	Göteborg (Relays Stockholm)	Sweden	10.00
941.0	318.8	Sofia	Bulgaria	0.50
941.0	318.8	Dresden (Relays Leipzig)	Germany	0.25
941.0	318.8	Naples INA (Relays Rome)	Italy	1 50
950.0	315.8	Marseilles, PTT	France	1.60
959.0	312.8	Cracow	Poland	1.70
959.0	312.8	Genoa, IGE (Relays Turin)	Italy	10.00
968.0	309.9	Cardiff	Wales	1.00
977.0	307.0	Radio Vitus (Paris)	France	0.70
977.0	307.0	Falun	Sweden	0.50
977.0	307.0	Zagreb	Yugoslavia	0.75
986.0	304.0	Bordeaux Lafayette, PTT	France	13.00
995.0	301.5	**North National (Manchester)**	England	50.00
1004.0	298.8	Tallinn	Esthonia	11.00
1013.0	296.1	Hilversum (Up to 4.40 p.m.)	Holland	7.00
1013.0	296.1	Hilversum (After 4.40 p.m.) (Exchanges wavelengths with Huizen every three months)	Holland	20.00
1022.0	293.5	Limoges, PTT	France	0.70
1022.0	293.5	Kosice	Czechoslovakia	2.60
1031.0	291.0	Viipuri (Viborg) (Relays Helsinki)	Finland	10.00
1040.0	288.3	**Scottish National (Falkirk)**	Scotland	50.00
1040.0	288.3	**British Relay Stations (Bournemouth, Plymouth)**	England	—
1049.0	286.0	Montpellier	France	0 80
1058.0	283.6	German Relay Stations (Berlin, Magdebourg, Stettin)	Germany	0.50
1058.0	283.6	Innsbrück (Relays Vienna)	Austria	0.50
1063.0	282.2	Lisbon CT IAA	Portugal	2.00
1067.0	281.2	Copenhagen	Denmark	0.75
1076.0	278.8	Bratislava	Czechoslovakia	13 50
1085.0	276.5	Heilsberg	Germany	60.00
1096.0	273.7	Turin	Italy	7 00
1105.0	271.5	Rennes, PTT	France	1.30
1112.0	269.8	Bremen (Relays Hamburg)	Germany	0.25
1112.0	269.8	Bari	Italy	20.00
1121.0	267.6	Valencia	Spain	1.50
1128.5	265.8	Lille, PTT	France	1.30
1137.0	263.8	Moravska Ostrava	Czechoslovakia	11.20
1147.0	261.5	**London National (Brookmans Park)**	England	50.00
1157.0	259.3	Frankfurt-a.M.	Germany	17.00
1167.0	257.1	Hörby (Relays Stockholm)	Sweden	10.00
1176.0	255.1	Toulouse, PTT	France	0.70
1185.0	253.1	Gleiwitz (Relays Breslau)	Germany	5.00
1193.0	252.0	Barcelona, EAJ15 (Assoc. Nat.)	Spain	1.00
1193.0	252.0	Almeria, EAJ18	Spain	1.00
1202.0	249.6	Prague, No. 2	Czechoslovakia	—
1202.0	249.6	Kalmar	Sweden	0.20
1202.0	249.6	Juan-les-Pins, Nice	France	0 80
1211.0	247.7	Trieste	Italy	10.00

[*To be continued on Data Sheet No. 16*

Presented with PRACTICAL WIRELESS, dated April 8th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 16

BROADCASTING STATIONS *(Continued from DATA SHEET No. 15).*

Frequency in Kc/s.	Wavelength in Metres.	Station.	Country.	Power in Kw.
1220.0	245.9	Varberg	Sweden	0.30
1220.0	245.9	Swansea	Wales	0.12
1220.0	245.9	Berne (Relays Beromünster)	Switzerland	0.50
1220.0	245.9	Eskilstuna (Relays Stockholm)	Sweden	0.20
1220.0	245.9	Särtle (Relays Stockholm)	Sweden	0.40
1220.0	245.9	Cassel (Relays Frankfürt)	Germany	0.25
1220.0	245.9	Linz Relays Vienna	Austria	0.50
1220.0	245.9	Pietarsaari (Relays Helsinki)	Finland	0.50
1220.0	245.9	Turku (Abo) (Relays Helsinki)	Finland	0.50
1220.0	245.9	Schaerbeck	Belgium	0 10
1229.0	244.1	Basle (Relays Beromünster)	Switzerland	0.50
1238.0	242.3	Belfast	N. Ireland	1.00
1247.0	240.6	Stavanger	Norway	0.50
1256.0	238.9	Nurnberg (Relays Munich)	Germany	2.00
1260.0	238.0	Nimes	France	1 00
1265.0	237.2	Bordeaux, Sud-Ouest	France	3.00
1274.0	235.5	Kristiansand	Norway	0.50
1283.0	235.0	Lodz (Relay Station)	Poland	1.65
1292.0	232.2	Kiel (Relays Hamburg)	Germany	0.25
1301.0	230.6	Swedish Relay Stations (Malmö, Norrköping, Karlstad and Trollhätten)	—	—

Frequency in Kc/s.	Wavelength in Meters.	Station.	Country.	Power in Kw.
1310.0	229.0	Umea	Sweden	0.50
1319.0	227.4	Flensburg (Relays Hamburg)	Germany	0.50
1337.0	224.4	Cork	Irish Free State	1.00
1345.0	223.0	Fécamp, Radio-Normande	France	10 00
1346.0	222.9	Hüdiksvall	Sweden	0 15
1365.0	219.9	Béziers	France	1.50
1373.0	218.5	Salsburg (Relays Vienna)	Austria	0.50
1382.0	217.0	Königsburg (East Prussia)	Germany	0'50
1382.0	217.0	Karlstad	Sweden	0.25
1391.0	215.6	Halmstad	Sweden	0.20
1391.0	215.6	Brussels, Radio-Chatelineau	Belgium	0.10
1400.0	214.3	Aberdeen	Scotland	1.00
1400.0	214.3	Warsaw, No. 2	Poland	10.00
1420.0	211.3	Newcastle	England	1.00
1430.0	209.0	Magyarovar and Miskolcz	Hungary	0.80
1450.0	207.0	Boras	Sweden	0.15
1460.0	206.0	Ornsköldsvik	Sweden	0.20
1470.0	204.1	Gävle	Sweden	0.20
1480.0	202.7	Kristineham	Sweden	0.25
1490.0	201.3	Hälsingborg	Sweden	0.25
1530.0	195.0	Karlskrona	Sweden	0.20

PRINCIPAL SHORT WAVE STATIONS

Frequency in Kc/s.	Wavelength in Metres.	Station.	Country.	Times of Transmission.
3,750	80.0	Rome	Italy	—
4,273	70.2	Khabarovsk	Russia	Daily 09.00–12.00
4,795	62.56	London, Ont.	Canada	Sun. 06.00
4,800	62.5	Long Island, N.Y.	U.S.A.	Fri. 24.00
5,146	58.3	Bandoeng	Java	Daily 12.20 and 07.00
5,172	58.0	Prague	Czechoslovakia	Tues. and Fri. 19.30
5,502	54.52	Brooklyn, N.Y.	U.S.A.	—
5,690	52.7	Tananarive, P.T.T.	Madagascar	—
5,714	52.5	Quito	Ecuador	Daily 12.30
5,857	51.22	Chapultepec	Mexico	—
5,930	50.6	Medellin	Colombia	
5,970	50.26	Vatican State, Rome	Italy	Daily 19.00
6,000	50.0	Christchurch	New Zealand	Wed. 03.00, Sat. 07.30
6,000	50.0	Bucharest	Roumania	—
6,000	50.0	Moscow	Russia	—
6,060	50.0	Barcelona	Spain	Sat. 20.00
6,005	49.96	Drummondville	Canada	(Relays CFCF, 01.00–05.00
6,005	49.96	Tegucigalpa	Honduras	Daily ex Sun. 00.00 05.00
6,020	49.83	Chicago, Ill.	U.S.A.	—
6,023	49.83	Mexico City	Mexico	Daily 01 00
6,042	49.67	Coytesville, N.J.	U.S.A.	—
6.050	49.59	Halifax	Nova Scotia	—
6,050	49.58	Empire Zones 4-5	—	—
6.060	49.5	Nairobi	Kenya Colony	Daily 16.30
6,060	49.5	Mason, Ohio	U.S.A.	—
6,060	49.5	Philadelphia, Pa.	U.S.A.	—
6,069	49.43	Vancouver, B.C.	Canada	—
6,072	49.4	Vienna	Austria	Tues. 13.00, Thurs. 15.00, Sat. 23.00
6,080	49.34	Kearny, N.J.	U.S.A.	—
6,080	49.34	Chicago, Ill.	U.S.A.	—
6,095	49.22	Bowmanville, Ont.	Canada	Daily 20.00
6,098	49.2	Johannesburg	South Africa	Weekdays 09.00, 14.00 [Sat. 14.30] and 17.00, Sun. 13.00 and 17.30
6,100	49.18	Bound Brook, N.Y.	U.S.A.	—
6,110	49.1	Calcutta	India	Daily 13.00
6,120	49.02	Long Island, N.Y.	U.S.A.	—
6,140	48.86	East Pittsburg, Pa.	U.S.A.	—
6,147	48.8	Winnipeg	Canada	Daily ex. Sun. 00.30
6,167	48.65	Mexico City	Mexico	—
6,205	48.35	Bogota	Colombia	Daily 15.00
6.220	48.2	Rome	Italy	—
6.243	48.05	Barranquilla	Colombia	Weekdays 23.45
6,250	48.0	Casablanca	Morocco	—
6,382	47.00	Quito	Ecuador	Daily 01.00
6,425	46.69	Bound Brook, N.J.	U.S.A.	—
6,426	46.67	London, Ont.	Canada	Sat. 01.00, Sun. 02.00
6,611	45.38	Moscow	Russia	—
6,667	45.0	Constantine	Algeria	Mon. and Fri. 23.00
6,667	45.0	Guatemala City	Central Amer.	Daily 03.00
6,860	43.75	Radio Vitus, Paris	France	Daily 20.30
6,970	43.0	Madrid	Spain	Tues. and Sat. 22.30
7,195	41.0	Singapore	Malay States	Sun. and Wed. 15.30
7,211	41.7	Teneriffe	Canary Islands	—
7,230	41.6	Zurich (Radio Club)	Switzerland	1st and 3rd Sun.
7,320	41.0	Bangkok	Siam	Mon. 14.00
7,443	40.3	Radio Nations, Prangins	Switzerland	Sun. 22.00–22.45
7,556	39.7	Bogota	Colombia	—
7,612	39.4	Nuevo Laredo	Mexico	Thurs. 16.00

Frequency in Kc/s.	Wavelength in Metres.	Station.	Country.	Times of Transmission.
7,797	38.7	Radio Nations, Prangins	Switzerland	Sun. 22.00–22.45
8,125	36.92	Bandoeng	Java	Daily 10.00–14.00
8,650	34.68	Long Island, N.Y.	U.S.A.	Fri. 23.00
8,650	34.68	London, Ont.	Canada	Mon. 21.00
8,928	33.50	Guatemala City	S. America	—
9,300	32.26	Rabat	Morocco	Sun. 21.00
9,500	31.58	Rio de Janeiro	Brazil	Daily 21.30
9,510	31.55	Melbourne	Australia	Wed. and Sat. 10.00
9,510	31.54	Empire Zones 2, 4, 5	—	—
9,520	31.51	Skamlebaek	Denmark	—
9,530	31.48	Schenectady, N.Y.	U.S.A.	—
9,560	31.38	Zeesen	Germany	Daily 13.00
9,570	31.35	Posen	Poland	Tues. and Thurs. 17.30.
9,570	31.35	East Springfield,	U.S.A.	—
9,582	31.3	Philadelphia, Pa.	U.S.A.	Daily ex. Thurs. and Fri. 21.00
9,580	31.3	Radio Nations, Prangins	Switzerland	Sun. 22.00–22.45
9,585	31.29	Empire, Zone 3	—	—
9,590	31.28	Sydney	Australia	Sun. 10.00
9,598	31.25	Lisbon	Portugal	Tues. and Fri. 22.00–24.00
9,640	31.10	Bangkok	Siam	Mon. 02.00–05.00
9,869	30.43	Aranjuez	Spain	Daily 23.30, Sat. 18.00
10,000	30.0	Belgrade	Yugoslavia	Mon. 19.00
10,238	29.3	Heredia	Costa Rica	Daily 22.00 and 02.00
10,350	28.98	Buenos Aires	Argentina	Daily 20.30
11,180	26.83	Funchal	Madeira	Tues. and Thurs. 10.30–12.30
11,700	25.63	Pontoise	France	Colonial Station E-W, daily 20.00
11,720	25.6	Winnipeg	Canada	Daily ex. Sat and Sun. 17.45
11,750	25.53	Empire, Zones 1 & 4	—	—
11,760	25.5	Chapultepec	Mexico	Daily 20.00
11,810	25.4	Bowmanville	Canada	Daily 18.00
11.810	25.4	Prato Smeraldo, Rome	Italy	16.00 and 19.30
11,840	25.34	Chicago, Ill.	U.S.A.	—
11.865	25.28	Empire, Zone 2	—	—
11,870	25.27	East Pittsburg, Pa.	U.S.A.	—
11,905	25.2	Pontoise (Colonial Station N-S)	France	—
12,830	23.38	Rabat	Morocco	Sun. 11.30
14,630	20.5	Chapultepec	Mexico	Daily 19.30
15,075	19.9	Heredia	Costa Rica	Sat., Sun. Mon. 16.00 and 21.00
15,140	19.81	Empire, Zone 5	—	—
15,120	19.84	Vatican State, Rome	Italy	Daily 10.00
15,200	19.73	Zeesen	Germany	Daily 13.00–17.00
15,210	19.72	East Pittsburg, Pa.	U.S.A.	—
15,244	19.68	Pontoise (Colonial Station E-W)	France	—
15,340	19.56	South Schenectady, N.Y.	U.S.A.	Daily 18.00
17,750	16.9	Bangkok	Siam	Sun. and Tues. 21.00
17,770	16.88	Empire, Zone 2	—	—
17,780	16.87	Bound Brook, N.J.		Weekdays 13.00
18,105	16.57	Chicago, Ill.	U.S.A.	—
20,730	14.47	Buenos Aires	Argentina	Sun. 21.00
21,470	13.97	Empire, Zone 3	—	Daylight working
21,540	13.92	East Pittsburg	U.S.A.	—

Presented with PRACTICAL WIRELESS, dated April 15th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 17

HANDY TABLES.

INSTRUMENT WIRE SIZES

No.	Dia.	No.	Dia.
4/0	.400	24	.022
3/0	.372	25	.020
2/0	.348	26	.018
0	.324	27	.0164
1	.300	28	.0148
2	.276	29	.0136
3	.252	30	.0124
4	.232	31	.0116
5	.212	32	.0108
6	.192	33	.0100
7	.176	34	.0092
8	.160	35	.0084
9	.144	36	.0076
10	.128	37	.0068
11	.116	38	.0060
12	.104	39	.0052
13	.092	40	.0048
14	.080	41	.0044
15	.072	42	.0040
16	.064	43	.0036
17	.056	44	.0032
18	.048	45	.0028
19	.040	46	.0024
20	.036	47	.0020
21	.032	48	.0016
22	.028	49	.0012
23	.024	50	.0010

LETTER SIZES OF DRILLS

A	.234	H	.266	O	.316	U	.368
B	.238	I	.272	P	.323	V	.377
C	.242	J	.277	Q	.332	W	.386
D	.246	K	.281	R	.339	X	.397
E	.250	L	.290	S	.348	Y	.404
F	.257	M	.295	T	.358	Z	.413
G	.261	N	.302				

WEIGHT OF EBONITE SHEET

Thickness.	Area of 1 oz.	Area of 1 lb.	Weight of 1 sq. ft.
in.	in.	sq. in.	oz.
1/2	2 3/4	44	52
3/8	3 1/2	56	39
1/4	5 1/2	88	26
3/16	7 1/2	117.5	20
1/8	11	176	13

TWIST DRILL GAUGE SIZES

No. Drill.	Decimal Sizes.	No. Drill.	Decimal Sizes.
1	.2280	31	.1200
2	.2210	32	.1160
3	.2130	33	.1130
4	.2090	34	.1110
5	.2055	35	.1100
6	.2040	36	.1065
7	.2010	37	.1040
8	.1990	38	.1015
9	.1960	39	.0995
10	.1935	40	.0980
11	.1910	41	.0960
12	.1890	42	.0935
13	.1850	43	.0890
14	.1820	44	.0860
15	.1800	45	.0820
16	.1770	46	.0810
17	.1730	47	.0785
18	.1695	48	.0760
19	.1660	49	.0730
20	.1610	50	.0700
21	.1590	51	.0670
22	.1570	52	.0635
23	.1540	53	.0595
24	.1520	54	.0550
25	.1495	55	.0520
26	.1470	56	.0465
27	.1440	57	.0430
28	.1405	58	.0420
29	.1360	59	.0410
30	.1285	60	.0400

WHITWORTH THREADS

Diameter	1/8 in.	5/32 in.	3/16 in.	1/4 in.	5/16 in.
Tapping size	3/32 in.	No. 31	9/64 in.	3/16 in.	Letter D
Clearing size	9/64 in.	11/64 in.	13/64 in.	17/64 in.	21/64 in.

B.S.F. THREADS

Diameter..	1/4 in.	9/32 in.	5/16 in.	3/8 in.
Tapping size	No. 5	Letter B	Letter G	Letter O
Clearing size	17/64 in.	19/64 in.	21/64 in.	25/64 in.

B.A. THREADS

Diameter	0	1	2	3	4	5	6	7	8
Tapping size	No. 10	No. 17	No. 24	No. 29	No. 32	No. 37	No. 43	No. 46	No. 50
Clearing size	Letter B	No. 3	3/16 in.	No. 19	No. 27	No. 30	No. 33	No. 39	No. 43

WOOD SCREWS

Size No.	00	0	1	2	3	4	5	6	7	8
Clearing size ..	No. 52	No. 51	No. 50	No. 44	No. 40	7/64 in.	1/8 in.	9/64 in.	5/32 in.	11/64 in.

MUSICAL FREQUENCIES

A	26	F	341
B	30	G	384
C	32	A	426
D	36	B	480
E	40	C	512
F	42	D	576
G	48	E	640
A	53	F	682
B	60	G	768
C	64	A	853
D	72	B	960
E	80	C	1,024
F	85	D	1,152
G	96	E	1,280
A	106	F	1,365
B	120	G	1,536
C	128	A	1,706
D	144	B	1,920
E	160	C	2,048
F	170	D	2,304
G	192	E	2,560
A	213	F	2,730
B	240	G	3,072
C	256	A	3,413
D	288	B	3,840
E	320	C	4,096

METRIC CONVERSION FACTORS

To convert—

Millimetres to inches ..	× .03937 or ÷ 25.4
Centimetres to inches ..	× .3937 or ÷ 2.54
Metres to inches ..	× 39.37
Metres to feet	× 3.281
Metres to yards ..	× 1.094
Metres per second to feet per minute ..	× 197
Kilometres to miles ..	× .6214 or ÷ 1.6093
Kilometres to feet ..	× 3,280.8693
Square millimetres to square inches ..	× .00155 or ÷ 645.1
Square centimetres to square inches ..	× .155 or ÷ 6.451
Square metres to square feet	× 10.764
Square metres to square yards	× 1.2
Square kilometres to acres	× 247.1
Hectares to acres ..	× 2.471
Cubic centimetres to cubic inches	× .06 or ÷ 16.383
Cubic metres to cubic feet	× 35.315
Cubic metres to cubic yards	× 1.308
Cubic metres to gallons (231 cubic inches) ..	× 264.2
Litres to cubic inches ..	× 61.022
Litres to gallons ..	× .2642 or ÷ 3.78
Litres to cubic feet ..	÷ 28.316
Hectolitres to cubic feet	× 3.531
Hectolitres to bushels (2,150.42 cub. ins.)..	× 2.84
Hectolitres to cubic yards	× .131
Hectolitres to gallons ..	÷ 26.42
Grammes to ounces (avoirdupois) ..	× .035 or ÷ 28.35
Grammes per cubic cm. to lb. per cubic inch	÷ 27.7
Joules to foot-lb. ..	× .7373
Kilogrammes to oz. ..	× 35.3
Kilogrammes to lb. ..	× 2.2046
Kilogrammes to tons ..	× .001
Kilogrammes per sq. cm. to lb. per sq. inch	× 14.223
Kilogrammes-metres to foot-lb.	× 7.233
Kilogramme per metre to lb. per foot ..	× .672
Kilogramme per cubic metre to lb. per cubic foot	× .062
Kilogramme per cheval to lb. per h.p. ..	× 2.235
Kilowatts to h.p. ..	× 1.34
Watts to h.p.	÷ 746
Watts to foot-lb. per second	× .7373
Cheval vapeur to h.p. ..	× .9863
Gallons of water to lb.	× 10
Atmospheres to lb. per sq. inch	× 14.7

"PRACTICAL WIRELESS" DATA SHEET No. 18

GRAMOPHONE PICK-UPS

PICK-UP CONNECTIONS.

The pick-up must be joined between the grid of a valve and the filament or cathode. To avoid the reception of radio whilst the gramophone is in operation a switch should be inserted in the lead at a convenient point. A single-pole change-over switch may be used, with the arm joined to the grid terminal of the valve-holder and one contact joined to the radio grid component whilst the other contact is joined to one of the pick-up leads. An alternative method is to connect one terminal of the pick-up permanently to the grid of the valve, and to insert a simple on/off switch in the remaining pick-up lead. In the latter case it is usually necessary to detune the aerial circuit to avoid wireless signals being received by the valve. The valve with which the pick-up is employed will depend upon the sensitivity of the pick-up—that is to say, a very sensitive instrument will only require perhaps one stage of amplification, whilst an insensitive instrument will require two or more stages. Therefore the pick-up will be used with a detector valve or one of the L.F. stages of the receiver.

POPULAR GRAMOPHONE RECORD IDENTIFICATION

Label Colour.	Make.	Size.	Type Prefix.	Price s.	Price d.
Black ..	Brunswick	10 ins.	—	2	6
	Decca	12 ins.	K	2	6
	H.M.V.	10 ins.	E	4	0
	H.M.V.	12 ins.	D	6	0
Blue ..	Broadcast	10 ins.	—	2	0
	Decca	10 ins.	F	1	6
	Panachord	10 ins.	—	1	6
	Panachord	12 ins.	—	2	6
	Parlophone	10 ins.	R	2	6
Dark Blue ..	Columbia	10 ins.	DB	2	6
	Columbia	12 ins.	DX	4	0
	Parlophone	12 ins.	—	4	0
	Radio	8 ins.	—	1	0
Light Blue	Columbia	10 ins.	LB	4	0
	Columbia	12 ins.	LX	6	0
Green ..	Zonophone	10 ins.	—	1	6
	Zonophone	12 ins.	A	4	0
Plum ..	H.M.V.	10 ins.	B	2	6
	H.M.V.	12 ins.	C	4	0
	Regal	10 ins.	MR	1	6
	Regal	12 ins.	MX	4	0
Purple ..	Sterno	12 ins.	—	2	6
Red	Broadcast	10 ins.	—	1	6
	Decca	10 ins.	M	2	6
	H.M.V.	10 ins.	DA	4	0
	H.M.V.	12 ins.	DB	6	0
	Imperial	10 ins.	—	1	3
	Imperial	12 ins.	—	2	0
	Parlophone	10 ins.	E	2	6
	Sterno	10 ins.	—	1	3
	Winner	10 ins.	—	1	6
	Zonophone	10 ins.	GO	3	6

ELIMINATING SCRATCH, OR SCRATCH FILTERS.

The simplest scratch filter consists of a condenser and resistance in series connected across the pick-up terminals. Suitable values are .002 for the fixed condenser and a variable resistance of 50,000 ohms. Adjustment of the resistance will enable the degree of top-note cut-off to be adjusted to suit different makes of record. As the higher musical notes are also removed by this method, it must be judiciously applied. With some makes of pick-up a variable resistance of 100,000 ohms only (that is, without the condenser) may be joined across the pick-up terminals and will give the desired degree of scratch elimination.

NEEDLE ANGLE AND TRACKING ANGLE.

The pick-up should be designed so that the needle forms the correct angle with the surface of the record. This should always be about 60 deg. from the horizontal. A steeper angle results in unnecessary wear, whilst a needle arranged more horizontally will not follow correctly the sound grooves in the record. When viewed from the surface of the record the needle should be perfectly at right angles. These two angles are naturally given from two points of view, the latter when looking at the front of the pick-up, that is, with the record rotating towards you, and the other when viewing the record from the side, that is, with the direction of rotation from right to left. The tracking angle must be chosen so that the pick-up at any point of its travel is in a position where the armature travels at right angles to the sound grooves on the record. Most makers supply a template, but where this is not obtained, or you desire to check the tracking angle, the following method is adopted. Place the needle on the first groove of the record and lay a straight-edge from needle-point to the centre-pivot of the turntable. The front of the pick-up should be perfectly in line with the straight-edge. Now put the needle on the last groove (that nearest the label) and again put the straight-edge from needle-point to centre-pivot. The pick-up should still be parallel. The same procedure should be carried out at two points between the first and last grooves and at each position the pick-up should answer (as nearly as possible) to this test.

TYPES OF PICK-UP.

The majority of gramophone pick-ups are of the high-resistance type, having resistances from 1,000 to 4,000 ohms. They may, therefore, be joined to the valve circuit direct. Special types of pick-up are obtainable, however, having a low resistance of the order of 50 ohms or so. With this type of instrument it is essential to use a special transformer, the secondary being joined in the grid circuit and the pick-up connected to the primary winding. The design of the transformer must be chosen to correctly match the resistance of the pick-up to the valve grid-circuit. The weight of the pick-up should be from 1.5 to 5 ozs. An instrument lighter than 1.5 ozs. will tend to jump from the record on a very loud passage, or very low note, and the heavier type of instrument will put unnecessary friction on the record resulting in greater wear. If the instrument is thought to be too heavy it may be lightened by employing a counterbalance on the pick-up arm. This may be made adjustable and consist of a weight on a threaded arm, or a spring with adjustable tension.

GRID BIAS AND THE PICK-UP.

With any form of connection, grid bias must be applied to the valve with which it is used. When connected in the grid circuit of an L.F. stage the normal biassing arrangement will hold good and no alteration will be necessary in the circuit. When joined in the grid circuit of the detector valve, however, this valve must be biassed to operate as an L.F. amplifier. With battery-operated valves, the pick-up lead should therefore be connected to the filament via a bias battery, the positive terminal of the battery being joined to the negative filament lead, and the negative terminal of the battery being joined to the pick-up. The correct bias for the valve working as an L.F. amplifier must, of course, be applied. With mains valves of the indirectly-heated type the bias may be obtained by means of a resistance in the cathode lead. In this case, to avoid the application of bias when the valve is working as a grid leak detector, the grid leak must be joined direct to the cathode terminal on the valve-holder. A switch will, of course, have to be inserted in the pick-up lead to break the circuit for use on radio.

TONE AND VOLUME CONTROLS.

The simplest volume control, which is necessary if the valve will not handle a very large input, consists of a potentiometer. The two ends of the potentiometer are joined across the pick-up and the arm of the potentiometer is joined to the switch or grid of the valve. If a transformer is used, a special high-value centre-tapped potentiometer (known as a "fader") may be used. One half is joined across the transformer and the other half across the pick-up. As the arm is rotated across the section shunting the transformer the radio signals will be reduced to inaudibility, and when the centre-point is passed the gramophone signals will be gradually introduced. The arrangement described under "Scratch Filter" may be used as a tone control for the higher notes, but for the low notes special arrangements are necessary. As the low notes are not recorded on the record at the same strength as the remaining notes special reinforcement is necessary, and whilst the majority of pick-ups are designed to have a rising characteristic towards the lower end of the musical scale, better results are obtained if one of the special tone compensators such as the Novotone or Tiltatone are employed. This employs special low-frequency chokes designed to give a corresponding emphasis to the notes as they go down the scale, and the compensation is designed in conjunction with the recording apparatus. This results in practically a straight line amplification from the record.

Presented with PRACTICAL WIRELESS, dated April 29th, 1933.

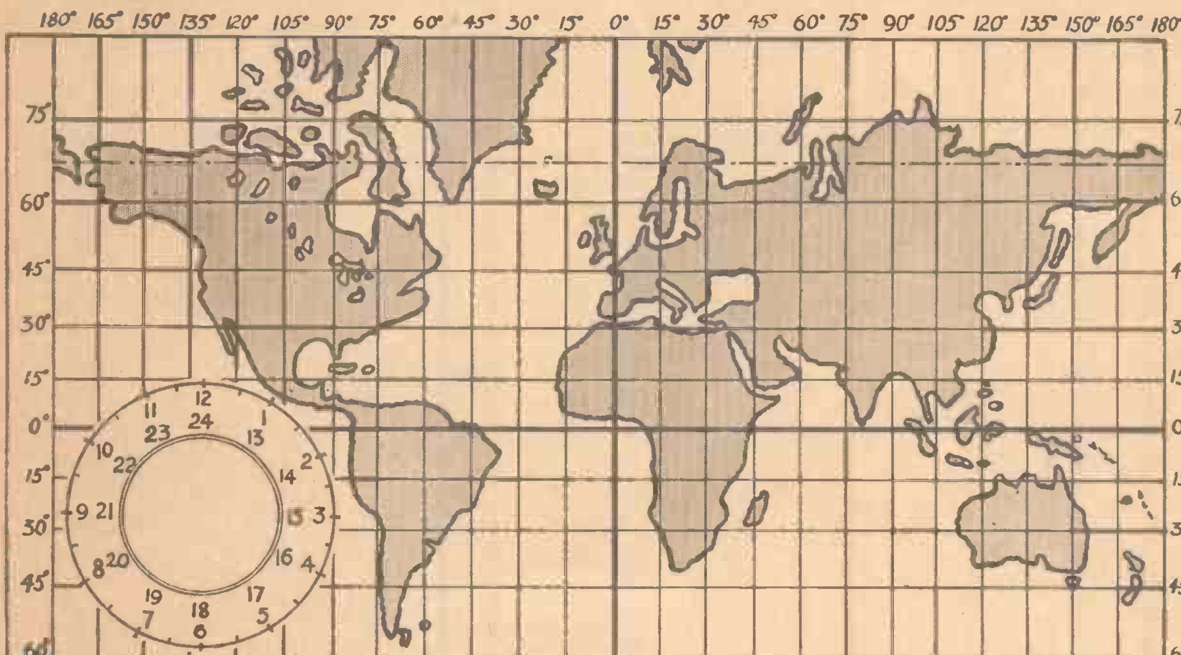
"PRACTICAL WIRELESS" DATA SHEET No. 19

"PRACTICAL WIRELESS" WORLD TIME TABLE

The times indicated are based on the 24 hour clock or Continental system, e.g. 1.0 p.m. (13.00) ; 8.0 p.m. (20.00) ; midnight (24.00).

G.M.T. (Greenwich Mean Time) is used by Great Britain, Ireland, Algeria, Belgium, France, Luxemburg (Grand Duchy), Morocco, Portugal and Spain.

B.S.T. (British Summer Time) is also adopted by France and Belgium ; when in force, it coincides with C.E.T. (Central European Time).



				P.S.T.	M.S.T.	C.S.T.	E.S.T.	Canada (East) Argentine.	Brazil (East)	Brazil.	Iceland. Canary Isles	G.M.T.	C.E.T.	E.E.T.	Kenya, etc.			Calcutta.						Fiji Islands.
24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00
01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00
02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00
03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00
04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00
05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00
06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00
07.00	03.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00
08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00
09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00
10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00
11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00
12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00
13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00
14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00
15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00
16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
18.00	19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
19.00	20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
20.00	21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
21.00	22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00
22.00	23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00
23.00	24.00	01.00	02.00	03.00	04.00	05.00	06.00	07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00

WEST.

True local time of a City or Town, etc., is obtained, in respect of G.M.T. by adding or subtracting one hour for every 15° the place is situated E. or W. of Greenwich. E.g.—When it is Noon at Greenwich it will be 13.56 at Istanbul, 19.36 at Hong Kong, etc. As these differences would cause confusion, a system of Standard Time has been adopted in most countries, in reference to the meridian at Greenwich, and one hour ahead (East) or behind (West) for each 15° E. or W. of Greenwich becomes the local time for a Zone extending 7½° on each side of the central meridian. Exceptions are made where boundaries of States fall within that belt.

EAST.

WEST (Behind G.M.T.)

E.S.T. (Eastern Standard Time) covers U.S.A. (Eastern States), Brazil (West), Canada, Colombia, Cuba, Dominican Republic, Peru.

C.S.T. (Central Standard Time) covers Canada (Central), U.S.A. (Central), Costa Rica, Honduras, Mexico (East).

M.S.T. (Mountain Standard Time) covers Western Canada, U.S.A. (Mountain States), Mexico (Centre and West).

P.S.T. (Pacific Standard Time) covers British Columbia, California, Nevada, Oregon, Washington (State).

EAST (Ahead of G.M.T.)

C.E.T. (Central European Time) covers such countries as Albania, Austria, Belgian Congo, Czechoslovakia, Denmark, Germany, Hungary, Italy, Lithuania, Norway, Poland, Sweden, Switzerland, Yugoslavia.

E.E.T. (Eastern European Time) is adopted by Bulgaria, Estonia, European Russia,* Finland, Greece, Latvia, Roumania, Turkey; the same difference in time also applies to Egypt, Union of South Africa, etc.

* Moscow (3 hours ahead of G.M.T.) see under 45°.

Holland (Amsterdam Time) 20 minutes ahead of G.M.T.