in place. This wiring is shown on the back view of receiver, as well as on the full wiring diagram. Other wiring could not be clearly shown on the small back view, which is only intended to show the position of components.

There are six connections to be made to terminals on the ebonite strip, and the most convenient method would be to cut off all wires sufficiently long and at the last make all connections to the strip at the same time.

Now run a wire from socket 1 on panel, round the back screw of terminal 4, and on to P or plate connection of valve holder 2. From G or grid connection of this holder (run a wire to G or grid connection (secondary) of transformer 2, the wire standing up clear of others, and clear of both valves. Now one secondary of transformer 1 connects to the end terminal on strip and the other to G or grid of first valve. P of this valve-holder is connected to P of transformer 2 and this wire must rise over the top of grid wire at least one inch. The other primary connection of transformer 2 runs to the positive B1 on strip, and should keep to the outside of the other wires, and not between P and G as shown. The last connection of the second transformer is GB to C2 terminal. This and all other wires shown dotted should be passed under the board, holes being drilled in a suitable position. From terminal 3 on panel a wire is run to positive B2 round the side of transformer as shown. The transformers may be placed an inch or so further from the ebonite strip than is actually shown, but T1 should be kept nearly two inches from either tuning-coil or condenser.

Transformers marked "IP, IS," etc., are connected as follows:—IP to positive B battery, OP to plate of preceding valve, IS to grid-bias, or C battery, OS to grid of next valve. This will not refer to the primary (IP, OP) of the first transformer, which will be connected, as shown, to E and socket.

The filament, or A battery, wiring is now to be carried out, the wires to pass under the board where shown dotted. From one side of the rheostat, a wire runs to the negative connection of both valve holders. The positive of each holder is connected together, and in this case the wire may be passed up through a hole in board to positive of holder 1, looped to the terminal or soldered, then passed down through the hole to continue to positive A terminal, this and the next wire to be kept close to the under side of board to allow grid bias wire to cross with a good space between it and filament wires. It is an advantage for wires under the board to be insulated. The remaining connection is from the other side of the rheostat to negative A terminal.

There is the short piece of flexible wire to be attached to the rear end of crystal cartridge, passed through hole in panel and attached to the split pin by twisting the bare wire round the screw and securing with the nut provided.

The C1 and C2 terminals connect to the negative taps of grid bias, or C battery, and in the event of only one C voltage being used, both these terminals would be permanently connected by a short-piece of wire, only one wire then would run to C battery negative. C positive is connected to the same terminal as the negative of A battery.

If only one B battery voltage is used, positive 1 and 2 would be connected together by a short wire or "jumper," and only one wire would connect to B positive, whilst in either case negative B connects to the same terminal as positive A battery.

VALVES AND BATTERIES

Up to the present stage, every receiver built from these specifications should be practically identical, but now we come to the choice of valves, and to some extent the valves to be used depend upon the battery power that is to be available, so the battery question must be settled first.

If dry batteries only are used good results will be obtained, but the amount of volume will be rather less than is consistently obtained from wet batteries. The advantage of dry batteries is an apparent financial gain, but the gain is only in first outlay, as the continual instalments paid for renewals will in time equal the amount that would be laid out on wet batteries.

For dry-battery operation valves requiring not more than 4 volts on the filament should be used. This will allow the employment of three dry-cells giving 1½ volts each, or a total of 4½ volts when connected "in series." Whilst the cells are new, the extra voltage is kept down by the rheostat, and this matter should be carefully atended to, as any excess voltage on dull emitter valves shortens their life, though with ordinary care there is little chance of trouble.

For dry-cell working then, the most suitable valves would be a pair of UX199's (4 volts), or a UX199 in first stage followed by a UX120 in the second both these valves taking the same filament voltage. In the Mullard series, two PM2's (2 volts, requiring only two dry-cells), or two PM3's (4 volts), or a PM3 followed by a PM4 (4 volts). In the Philips series, two B205's (2 volts, 2 dry-cells), or a pair of B406's (4 volts), or an A409 (4 volts) followed by a B406.

On the above valves grid-bias will be from 1½ to 3 volts on the first stage, and when the B battery voltage is the same on both stages with the same valves, will be the same on each. When a higher B voltage is used in the second valve, grid-bias will be from 4½ to 6 volts in most cases, so that a grid-bias battery capable of giving 6 volts will suffice. Exact particulars regarding grid-bias are supplied in leaflets packed with the valves. Many people are inclined to dispense with grid-bias, but for the small cost of the battery it is worth while, for two good reasons. Firstly, correct grid-bias improves the tone of the amplifier, and secondly, its use lessens the drain upon the B battery, making it last longer, which is important when dry batteries are in use. There is no actual current taken from the grid-bias battery, so that it will run for many months without need for renewal.

WITH A ACCUMULATORS

In the case of adopting accumulators for the A supply, whether the B battery is dry or not, the position is improved. Listeners who have to take accumulators some distance to be re-charged, may keep down the consumption of current by using the economical valves mentioned above for dry-cell use. Where the accumulators can be quickly replenished, there is less need to study consumption so carefully. The four-volt valves mentioned above are quite suitable for use with two of the small glass-container "Exide" type of accumulators which are not at all expensive to buy, will run two valves with a charge once a fortnight, at small cost. Three such cells will run 6-volt valves, but some valves of this voltage require a good amount of current (expressed in amperes) which would cause the accumulators to need charging too frequently, unless an accumulator of large capacity (30 to 60 ampere hours) were employed. The small Exide cells are rated at 10 ampere-hours which means that they will supply one ampere for 10 hours, but as some of the valves quoted above only require one-tenth ampere or less, the time an accumulator will last is greatly extended. It is not good to run an accumulator until it will give no more current, but appoint a regular period for recharging when about three-quarters of the total capacity has been used.

A four or six-volt accumulator of thirty or more ampere-hours capacity would suit this amplifier very well, voltage according to the valves to be used. Very good results are obtained on four-volt valves.

Where a "wet" B battery, that is an accumulator, is to be used, full advantage may be taken of the use of a good power-valve in the first stage, and a super-power in the second. the latter requiring a plate voltage of anything from 120 to 170 volts to give full efficiency.

SIX-VOLT VALVES.

The valves usually classed as "six-volt" require a 6-volt accumulator supply, but the actual voltage required by the filament is considerably less than six volts, and usually from 5 to 5½ volts.

The UX201A may be used in both stages, or may be followed by a UX112 or UX 171 in the last stage, if a wet B battery is employed. The PM6 may be used in both stages, or followed by a PM 256 power valve with B accumulator. A Philips A609, followed by a B605, would be a good combination. Two de Forest D401A's may be used, or in the second stage a D412 or D471.

CHOOSING VALVES.

In selecting valves for dry-cell work the filament voltage must not be more than four volts. Regarding the B battery supply, the plate current is what must be studied, and this is measured in "milliamps," or thousandths of an ampere. The more milliamps taken, the shorter time will the B battery last. The higher the B voltage, the more milliamps will be passed. An ordinary general-purpose or small power-valve will take from one to three milliamps at 60 to 75 volts, and such consumption is suited to a dry battery. Super-power valves require a high B voltage and will consume as much as 20 milliamps, which would soon exhaust a dry battery, and that is the reason why they cannot be used. In the "Record" of January 13, there was a list of characteristics of the three leading makes of valves. This should be cut out and kept for reference by every constructor.

B BATTERY VOLTAGE.

Amplifiers will stand any voltage up to 100 or 120, but the higher the voltage, the greater the drain on the battery, so that if dry batteries are used, moderation is best, so that 60 or 90 volts will be very suitable.

OPERATION.

The operation of this receiver is very simple. With the batteries connected to their proper terminals, and the aerial and earth connections made, the rheostat is used to turn on the amplifier filaments, the rheostats only being turned a small amount at first. The loud-speaker is connected to the two right-hand terminals on the panel and the plug, or split pin, is placed in the socket marked A. Now turn the tuning knob or dial slowly until maximum volume is heard, then turn the rheostat slowly a short space further to find the point where greatest volume is obtained. Let the rheostat remain fixed at that point, as any increase is unnecessary. The aerial Tuning will practically remain always the same for the local station, and will not require frequent adjusting.

The positive or marked 'phone or speaker cord must always be connected to terminal 3 on panel, which should be marked.

The numbers are not intended to be marked on panel, but the sockets A and C should be so marked.

It should be noted that resistance-coupling amplification cannot follow immediately after a crystal, as this method relies upon impulses from the plate of a preceding valve.

Probably the majority of constructors will run this amplifier with dry cells, and quite good results will be obtained. Where high B voltages are used with a super-power valve in the last stage, an output filter or output transformer is necessary to protect the speaker windings. This is also a good addition even when only moderate power is used. Next week an article will deal with this matter in connection with amplifiers generally.

In order to provide for all requirements, two voltages are included for both B and C batteries. If only one voltage is used for either of these, positive B1 and positive B2 are connected together by a short bit of wire, and the B battery connected to one of the terminals, or C1 and C2 (both negative) are both connected together in the same way for one voltage.

Constructors should watch the next issues for further details in reply to queries.

Next week there is to be a short resume of the Browning-Drake receiver, and in that constructors will find details of the construction of space-wound coils.

ANSWERS TO CORRESPONDENTS

R. W. (Hawke's Bay).—Best to make your kit up as recommended by the makers, then you will not be likely to have any trouble. When you have got used to the correct working, and know what it is capable of, then you will be able to try alterations and judge of their value.

"Radiobug" (Nelson).—A loudspeaker would not be sufficiently sensitive for testing condenser capacity.

W. McN. (Greymouth).—One of the wavelengths on which you receive 4YA is a "harmonic." Harmonics are simply sub-multiples of the fundamental wavelength. The wavelength of 4YA is 463 metres, and the second harmonic is found by dividing this by two, giving 231.5 metres. To determine the fourth harmonic divide by four, the sixth, divide by six, and so on.

Increasing your detector voltage from 16½ to 22½ may be an advantage, but you yourself can judge best by the result, especially as no details are given. The higher voltage will certainly not harm the valve.

THE "UMBRELLA" AERIAL

USEFUL IN CRAMPED QUARTERS.

A Christchurch reader sends the result of experiments with an "umbrella" aerial. This type of aerial is by no means new, but has generally given place to the single-wire flat-top aerial with two poles. Our correspondent points out that for listeners with limited backyard space this type of aerial will give good results.

The principle is to erect only one pole, but this is to be as high as possible, even 50 or 60 feet. At the top a post office pattern insulator is fixed, and to this are attached four wires, all soldered together. These wires act as both stays and aerial, and a few feet above the ground an insulator is inserted in each, and just above the insulator a lead-in is taken from one of the wires.

Not every listener would care to have the responsibility of a 60-foot pole in cramped quarters, and unless a really good spread can be secured for the stays it is safer to reduce the height to get a safe angle. Poles thirty feet or over in height should have stays half-way up as well as at the top, and over forty feet it is safer to have two intermediate sets of stays, unless the pole is strong and almost self-supporting.

NOTES

DOUBLE-GRID VALVES.

Philips Laboratories turn out four patterns of double-grid receiving valves. The A141 requires a filament voltage not exceeding 1.3 volts, the A241 maximum 2 volts, A341 maximum 3.3 volts, and A441 a maximum of 4 volts on the filament. They all work on the low filament current of 0.06 amp. They can be used as amplifiers or detectors, the latter only requiring a plate voltage of 2 to 4 volts. A filament rheostat of not less than 12 ohms is required. These valves were on sale in Wellington over twelve months ago, but do not appear, so far, to have received proper recognition. A shipment has now arrived.

THE GRAVITY DANIEL CELL.

Several correspondents constructing this cell have written stating that when the weak sulphuric acid solution has been put in there has been violent action on the zinc. Whilst this action should not be unduly violent, it must be there, for the object of the sulphuric acid to "start" the cell is to act upon the zinc, so that the acid solution is turned to zinc sulphate, the required solution for the working of the cell.

The zinc sulphate forms a layer of its own above the solution of copper sulphate lower down, and the object of keeping the zinc a shallow or flattish shape is to ensure it not reaching down to the copper sulphate solution. Normal voltage should not be expected until the "starting" is complete, and the cells have settled down.

Another way of starting the cells is to place ready-made zinc sulphate solution in them, instead of the weak acid.

A HANDY RESISTANCE UNIT.

An extremely compact and handy resistance-coupling unit was handed to "Megohm" for testing purposes. This unit, the product of the Philips Laboratories, is in keeping with their many other excellent and well-known products. The chief thing looked for from an audio amplifier is tone, combined with reasonable volume. Tone cannot be measured with a meter, so the unit was simply dropped into the first audio stage of a Browning-Drake, and its excellence was apparent at once. The writer is at present engaged in finding out the very best way of improving the first audio in this set, and this unit can certainly be recommended to replace with advantage any transformer of doubtful pedigree. The unit is provided with four terminals, just like a transformer, and simply connects to the same four wires. The retail price is 25s.

A high-amplification detector and increased plate voltage is necessary for best results.