The R·C· Threesome

Resistance Coupling

3

1 PERFECT

2 EASY

3 CHEAP

3 VALVE RECEIVER

3 HOURS TO MAKE

£3 *(or less)* **FOR PARTS**

INSTRUCTION BOOK

INTRODUCTION

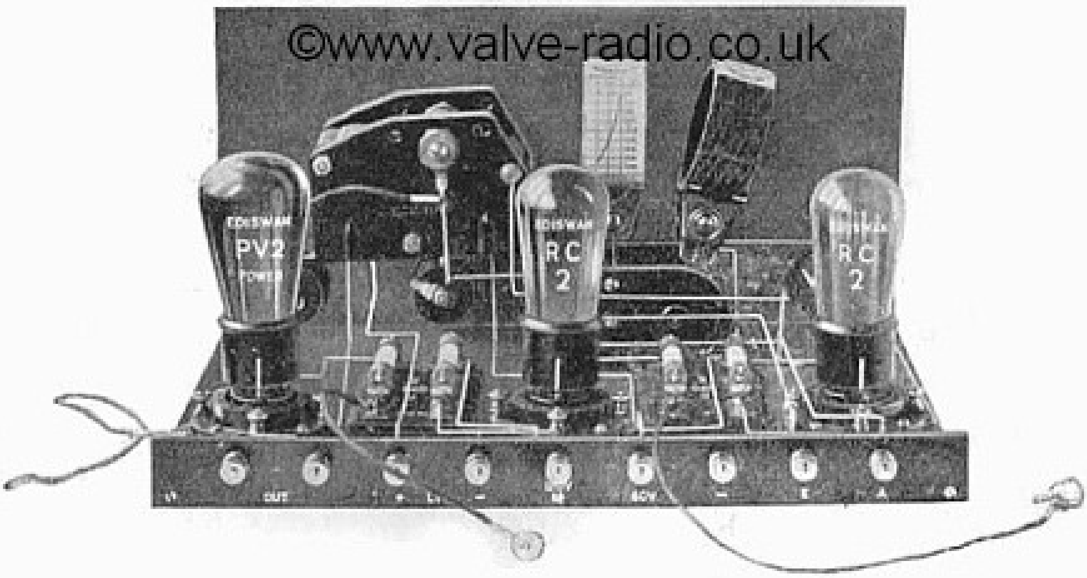
For more than a year past it has been repeated in well-informed quarters that wireless receivers employing resistance capacity coupling and anode bend rectification were the sets of the future. With the successful introduction of the home-constructed receiver described in these pages, resistance capacity voltage coupling—following long experiments and exhaustive tests, particularly on anode resistances and grid leaks, by the Ediswan organisation —*can now definitely be stated to have arrived*; for what until recently was little more than a promising experiment for the few, is now an established and proved success, for the enjoyment of the million.

"THE R.C. THREESOME" will be welcomed not alone for the amazingly high quality of the reception yielded, which itself is a revelation: it is also so simple of construction that the entirely inexperienced amateur can assemble the equipment with the greatest ease and economy of time (three hours for construction will be found ample); and the cost of parts is well within the surprisingly low sum of £3, exclusive of valves, batteries, and loudspeaker.

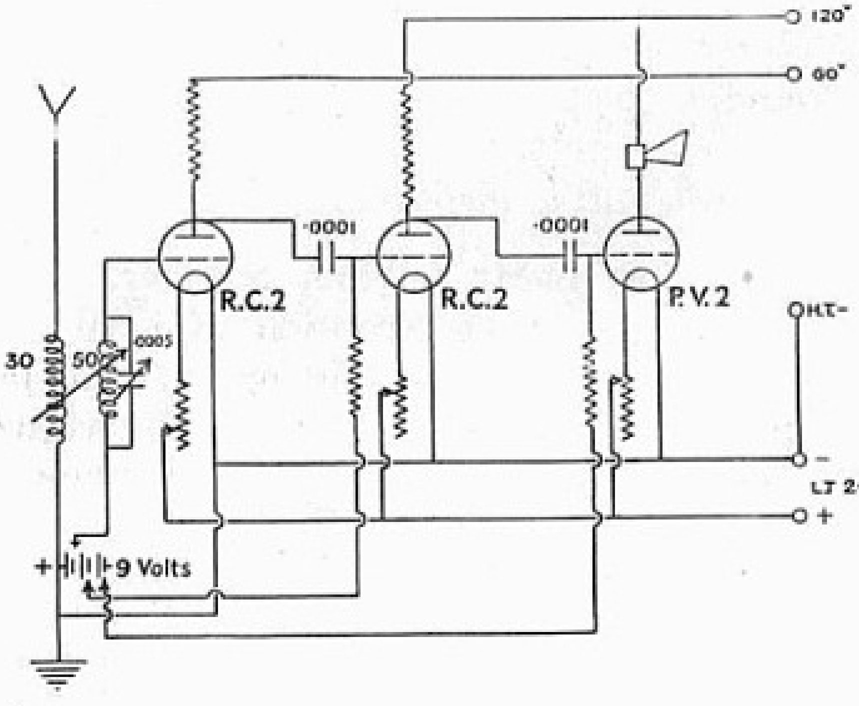
The outstanding merit of this receiver, however, is the sheer perfection of reception of local station (and high-power station) transmission. Tonal purity, volume, and entire absence of "mush"—these qualities are provided in a degree which is truly remarkable.

Yet it is easily possible for the amateur constructor to enjoy the rich fruits of his own handiwork on the same evening on which he actually starts to assemble the parts, and at so modest an outlay!

R.C. THREESOME



Theoretical Diagram



BRIEF HISTORY

The technical reason for the use of anode resistances of high value is that all that is required up to the last stage is the voltage swing on the grid ; and a voltage swing is obtained, in accordance with Ohms Law, either by high current and low resistance or by low current and high resistance. The latter method—the R.C. THREESOME principle—has decidedly marked advantages, namely :

1. **Considerably lighter load on the H.T. batteries ;**
2. **Straightened valve characteristics due to high anode resistance, thus definitely enhancing the quality of reception ;**
3. **The possibility it gives for the employment of a valve specially designed for low rate of emission and high degree of amplification ;**
4. **There is afforded a definitely better quality of reception than is obtained with transformer amplification, while the use of expensive transformers is eliminated.**

It is not claimed here that resistance capacity coupling is an entirely new idea. Patent No. 220488 was indeed applied for as long ago as 1923, when excellent results were obtained with the use of " R " type valves—at that time almost the only type of valve available. Later, certain experimenters achieved notable success by the combined use of high anode resistances with modern valves of high amplification.

Anticipating a demand (now exceedingly active) for a high amplification valve for use in resistance capacity coupling, Ediswan engineers persevered until at length they brought into being their now justly famed Type R.C.2 ; and it is chiefly due to the excellence of that valve that the principle of resistance capacity coupling has been made a practical success.

With the successful introduction of Type R.C.2, and the knowledge that, in consequence, the more experienced experimenters were rapidly changing to resistance capacity coupling, Ediswan engineers set themselves to the design of a receiver which would serve as a model for the amateur constructor—a model which, while sacrificing nothing in respect of quality of reception, would be extremely simple to assemble and inexpensive in its construction and maintenance.

The splendid outcome is the R.C. THREESOME—*a truly wonderful three-valve receiver : a receiver which establishes a new perfection of reception, a new degree of simplicity, a new standard of comparison in terms of value for money.*

THE R.C. THREESOME

HOW TO CONSTRUCT IT

The first step is to take this book to your wireless dealer and ask to be supplied with the following list of components, bearing in mind that the principal items are the valves and the coupling units. Be sure to specify Ediswan valve types R.C.2. and P.V.2., and Ediswan Resistance Coupling Units; otherwise you cannot reasonably expect to obtain the wonderful results which these specially designed valves and units alone will give you. Do not be persuaded to accept substitutes.

Component Parts

Here are the parts you will want :—

- Panel of wood or ebonite, 12″×6″×¼″.
- Wood baseboard, 12″×8″×⅜″.
- Ebonite strip, 12″×1″×$\frac{3}{16}$″.
- Tuning Condenser, ·0005 mf. variable.
- Two Ediswan Resistance Coupling Units.
- Six yards, 16-gauge tinned copper connecting wire.
- One 30-turn coil, and one 50-turn coil.
- Two-way coil-holder.
- Three valve-holders.
- Three filament rheostats, 6 or 15 ohms.
- Nine terminals.
- Three wander plugs.
- One dozen countersunk screws.
- One dozen roundhead screws.

The above can be purchased for a total of £3, or less.

Also required are the following :—

- Two Ediswan Type R.C.2. Valves (see page 8).
- Ediswan Type P.V.2. Valve (see page 9).
- 9 volt Grid Bias Battery.
- 2 volt, 40-amp. hour Accumulator.
- Two 60-volt H.T. Batteries.
- Loudspeaker.

Assembly of Components

1. Drill panel to receive variable condenser, the three filament rheostats, and coil-holder spindle (see page 10). Mount these parts on panel.

2. Drill ebonite strip to receive the nine terminals (see page 7), spaced 1¼ inches apart, working from the centre (E).

3. Fit to the baseboard the coil-holder, coupling units, and valve-holders. Set last mentioned with anode-pin socket pointing to terminal strip. (The anode-pin socket is the one which is slightly removed from the three other sockets; the grid pin socket is opposite). The baseboard used should be well seasoned and perfectly dry.

4. Fit the nine terminals securely to the ebonite strip, and 'tin' the ends to which connecting wires will be soldered. Assuming you have obtained terminals of the type illustrated (page 7), the connections should be made by means of loops; but if you use terminals with protruding shanks it will be advisable to solder the connections.

The Wiring—Step by Step

You are now ready to proceed with the wiring; and, if you are about to tackle your first job of soldering, you will find these hints worth following :—

> Thoroughly clean the terminal ends, and smear them with a very little flux. Clean the tip of the soldering iron with a file. Bring the iron to a fair heat (not red heat), thoroughly tin it by first dipping in the flux, then apply the solder. Follow these simple rules and you will find it easy to run the solder from the tip of the iron to the terminals.

Lay out Wiring Diagram, viewing it from the rear — with the terminal strip nearest to you. Note that all the connections are numbered. Start with Connection No. 1, and proceed in numerical order until you have completed Connection No. 24. Take care to make all connections thoroughly efficient; and, in connecting a wire to its terminal, bend it neatly round the stud to ensure permanency.

No. 1. Connect rear terminals of all three rheostats together. Bend wire into a loop at each end. Make further loop in suitable position for middle rheostat, so that only one length of wire is used.

Screw panel to baseboard (at side nearest to coil-holder).

No. 2. Now take the terminal strip and connect terminal " a " to terminal " e," that is, the connection marked " 2 " on wiring diagram.

Screw terminal strip to baseboard, using three wood screws.

No. 3. Connect free terminal of rheostat R 3 to right-hand side of valve-holder V 3.

No. 4. Connect free terminal of rheostat R 2 to right-hand side terminal of valve-holder V 2.

No. 5. Connect free terminal of rheostat R 1 to right-hand side terminal of valve-holder V 1.

No. 6. Connect to the wire which connects the three terminals of the rheostats together a further connection from terminal " c " to midway between R 2 and R 3.

No. 7. Connect left-hand terminal of V 3 to the similar terminals of V 1 and V 2, thus: run a length of wire from V 1 to V 3, then connect a short length of wire to the left-hand terminal of V 2, and solder to wire running from V 1 and V 3; continuing wire to terminal " d." Now join terminal " h " to Connection No. 7 at nearest convenient point.

No. 8. Connect terminal " i " to *fixed element* of coil-holder, at terminal nearest panel.

No. 9. Connect remaining terminal of *fixed element* of coil-holder to wire No. 7, where the latter is joined to connection from terminal " h."

No. 10. Join terminal " g " to wire No. 7.

No. 11. Connect terminal " f " to positive (+) terminal of coupling unit, U.1.

No. 12. Connect + terminal of U 2 to terminal " e " on terminal strip, to which Connection No. 2 has already been made.

No. 13. Connect terminal " G " of U 1 to grid terminal of V 2 (*i.e.*, terminal nearest panel).

No. 14. Connect grid terminal of V 3 to terminal " G " of U 2.

No. 15. Connect terminal " b " to anode terminal of V 3.

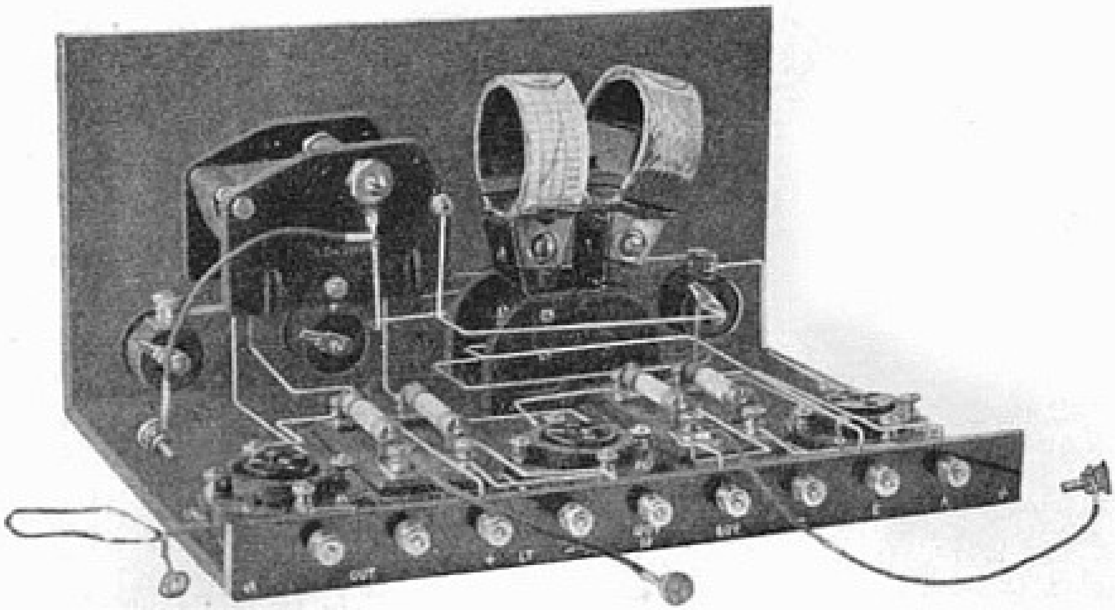
No. 16. Connect terminal " P " of U 2 to anode terminal of V 2.

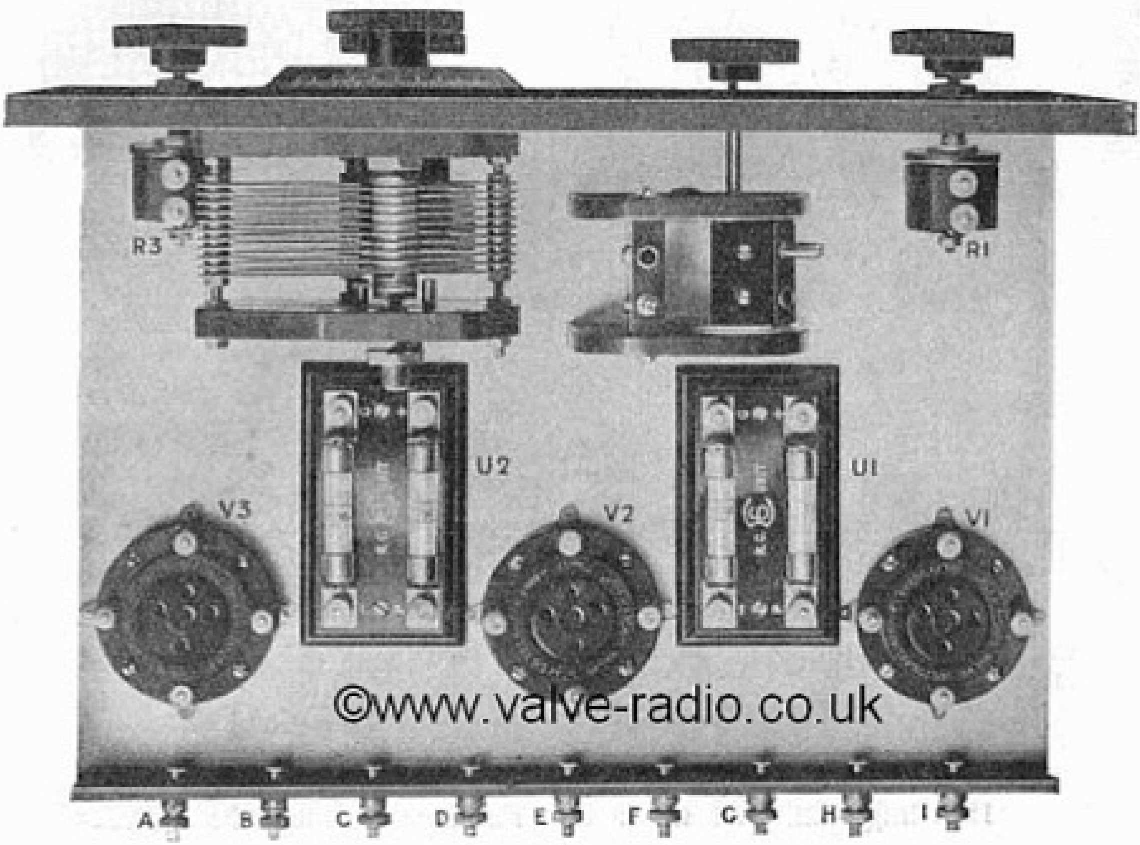
No. 17. Connect anode terminal of V 1 to terminal " P " of U 1.

No. 18. Join that terminal of the variable condenser which is connected to the fixed vanes to a convenient position near the movable element of the coil-holder. Later you will make a connection at this point to wire No. 20 (see wiring diagram).

contd. page 11.

R.C. THREESOME





EDISWAN

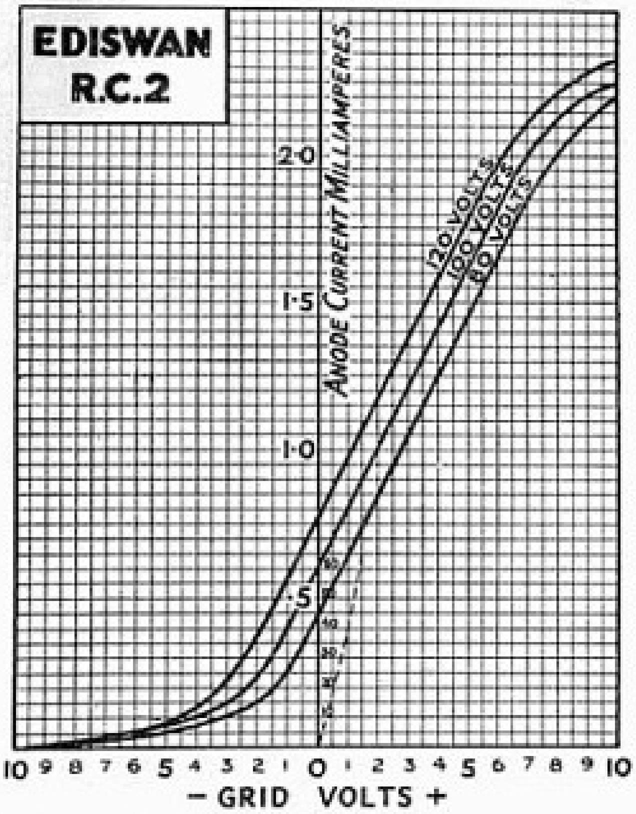
TYPE

R . C . 2

(Dull Emitter)

RESISTANCE COUPLING VALVE

Price
14/-
each



SPECIFICATION

Filament volts	1·8—2·0	Impedance, ohms ...	150,000
Filament current ...	0·1 amp.	Overall length	107 m/m
Anode volts	60—120	Bulb diameter	35 m/m
Amplification factor ...	30	Cap	4 pin

Slope ... ... $0 \cdot 2 \frac{M.A.}{V.}$

It is important that the anode resistances should be between 1 and 5 megohms.

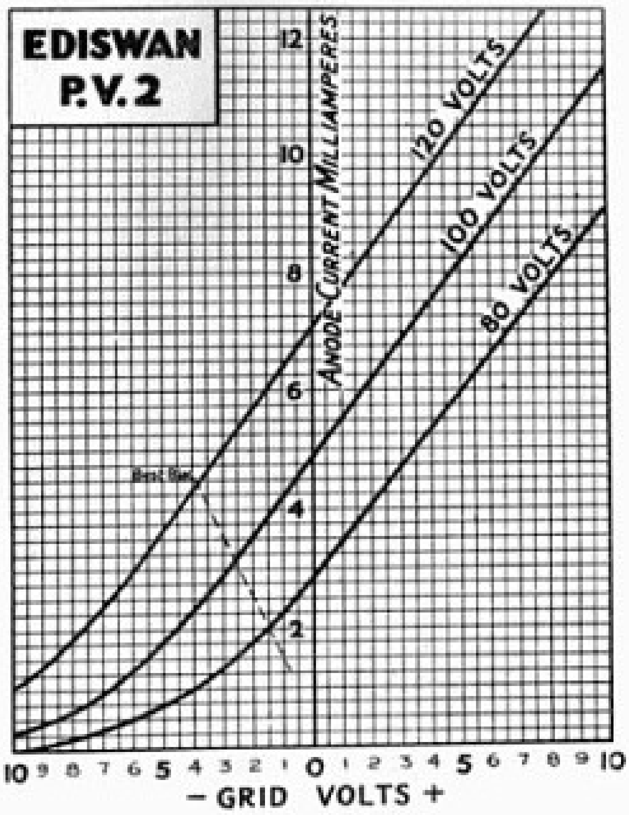
EDISWAN

TYPE

P.V.2

(Dull Emitter)

POWER VALVE



Price
18/6
each

SPECIFICATION

Filament Volts	1·8—2·0	Impedance, ohms ...	9,000
Filament current ...	0·15 amp.	Overall length	110 m/m
Anode volts	80—120	Bulb diameter	45 m/m
Amplification factor ...	6	Cap	4 pin

Slope ... ... 0·65 $\frac{\text{M.A.}}{\text{V.}}$

This valve is also recommended for use in combination with other Ediswan Quarter-Watt Valves (see page 16).

R.C. THREESOME

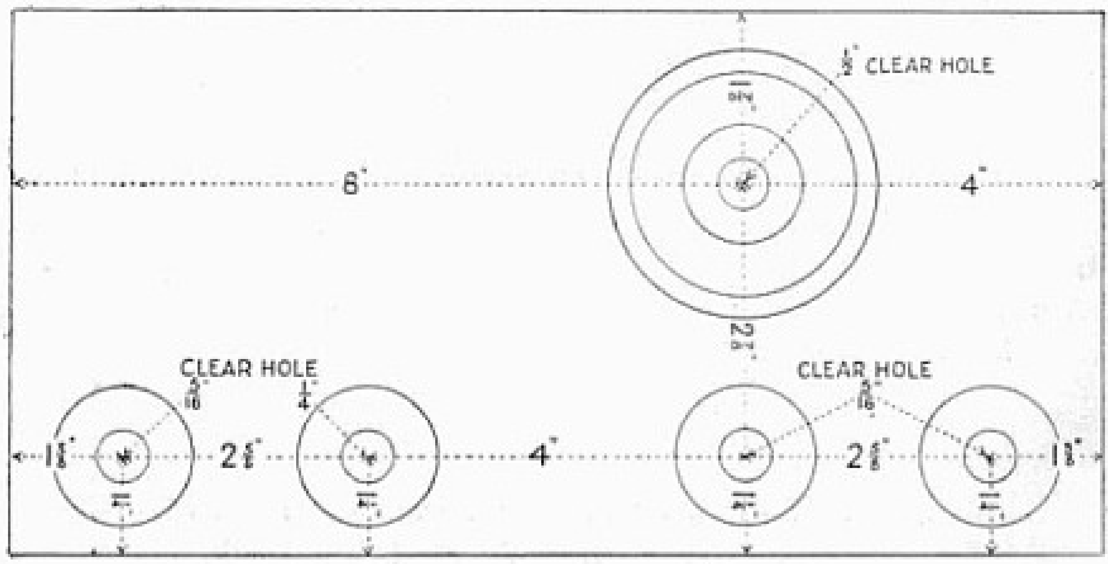
Front Panel

Above :

The panel mounted with variable condenser, filament rheostats, and coil-holder spindle

Below :

DRILLING DIAGRAM



No. 19. Connect terminal attached to movable vanes of condenser to a point adjacent to the position where connection No. 18 terminates. It is necessary to connect each of these two points to the movable element of coil-holder by means of short lengths of flexible wire, in order to allow of free movement of movable element.

No. 20. Connect grid terminal of V 1 to Connection No. 18.

No. 21. Connect a 6-inch length of flexible wire from Connection No. 19 (where the latter leaves the variable condenser) to a wander plug which will be plugged to the 1½-volt socket of grid bias battery.

No. 22. Solder a 6-inch length of flexible wire to Connection No. 7, where this leaves left-hand terminal of V 3.

No. 23. Connect a 6-inch length of flexible wire, fitted with wander plug, to negative (—) terminal of U 2.

No. 24. Connect a 10-inch length of flexible wire, fitted with wander plug, to negative (—) terminal of U 1.

Flexible Connections.—These, as indicated, are kept comparatively short, because the grid battery can conveniently be placed on the baseboard at the left of the variable condenser. Thus is rendered unnecessary the appearance of unsightly loose wires leading to the receiver.

Grid Battery Connections

There are four flexible wires to be joined to the grid bias battery. Connection No. 22 goes to positive terminal of battery ; Connection No. 21, fitted with wander plug, to 1½-volt socket ; Connection No. 23 to 9-volt socket ; and Connection No. 24 to 6-volt socket.

Accumulator Connections

Connect 2-volt accumulator to terminals marked L.T.+ and L.T. — (" c " and " d " on diagram). The + (positive) terminals on battery and on accumulator are either painted red or marked +.

The Valves

Insert R.C.2. Valves—one in valve-holder V 1, the other in valve-holder V 2. Insert power valve P.V.2 in valve-holder V 3. Turn on filament rheostats, when filaments should light. (The lighting of P.V. 2 amounts only to a dull red glow, due to the special process employed in the manufacture of this remarkably fine valve.)

To Test for Short Circuit.—Remove connection from terminal "c" and connect to terminal "e," at the same time joining temporarily terminal "e" to terminal "f"; then follow the same procedure of turning on the rheostats—in which case, of course, the filaments should not light. Satisfied that all is in order, change accumulator back to its original position and connect negative terminal of one H.T. battery to terminal marked "g," on diagram; connect terminal marked "f" (on diagram) to the positive terminal of the same battery, and also connect this positive terminal to the negative terminal of the second battery. This leaves the positive terminal of the second battery free for connection with terminal marked "e" on the diagram.

Tuning Coils

Place tuning coils in coil-holder, as shown in wiring diagram. The movable coil is that marked No. 50. The fixed coil is marked No. 30.

The purpose of the 2-way coil-holder is to eliminate unwanted reception.

Aerial and Earth Connections

Connect aerial and earth wires to their respective terminals —"i" and "h" on diagram.

Loud Speaker Connections

Connect loud speaker to terminals "a" and "b," the positive being "a."

To Operate the Receiver

Turn on the filament rheostats to their full extent. Set the coils as far apart as possible (*i.e.*, at 45°) and slowly revolve the condenser dial from 0 to 180°.

When the signal is received adjust the condenser to that point where reception is at its loudest, and then bring the coils closer together, at the same time making such slight readjustment of the condenser as is found necessary.

Finally, adjust the filament rheostats to the lowest position consistent with good volume, so that the valve filaments are always working at their lowest temperature.

To Disconnect the Receiver

To switch off the set it is only necessary to turn the three filament rheostats to the "off" positions. If desired, the connections to the L.T. and H.T. negative terminals of the accumulator and high tension batteries may be removed.

THEORY OF RESISTANCE COUPLING WITH HIGH VALUE RESISTANCES

Notes for the More Experienced Experimenter

The development of the R.C.2 type of valve and its method of use with high anode resistances started from the conception that the old method of using a wireless receiver as a " power " unit was entirely wrong, because until we come to the last stage of amplification there is no need to have any appreciable current flowing at all. All that is required is continual voltage amplification from stage to stage. The grid of the first valve is operated by the potential difference, set up across the tuning inductance by the incoming signal which impresses a certain definite " grid swing " on the first valve.

Now, provided that we can arrange that this grid swing, when passed on to the second valve, is considerably magnified, we have achieved our object and may continue in this way until we come to the last stage of the amplifier. As this last valve has definite work to do, *viz.*, to set a column of air in motion, we must have power, and this can be obtained from the voltage grid swing of the grid by using a valve of low impedance and low amplification constant which will permit a larger current to flow, thus providing power which will work the loud speaker.

To give some idea of the amplification obtainable the following simple calculation may be made. The amplification obtainable per stage is given by the well-known formula

$$A = \frac{\mu \times Ra}{Ra + Ri} \text{ where}$$

A —Amplification
μ —Amplification constant of the valve
Ra—Resistance in ohms in anode circuit
Ri —Internal resistance of valve.

The R.C.2 valve has an μ value of 30 and an internal resistance of 150,000 ohms. Taking an anode resistance of 5 megohms it will be seen that the expression

$$\frac{Ra}{Ra + Ri} \text{ becomes } \frac{5{,}000{,}000}{5{,}000{,}000 + 150{,}000} = .97 \text{ approx.}$$

thus giving a total amplification per stage of $30 \times .97 = 29.1$. This cannot be obtained by the use of a transformer and valves of low impedance without distortion.

It may be thought that there is no limit to which this amplification may be pushed, but consideration of the formula $\frac{Ra}{Ra + Ri}$ will show that it can never equal unity and therefore the amplification factor of the valve can never be quite reached.

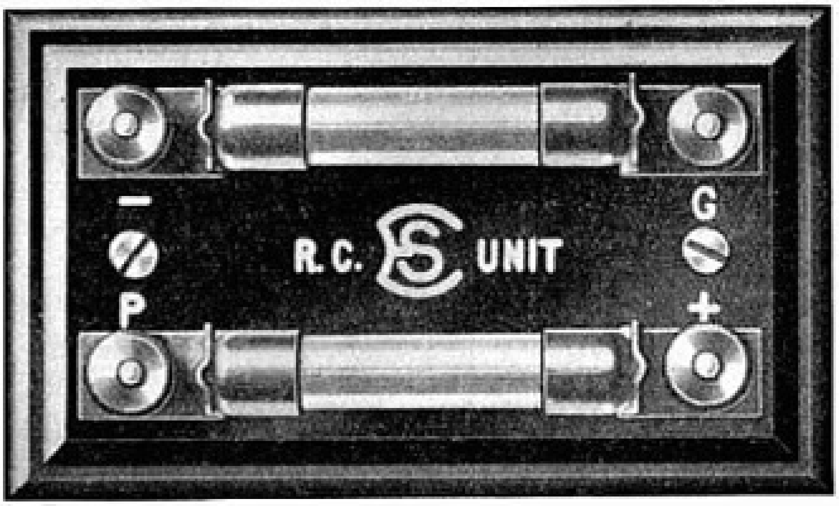
Again we have to remember that the internal capacity of the valve (which, though quite small, is shunted across Ra) is of the order of 3 megohms where the frequency is 1,000, and for this reason very little will be gained by exceeding 3 megohms in the anode lead.

It is most important that this shunted capacity of the valve should not be increased by additional capacity due to the leads, and the usual care should be taken in wiring.

The most important feature of all is the choice of the type of resistance, and there is no resistance equal to that manufactured by The Edison Swan Electric Company, Ltd., owing to the fact that its value does not change with applied voltage whilst residual capacity effects and charges are absent.

We now come to the coupling condenser which hitherto has been of the order .25 microfarads. Since the current flowing is so minute the impedance of this condenser may be high, and, so long as it is large compared with the grid filament-capacity of the following valve, most excellent results will be obtained. Any value from 300 to 500 micro-microfarads will be found suitable. The grid leak should be of very high value, viz., 5 megohms, to secure the best results, and must be of the type specially designed for the purpose.

EDISWAN
RESISTANCE COUPLING UNIT



Catalogue No. WL 635

THIS coupling unit contains the necessary resistances and coupling condenser for the R.C. Threesome in a compact form, and saves the constructor much time and labour. Only four connections require to be made. It will be found that the resistance value of the Grid Leak does not change with the applied voltage. An instruction leaflet is enclosed with the unit.

Price 7/- each

Recommended Accessories for use with the R.C. THREESOME

Ediswan "Dulcivox" Loud Speaker. Prices from 37/6.
Ediswan L.T. Accumulator, H.T. and (Grid Bias Batteries, etc.). See page 4 for types required.

THE EDISWAN RANGE OF VALVES

Type			Fil. Volts.	Amps.	Anode Volts.	Prices.
New Quarter Watt Valves						
Ediswan	**R.C.2**	**(Resistance Coupling)**	1·8—2	·1	60—120	14/-
,,	**P.V.2**	**(Power)**	1·8—2	·15	80—120	18/6
,,	G.P. 2	(General Purpose)	1·8—2	·1	60—120	14/-
,,	D.R. 2	(Detector)	1·8—2	·1	40—80	14/-
Ediswan	A.R.D.E.	(H.F.)	1·8—2	·3	20—100	14/-
,,	A.R.D.E.	(L.F.)	1·8—2	·3	20—100	14/-
,,	P.V. 6	(Power)	1·8—2	·5	60—120	18/6
,,	A.R.·06	(H.F.)	2·5—3	·06	20—100	14/-
,,	A.R.·06	(L.F.)	2·5—3	·06	20—100	14/-
,,	P.V. 8	(Power)	3	·12	60—120	18/6
,,	G.P. 4	(General Purpose)	3·5—4	·15	60—120	14/-
,,	P.V. 4	(Power)	3·5—4	·35	60—120	18/6
,,	A.R.	(H.F.)	4	·75	30—80	8/-
,,	A.R.	(L.F.)	4	·75	30—80	8/-
,,	R.	(General Purpose)	4	·75	50—100	8/-
,,	P.V. 5	(Power)	5	·25	50—150	18/6

NEW QUARTER-WATT VALVES

EDISWAN 2-VOLT QUARTER-WATT VALVES			
H.F.	Detector	1st L.F.	2nd L.F.
G.P. 2	D.R. 2 G.P. 2	G.P. 2 P.V. 2	P.V. 2 P.V. 6 (1-Watt)
		Resistance Coupling	
		*R.C. 2	P.V. 6 (1-Watt)

*The anode resistance used should not be less than 1–5 megohms.

RECOMMENDED EDISWAN VALVE COMBINATIONS

A.R. (H.F.) A.R. (L.F.) R.	P.V. 5 P.V. 6	G.P. 4	P.V. 4
A.R.D.E. (H.F.) A.R.D.E. (L.F.)	P.V. 6	G.P. 2 D.R. 2	P.V. 2
A.R. ·06 (H.F.) A.R. ·06 (L-F.)	P.V. 8	R.C. 2	P.V. 6

B. & S. Ltd. 50M/11.26.