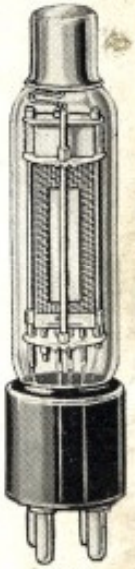
HIVAC THE PIONEERS OF "MIDGET" VALVES

XL
Actual Size

Used the World over for Police Work—Deaf Aids—Short Wave—Pocket and Midget Portable Radio

HIVAC
THE SCIENTIFIC VALVE
BRITISH MADE



XSG
Actual Size

THE POCKETPHONE USES HIVAC MIDGETS

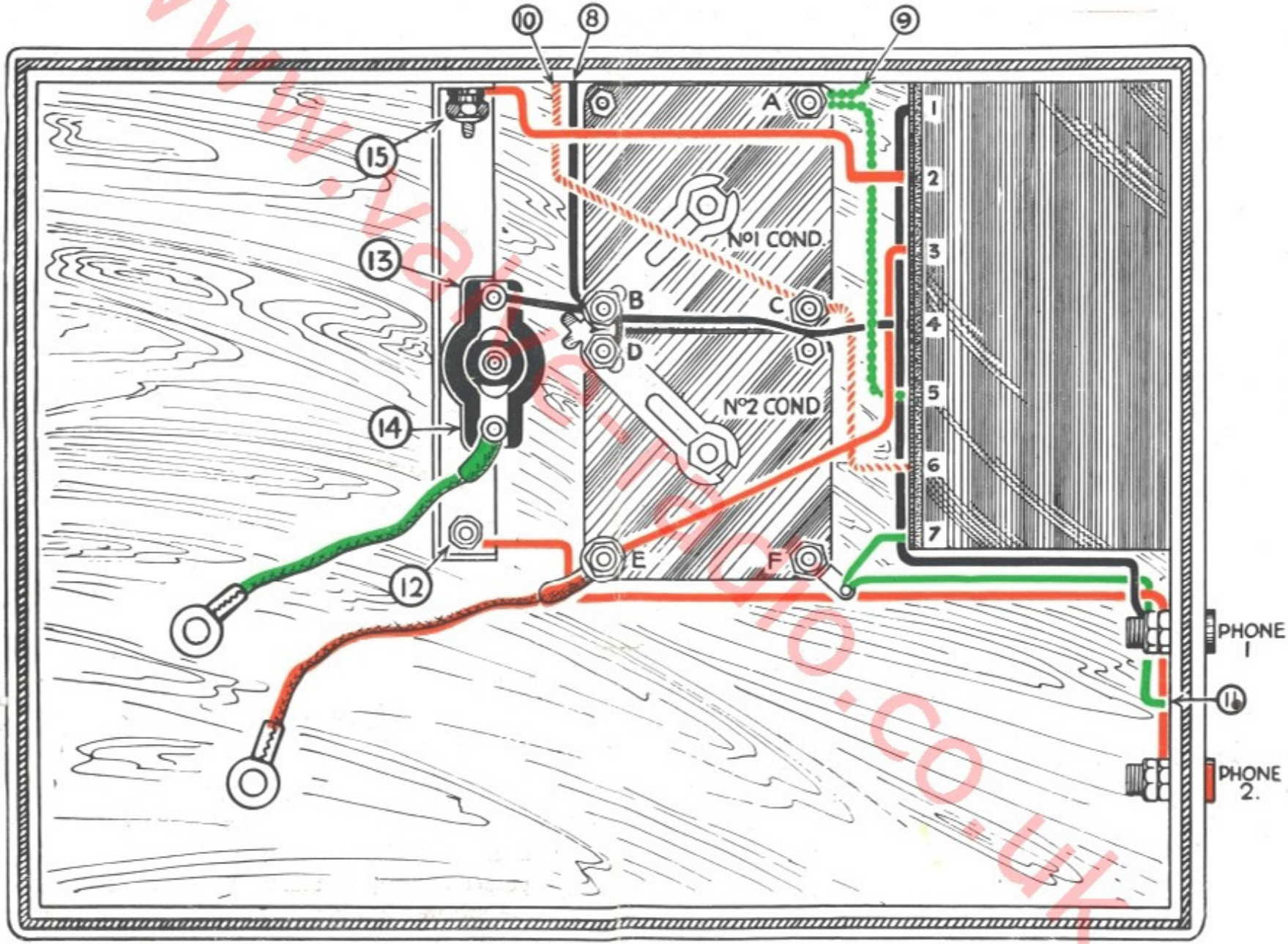
HIGH VACUUM VALVE CO. LTD., 113-117, FARRINGDON ROAD, LONDON, E.C.1 Telephone: CLErkenwell 7587

"Grid Leak's" POCKETPHONE HANDBOOK

PRICE 6D

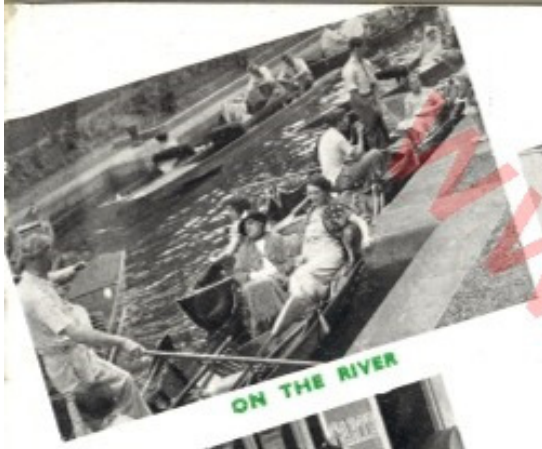
THE PERFECT POCKET RADIO

WHICH ANYONE EVEN WITHOUT EXPERIENCE CAN EASILY BUILD IN 40 MINUTES

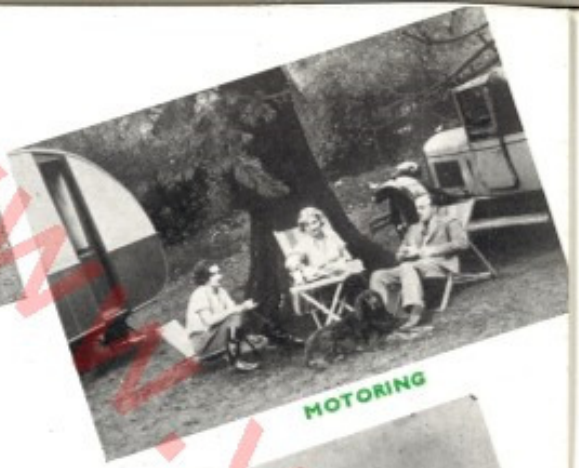


Printed by Withy Grove Press, Manchester 4.

FULL INSTRUCTIONS FOR ASSEMBLING THE "GRID LEAK" POCKETPHONE ARE GIVEN ON PAGES 13 TO 20

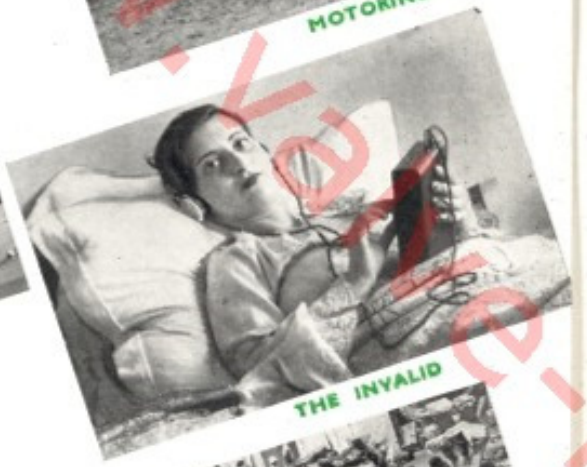


ON THE RIVER



MOTORING

IN THE QUEUE



THE INVALID

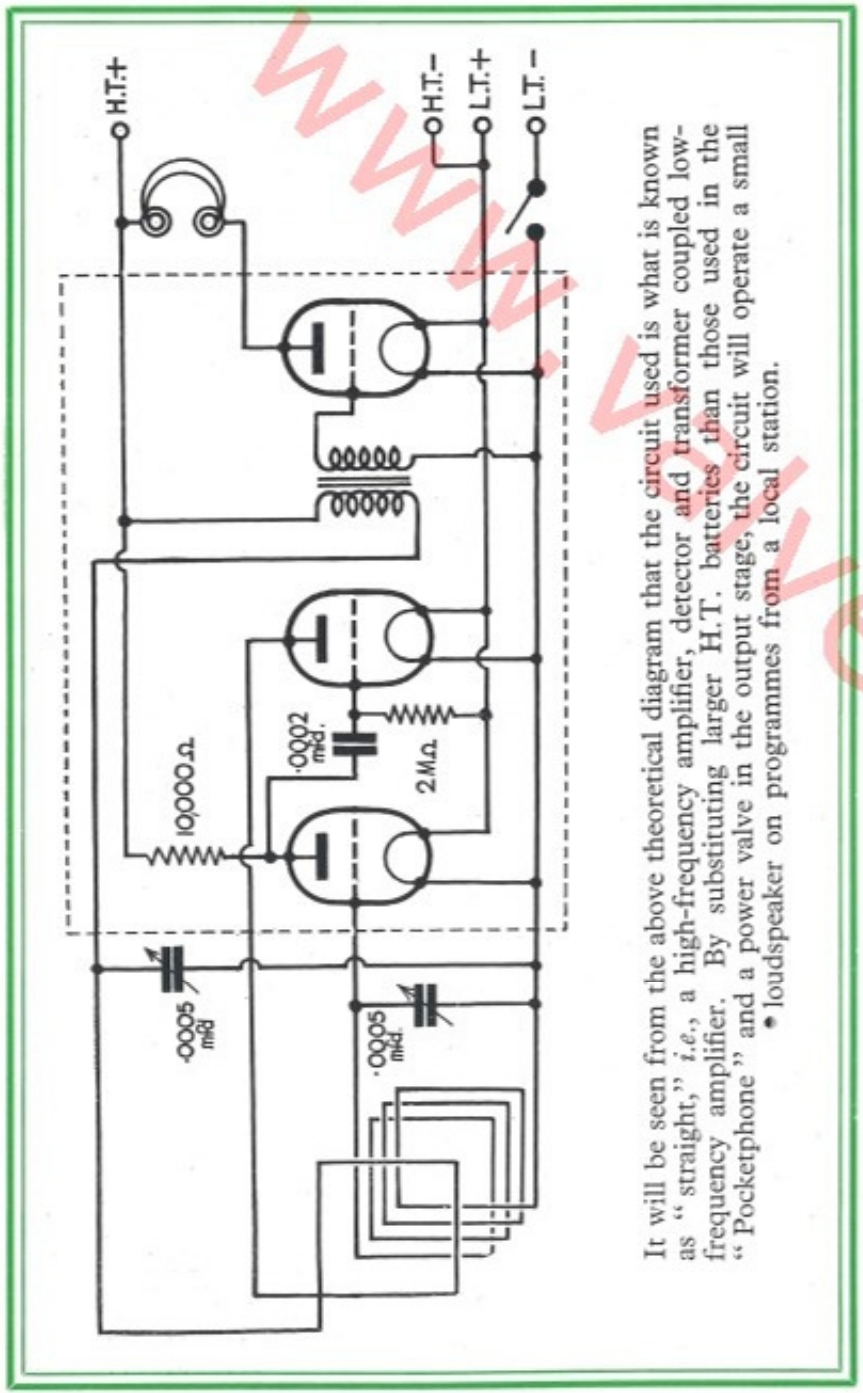
IN THE TRAIN

ON THE BEACH

"*Grid Leak's*" *POCKETPHONE* is your essential link with every important event wherever you may be—at home, on holiday, or at business. As handy as a pocket camera, or binoculars, it will go with you everywhere and keep you in touch with the world.

A NUMBER OF PERSONS can listen with ease on one "Pocketphone"

CONTENTS OF THIS HANDBOOK



It will be seen from the above theoretical diagram that the circuit used is what is known as "straight," *i.e.*, a high-frequency amplifier, detector and transformer coupled low-frequency amplifier. By substituting larger H.T. batteries than those used in the "Pocketphone" and a power valve in the output stage, the circuit will operate a small • loudspeaker on programmes from a local station.

THE NEW POCKET RADIO

The most amazing achievement since Radio began.

A miracle in range, power and performance.

GRID LEAK'S *Pocketphone* has come to revolutionise Radio reception and add a new pleasure to listening in. It is an entirely new type of Radio Receiver, new in principle as in performance . . . and it opens up undreamt-of possibilities. So small and compact is it, that it can be carried in the pocket or suspended from the shoulder like a folding-camera. It costs but little to run and needs no outside aerial or earth. Yet it enables broadcast programmes and messages to be picked up anywhere with perfect ease, of great power and clarity.

The *Pocketphone* is the first *real* Pocket-Wireless set. Compact and self-contained and capable of receiving wireless programmes without distortion, it gives the listener the choice of at least *two* British programmes and generally several Foreign stations as well. As many as four pairs of headphones can be used, if desired. An outstanding feature of the *Pocketphone* is that it functions admirably under the most adverse conditions. Thus, it has been tested in large steel buildings, on electric trains, in motor-cars, boats, aeroplanes, etc., and has given perfect reception.

The wonderful little "Hivac" valves which, coupled with "Grid Leak's" specially devised unit have made the *Pocketphone* possible, function to a degree of perfection hitherto held to be unattainable on such a low current-consumption.

THE RADIO SENSATION OF THE CENTURY

And the man who made it possible

AS you are doubtless aware, "Grid Leak" is recognised as the leading British authority on practical Wireless. By special arrangement, the *Pocketphone* is being introduced exclusively to the public through the papers which have attained prestige for their activities in radio pioneering.

The Receiver cannot at present be bought in the shops, and the economy thus effected is passed on to our readers in the specially low price.

This booklet contains full description of "Grid Leak's" epoch-marking invention, together with an Order Form that will enable you to obtain, at a moderate price, either a complete kit of components—which you can assemble with the aid of instructions given in less than an hour—or a built-up and tested set.

"Grid Leak" has the largest following of any radio writer in the general and technical Press. He wrote the very first regular wireless feature to appear in any daily newspaper. His connection with the science of radio dates back to 1897.

CHANCE MEETING CHANGES HISTORY

When studying Electronics at a Manchester College he visited Weston-super-Mare for his health. Long walks over the Derbyshire moors had made him intensely interested in bird life.

Knowing the famous Brean Down headland, which crowns the beauty of Weston's Bay, was a bird sanctuary, it had a natural call for a visit. Tramping over the lonely downs he eventually arrived at a point where the cliffs dropped almost sheer to the waters of the Bristol Channel. Here he found, to his amazement several men with strange electrical instruments and a state of great activity prevailing.

They proved to be members of the staff of Marconi, experimenting and testing with a view to sending and receiving messages without the aid of wires between Nash Point, on the Welsh Coast, and the Somerset headland. Their subsequent achievements between Poldhu, Cornwall, and America, fired his enthusiasm for the new science and changed the whole course of that young man's studies—with far-reaching consequences.

A PUBLIC PROPHECY COMES TRUE

When you heard your first radio broadcast programme reproduced on a big wireless receiving set, you were naturally thrilled with wonder at this great achievement. *But you said: "Some day we shall be able to carry small sets in our pockets and hear music and messages wherever we may be."*

Since then, fiction-writers and film producers have toyed with the idea—but a *practical* pocket wireless receiver has remained a figment of the imagination—until the advent of the *Pocketphone*.

Clever radio technicians have produced miniature sets but the circuits were so complicated that the making and maintenance of these sets were quite beyond the capabilities of the average home-constructor; moreover, they were commercially uneconomic.

A set used by the police force of one of our provincial towns, of which much has been heard, employs a one-valve circuit for the reception of signals from headquarters, but the circuit is designed for the reception

of messages from short distances only, and is very difficult to handle when reception of a broadcast programme is desired.

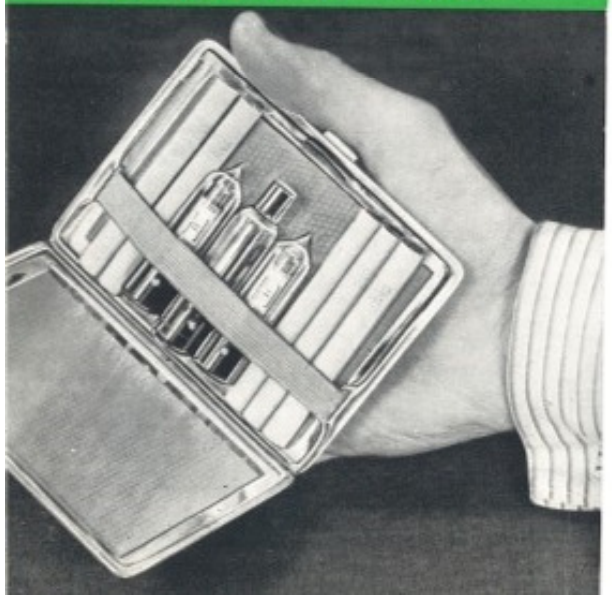
Particulars of other miniature sets have been published from time to time, but in these, high-frequency amplification has *not* been employed. Experience has proved this to be essential. When a detector and two low-frequency amplifiers are used for a miniature set exceptional precautions have to be taken to preserve stability, and difficulty is experienced in picking up signals from a distance in a neighbourhood where screening occurs from large steel buildings, etc.

" Grid Leak's " wide knowledge and unique experience have enabled him to anticipate the requirements of the public and to fulfil their demands.

It was he who persuaded British manufacturers to bring *all-wave* receivers into production. It was he also who realised the need of miniature sets which could be carried easily from room to room, used on train and in car, and packed snugly when travelling.

THE COMING OF MINIATURE VALVES

THE NEW "HIVAC" VALVES



His sound arguments succeeded in influencing the HIVAC valve manufacturers to spend thousands of pounds on research work. They eventually produced several new miniature valves which are making the name of the firm famous all over the world.

When the first

samples were ready, " Grid Leak " took these valves to his laboratory and worked long hours to perfect a circuit round them which could be so stabilised that it would give perfect reproduction of broadcast signals.

THE "GRID LEAK" UNIT

The valves have extremely small physical dimensions, and exhaustive tests show they will function to a degree of perfection never considered possible with a small H.T. voltage and very low L.T. current.

These experiments have resulted in the smallest and most efficient three-valve wireless receiver that the mind of man has yet conceived, or his hands produced. It has been aptly called the "*Pocketphone*."

THE WONDERFUL NEW " GRID LEAK " UNIT

Its actual measurements are only $2\frac{3}{4}$ inches long, $1\frac{3}{8}$ inches high, and $1\frac{1}{2}$ inches deep. It is a truly remarkable example of radio engineering and ingenuity.

This new unit embodies the high-frequency amplifier, detector, and transformer-coupled low-frequency amplifier (three valves); that is, a wireless receiving circuit complete, wired and ready for insertion in the cabinet.

By its use it is now possible to construct a miniature receiver with a minimum of labour and without the troublesome soldering and intricate wiring that have previously made home-construction something of a nightmare to all but the highly-skilled enthusiast.

THE BATTERIES AND THEIR MAINTENANCE

Large high-tension and low-tension batteries are not required in the *Pocketphone*, and special batteries have had to be introduced expressly for the purpose.

The Chloride Electrical Company—makers of EXIDE and DRYDEX batteries—showed great enterprise in producing a small unspillable accumulator giving ten hours' continuous discharge when used with this new receiver, and a dry H.T. battery for the supply of current to the plates which would give satisfactory service for some months.

On pages 24 to 28 will be found useful information concerning both high and low-tension batteries together with various methods of charging from A.C. or D.C. mains, motor-car generators, and large batteries.

THE BATTERIES—ACTUAL SIZE

THE INDISPENSABLE POCKETPHONE

Not a "Luxury," not merely a "Novelty," but a real Necessity to Everybody!

THOUSANDS of people will be eager to be among the first to possess a *Pocketphone*.

Just think how often and how highly you would value such an instrument! At public functions, like the forthcoming Coronation Procession, it will be literally indispensable. Thus, you could while away the waiting by listening to music, and when the great event happened, could follow it with eye and *ear*. Similarly, at Cup Final, Boat Race, Boxing, the Derby, Wimbledon, or any other important event, you would not only see but enjoy the "running commentary" from your trusty *Pocketphone*.

On long country walks you need not feel cut off from civilization or bored by your own company. Your *Pocketphone* will always be at hand to bring you *in touch* (should you so wish it) *with the world* and give you music or speech at the turning of a knob. And at home, when others are enjoying dance music from the big loud-speaker set, you can don your headphones and listen to your heart's content to whatever else you fancy.

At the office, in the train, in the car, cycling, hiking—wherever you are—if you possess a *Pocketphone* you will be able with the greatest ease to pick up at will one or other of two B.B.C. stations and probably a choice of half-a-dozen "foreigners" as well. (This latter, of course, depends on location and conditions.)

WHAT THE SET WILL DO

"When designing this receiver (writes "Grid Leak") I did not set out with a view to producing a set which would enable a great number of stations to be tuned in irrespective of the quality of the received signals. I wanted to be certain that whoever used the set would be able to hear perfectly at the very least *one* B.B.C. station."

This, of itself, would have been no mean achievement. On trial, however, the receiver has surpassed all expectations. It has been tested successfully in all parts of the British Isles, and under the most arduous conditions—in electric and steam trains, trams, aeroplanes, motor-cars, and printing works, where the electrical interference has been such that other receivers were unworkable. The *Pocketphone* has given a splendid account of itself under *all* conditions.

Thousands of young married people, having left the old home, have written to "Grid Leak" asking for information on a suitable wireless receiver to give the old folks to help to while away their lonely hours.

THE BOAT RACE: seen and heard, thanks to the "Pocketphone"

What could be better than this small set which is easy to tune, carry anywhere, and the cost of upkeep of which is negligible?

It is not intended to lead the reader to expect that he can pick up an unlimited number of stations on the *Pocketphone* just wherever he may be, but it has been proved that under ideal conditions as many as eighteen foreign stations have been tuned-in. Because you may be able to do this, you must remember *the main purpose of the set is to receive your nearest Regional and S.W. National Stations with that perfect reception which makes broadcast listening worth while.*

KITS FOR HOME CONSTRUCTORS

As has been stated, the *Pocketphone* can be obtained either complete, or as a Kit of Parts for the home-constructor.

The latter can be put together in less than an hour by the most non-technical person. There is no soldering to be done. Each of the ten wires is taken to terminals clearly marked on the plan and tightened with a screw-driver or a pair of pliers. Even if you have never made a set before, it should not take you more than twenty minutes to place the components in position in the cabinet and, say, another half-hour to connect the wires.

THE LICENCE

There is no necessity for a further wireless licence for the *Pocketphone* if you have already a licence for a set in the home.

HOW TO ASSEMBLE THE "GRID-LEAK" POCKETPHONE

Tools required—a pair of small Pliers and a Screwdriver.

PLACE the diagram and lay-out of the circuit (see inside front cover of this Booklet) on your left-hand side and the cabinet in front of you. The lid is opened and should be facing you. Each terminal and component is marked on the plan with a number or letter.

PLACING COMPONENTS IN POSITION

(1) Place the condensers in position. No. 1 in the drilled hole in base of cabinet nearest cover, and No. 2 in the hole nearer the centre. Insert the shaft through hole from the inside of case and fasten up with the nuts on the outside of the case. Tighten these nuts with a pair of pliers so there will be no chance of them becoming loose when the knobs are attached later.

THE DERBY: Follow it from start to finish on your "Pocketphone"

(2) Take a small screw and the metal partition. This is placed a little to the left of the condensers. Insert the screw-bolt, 15, through the hole in the side of the cabinet under the hinge of the lid. Put the metal screen on the bolt and then the nut. Hold the nut with a pair of pliers or the fingers and tighten the screw from the outside of case with the screwdriver. The terminal head can then be tightened up later when the wire is attached.

Another similar bolt, 12, is then passed through the hole in the bottom of the case from the outside to keep in position the metal screen partition. This is done in a similar manner to the former. Here, too, there is a screw top terminal head. Make sure the partition is upright and square.

The condensers and metal screen are now in position, but there is no need to put the terminal heads in position on the bolts until later.

(3) THE SWITCH. Take off the knob and washer nut. Insert this from the inside of case through the hole between the screen and the tuning condenser. Then screw nut washer on the outside and tighten up with pliers. Screw the knob on top of the plunger, but hold the inside of the plunger to prevent it from turning while being tightened. Do not over-tighten or bush may be fractured.

(4) THE G.L. UNIT. From this unit there are several wires, numbered 1 to 7. Looking at the component, No. 1 is on the left. Take the unit and place it, with the wires near the bottom of the case and valve sockets on top, in the right-hand corner of the cabinet, with the wires coming out over the condensers. Two bolts are provided for screwing the unit in position. The holes will be found on the right-hand side of the case.

The bolts are inserted from the outside, and as the holes in the unit are tapped to take the bolts there will be no difficulty in getting the unit into position and tightening up the screws with a screwdriver.

WIRING

Wires on unit are clearly marked. Start with No. 1 on the top right-hand corner. Press wire along the base of unit and cabinet, under all other wires, and bring it round the unit to the first phone socket (Phone No. 1) already inserted in the case. Cut wire to correct length, allowing sufficient wire to make a loop round the socket. Now take a length of BLACK sleeving to insulate the wire and then tighten up under the phone socket nut.

WIRE No. 2. This is taken to the terminal on metal screen marked No. 15 on plan. It must be covered with RED sleeving and pressed flat and close over No. 1 tuning condenser before tightening under the terminal head with pliers.

WIRE No. 3. This is covered with STOUT RED sleeving and taken flat across the tuning condenser to terminal E on No. 2 condenser, to complete this section you will find a small red flex lead in kit. Connect small tag on the end to terminal E also. Then tighten up the terminal head with pliers.

WIRE No. 4. This, again, is pressed flat against the condensers after having covered it with HEAVY BLACK

WIMBLEDON: The "Pocketphone" keeps you in touch with results

PUBLIC CEREMONIES: Crowds don't matter if you own a "Pocketphone"

sleeving and take a bare section of the wire round terminal B and from thence—insulated again—to terminal 13 on the switch. Tighten on switch but leave the terminal head of B slack for a moment.

It is now necessary to turn your attention to lead 8 coming out of the cabinet in the centre facing you and nearest the lid. Cover with thin BLACK sleeving and press down in position flat on the condenser. Take it also round terminal B and then continue round terminal D on No. 2 condenser. Tighten up both terminals with pliers.

WIRE No. 5. On the cabinet side to the left of, and near unit, will be found a lead—No. 9. This is situated near terminal A on No. 1 tuning condenser. Loop it round terminal A and bring lead No. 5 from the unit to same terminal, after having covered it with GREEN sleeving. Press it down in space between unit and condensers and then tighten up the terminal.

WIRE No. 6. To the left of the lead marked 8 will be found a lead marked on plan, No. 10. Cover No. 10 with YELLOW sleeving and pass it to terminal C on No. 1 condenser. Now take lead 6 with a short length of

YELLOW sleeving to same terminal and tighten up the terminal head.

WIRE No. 7. Lead No. 11 from near telephone terminal is covered with BLUE or GREEN sleeving and taken to terminal F of No. 2 condenser. Push the wire square along the unit base, then lead No. 7 is covered with a short piece of BLUE or GREEN sleeving and connected to the same terminal.

TERMINAL 14. Take the BLACK flex lead in kit and insert the small tag under terminal 14 on switch.

PHONE SOCKET No. 2. The wire connected to this socket must be covered with RED sleeving and taken to terminal 12 on the metal screen. *Keep this and all wiring as short and direct as possible.*

VALVES. These will be found to consist of two HIVAC XL and one XD. The two XL valves occupy the two outside positions on the unit and the XD in the centre.

ACCUMULATOR. The negative terminal will be placed nearest the metal screen with label of battery on top. Remove the terminal heads and drop the tag on RED lead over the terminal screw marked + RED, and the tag on BLACK lead over screw marked — BLACK. Replace terminal heads and tighten. Particular care must be taken to connect leads from 14 and E to the correct terminals on the accumulator.

H.T. BATTERY. This is plainly marked H.T. negative and H.T. plus. When placed in position negative pole will be on the left-hand side of the cabinet and making contact with accumulator negative terminal, and the plus to the polished spot on the metal screen.

If the home-constructor prefers he may solder a flexible lead from phone 2 to + of H.T. battery, and one to H.T. negative from terminal E. By so doing lead 2 to 15 must be taken instead of 2 to phone 2. This will prevent scratching noises.

Now close the cabinet and attach the knobs for the tuning condenser and volume control. Press the knobs

on the spindles and tighten the grub-screws which will be found on the side of the knobs. You may now insert the phone leads, pull out the switch and listen. See page 29 on Tuning.

MOST IMPORTANT.—*As each wire is connected in circuit, check over connections before proceeding and see that no ends of wire are touching other terminal leads or heads.*

Although the novelty of being able to carry a wireless set in your pocket has an enormous appeal, this instrument is sensitive and should be treated with reasonable care.

Before putting a freshly charged accumulator into use, it is *most important* that any free acid be poured off, or, preferably, removed with a fountain pen filler. The slightest trace of acid in the set will damage it. Should any be spilled, it is possible to prevent the damage spreading by the *immediate* application of a few drops of ammonia, or a pinch of soda.

OTHER USES FOR UNIT.—The ingenious craftsman may find use for many components to work in conjunction with the G.L. UNIT for building many kinds of miniature receivers.

This can be obtained from any radio store at 18s. 9d. In winding an aerial on a cabinet, 40 feet of enamelled covered wire should be used for tuning, with a .0005 mfd. variable condenser, and one turn only (2 feet) for the reaction, tuned with a condenser of the same value.

If any difficulty is found in getting smooth reaction, this one turn of wire (two feet) should be moved slightly away from or closer to the aerial pick-up wire. In extreme cases it might be necessary either to lengthen or shorten the wire used for reaction.

The wire size most suitable for pocket radio is 28 or 30, enamel covered. Do not damage the enamel covering when winding aerial in slot around the cabinet.

THE "HIVAC" VALVES

THE VALVES (Actual size)

THERE has, for some time, been a growing demand from the police, Government Departments, and the public, for miniature long-range receivers that will fit into the pocket, be completely self-contained, and yet will operate on the ordinary broadcast wave-band. The limiting factor has always been the size of standard valves and the fairly large batteries required to operate them.

EXHAUSTIVE TESTS AND EXPERIMENTS

The High Vacuum Valve Company decided to investigate the possibility of producing a really small high-efficiency valve, having an exceptionally low filament current, as well as a long life. The manufacturing problems of such a midget valve at first appeared insurmountable, owing to the difficulties of assembling the component parts accurately, and of manufacturing a filament sufficiently fine to require only a small current to bring it to the correct emitting temperature, yet sufficiently strong to withstand the shocks of every-day use in a pocket receiver.

After much development work these technical difficulties were overcome, firstly, by devising a method

of assembling all the electrodes on to two mica end-pieces before they were sealed into the glass bulb. Secondly, by developing a filament only one thousandth of an inch in diameter, which will operate on two volts, and requires only 66m/a of filament current.

It must be remembered that the efficiency of a valve, measured by its Mutual Conductance, is almost entirely dependent on the emitting area of the filament, coupled with the geometric arrangement of the electrodes with respect to each other. It was therefore essential to employ a filament having the greatest possible length, since it was only a thousandth of an inch in diameter.

OVERCOMING THE DIFFICULTIES

In consequence a hair-pin shaped filament was devised, suspended at its apex by a special spiral spring hook designed to keep it at a constant tension when it expanded with the heat on being turned on, and equally, when it contracted as it cooled, on being turned off. Owing to its length of 56mm. it naturally tended to vibrate and set up microphony, until an adequate means of damping it was devised. This was accomplished by fitting three ingeniously contrived mica bridges, across which the filament was stretched, and this effectively damped all microphonic disturbances, even under the severest mechanical tests.

In order to ensure that unforeseen troubles shall not arise during the life of the valve, a representative number of each batch produced are subjected to a life test under full operating conditions. In addition, the filaments are automatically switched on and off 300 times an hour, and the valves are, 40 times an hour, subjected to a mechanical shock, equivalent to dropping the valve on to the floor from a height of about two feet. Valves under these exacting tests last well over 1,000 hours, which is a most remarkable indication of their very robust qualities.

TAKING CARE OF THE BATTERY

How it should be charged whether at home or charging station.

CHOOSING one of the shown methods suggested and carefully following the instructions will mean the battery will last for years, and the reproduction from the receiver will be as nearly perfect as reproduction can be.

"GEL-CEL" TYPE PRA3S

Capacity 3 ampere-hours at the 20-hour discharge rate.
Charging current 0·25 amperes.

(1) GENERAL. When charging the battery use *direct* current only. If alternating current only is available it must be converted to uni-directional current by means of a rectifier or other device.

(2) CHARGING FROM D.C. MAINS. Connect as shown in Figure 1, positive cell terminal (marked +) to positive charging wire and the remaining terminal (negative) to negative charging wire. If reversed, serious injury may result. The polarity of the mains may be tested by dipping the ends of the charging wires into a glass of water in which a teaspoonful of salt has been dissolved (see Figure 1a). Connect a lamp of mains voltage in series with the wire to avoid risk of trouble from short circuits (see Figure 2). Bubbles of gas will form on the *negative* wire. It is necessary to include in circuit some means of regulating the charging current, and this may be done by means of a variable resistance or by lamps used as resistance units.

(3) HOME CHARGING (*a*). Where direct current mains are available, charging of one or two cells may be undertaken from the ordinary lighting circuits by means of a special switch-plug fitting. A lamp which is frequently in use and which is of approximately the correct wattage should be chosen and the special plug-switch substituted for the ordinary lighting switch on this circuit. A diagram of connections is given in Figure 3, and it will be