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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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## EDITORIAL COMMENT

### Valve Developments

#### *Are Multiple Types Worth While?*

VALVE development of recent years has taken two distinct trends. On the one hand we have the tendency towards the production of multi-electrode valves as exemplified by the screen-grid, the pentode, and the heptode or pentagrid, while on the other we have the trend towards the multiple valve, of which the Class "B" valve and the multiple diode types are good examples.

No one can have anything to say against the development of *multi-electrode* valves, since these represent a definite advance in technique, and function in a manner which cannot be duplicated by any other valve or combination of valves. The same cannot be said, however, of *multiple* valves, for their equivalent can always be obtained by a combination of existing valves of simple types.

The multi-electrode valve represents a definite contribution to the advance of radio, but the multiple valve has no technical merit, and it may even be argued that it is a retrograde step, except in so far as it serves as an exercise for the ingenuity of the valve manufacturer.

The characteristics of the individual sections of a multiple valve are usually inferior to those of their equivalents built as separate valves, and the common cathode to the sections renders such valves less convenient to use. It is the experience of most receiver designers that the grouping of so many connections in a single valve base leads to such a serious congestion of components and wiring around the valve holder that efficiency and stability are impaired.

Perhaps the strongest argument which can be advanced against the

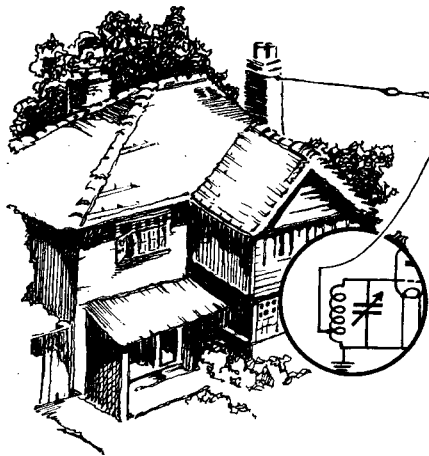
multiple valve, however, is the infinite variety of combinations possible. Valves to-day are quite numerous enough, and it is easy to visualise the difficulties which would be brought about by still further increases in the numbers of the multiple types. If we use a duo-diode-triode, it is but a step farther to a combination of two triodes for an L.F. stage and the output valve and, indeed, such a valve has already appeared in America. A logical development would be to incorporate all the valves of a set in a single glass envelope, and the absurdity of this will be readily apparent. Not only would the whole multiple valve have to be replaced when only a single section had failed, but the manufacturer would have to provide, and the dealer to stock, innumerable types to suit the infinite combinations of sections required by different receivers.

#### *Need for Prompt Action*

If such an unnecessary and technically indefensible situation is to be avoided it is obviously necessary that some action be taken at once, so that manufacturers may reach agreement before they have committed themselves too far.

The ordinary type of full-wave rectifier valve for mains equipment, which is really a double diode, would, of course, be retained, and a double or triple diode type for signal detection and A.V.C. purposes would be satisfactory, but there can be no real justification for combinations of diodes and other types in the same bulb.

We are not suggesting, in fact, that any existing valve types should be discontinued. Such a course is obviously impracticable on account of the large number of sets now embodying them for which replacements will be needed in the future.



# The Best Aerial Coupling

The First Link in the Chain

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

A SUPERFICIAL study of contemporary technique might lead one to suppose that by this time every detail of a receiving system has been minutely investigated and raised to a very high degree of efficiency. The truth of the matter is rather that pure efficiency is falling into neglect.

Modern transmitters provide such strong signals, and modern valves make possible so much amplification of them, that efficiency is squandered right and left. Perhaps it is to the extreme left (of the usual circuit diagram) that there is the most striking example of haphazardness, leading to wholesale waste of what the good broadcasters have given us.

## Definite Data Needed

There seems to be no agreement as to how the aerial should be coupled to the receiver, or knowledge of which of the several methods in use is the right one. Even if in these days we can afford to give away signal strength, we are still in no position to do the same with selectivity. The aerial coupling affects both. Yet many designers, when they come to this part of the work, make a hopeful guess; or buy an aerial coil unit from somebody else, which usually amounts to the same thing.

The two commonest systems are the capacity or series condenser method, and the inductive method (Fig. 1). The latter appears in two variations—the transformer and the tapped coil. These two are essentially the same; it is mainly a matter of convenience whether the coils are separate or combined.

The first step in settling the question of which of these methods is the right one is to decide what we expect the ideal aerial coupling system to do. The aerial picks up small voltages from all the wireless waves that are splashing up against it. These voltages cause corresponding currents to flow up and down in it. The object of the game is to cause all or part of these aerial currents to flow through a tuning circuit (coil and condenser) in such a way as to make one set of them deliver a magnified voltage to the grid of the first valve.

Now it should be quite clear that there are two distinct considerations here. If it were not for the magnifying effect of the coil on signal voltages of one particular wavelength—in a word: *tuning*—all the sets of voltages, due to all the transmitters “on the air,” would be reproduced in proportion to their original strengths.

Of course, that would be quite hopeless. Unless there were some means of select-

*THIS article clears up many popular misconceptions on the subject of aerial coupling, and gives valuable data on choosing the most satisfactory operating conditions. The theory that small aerials increase true selectivity is exploded.*

ing the desired wavelength, all interest in broadcasting would cease forthwith. The tuned circuit performs its function by causing aerial currents of one wavelength to build up a much bigger voltage across the input to the valve than those due to any other wavelength. The smaller the “losses” of the tuned circuit, the sharper the response to the desired wavelength.

Now, while it may sound very thrilling

an  $m$  of about 100. The thing that must be understood quite clearly is that this magnification is not at all the same sort of thing as the amplification factor of a valve. Although it is quite useful to have the desired signal voltage made bigger, that in itself is not the most valuable asset. It is the fact that it is made bigger *relative to interfering signals* that gives significance to  $m$ . A tuned circuit with an  $m$  of 120 magnifies the desired signal 120 times, and other signals less and less as the wavelength differs more and more, until at very remote wavelengths the relative strength is only about 1.

When an aerial is coupled to the tuned circuit it brings the programmes to it, but it also inevitably introduces a certain amount of loss. The more completely it is coupled the more the tuned circuit magnification is pulled down, or damped; and the poorer the selectivity becomes. If the coil is very good to start with, the aerial has a correspondingly large damping effect. If in the interests of selectivity the aerial is very loosely coupled, it fails to communicate a large enough proportion of the signal strength. That is the dilemma.

## Selectivity and Sensitivity

Present-day conditions bias one heavily in favour of loose coupling. Mere signal strength can be made up by the wonderful valves we have now. But selectivity is very precious. At the same time, we don't want to throw away a shilling's worth of signal strength to gain a ha'p'orth of selectivity. The increased amplification needed to put things right is only too apt to bring in a noisy background. And, anyway, it costs money.

That is why a good deal of space has already been taken up in trying to make clear just exactly why the aerial coupling is important. We want it, first of all, to injure the selectivity of the tuned circuit as little as possible. Secondly, we want it, subject to this, to pass as large a proportion as possible of the signal strength picked up. Thirdly (and very decidedly if the tuning is ganged), the coupling ought to be such as to disturb the tuning as little as possible; the capacity it puts in parallel with the tuning condenser should

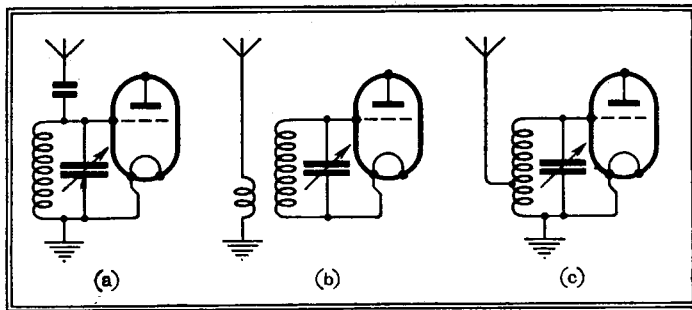


Fig. 1.—Simple capacity coupling compared with alternative systems of inductive coupling.

to talk about “knife-edge” selectivity, which presumably is a stage inferior to “razor-edge” selectivity, a more informative method of comparison is the statement of actual figures. And because the tuning circuit functions by virtue of magnifying signals of the desired wavelength above its fellows, the best basis of comparison is the so-called *magnification*,  $m$ . A fair average coil (the losses are supposed to be concentrated mainly in the coil) has

**The Best Aerial Coupling—**

be reduced to the lowest possible value.

The first requirement has already been fitted with a numerical standard—*m*.

The second we can express in terms of the number of volts (or millivolts, or microvolts) produced across the tuned circuit by a desired signal for each volt (etc., etc.) picked up by the aerial, and call it *v*. Assuming, for example, an *m* of 120, and a coup-

Here they are:—

**Wavelengths.**—One in the medium band (375 metres) and one in the long band (1,500 metres).

**Coils.**—Two for each waveband. Medium wave—160 microhenries. Coil G (good), *m* 200; Coil B (bad), *m* 64. Long wave—2,000 microhenries. Coil G, *m* 100; Coil B, *m* 32.

**Aerials.**— Three representative types.

(1) Large outdoor aerial; with a rather high capacity, such as might be due to a screened down-lead, but no excessive losses. A good aerial. Equivalent capacity, 500 m.mfd.; and resistance, 20 ohms on medium wave, 36 ohms on long wave.

(2) Rather poor outdoor aerial. Lower capacity; but higher losses, such as might be caused by buildings

ances. Actually (2) is the least efficient.

The curves in Figs. 2 to 9 show how *m* and *v* are affected by the closeness of coupling. The figures attached to the individual curves refer, of course, to the aerials.

In the case of series-condenser coupling, the coupling is least when the capacity is smallest; and, in the inductive system, when the proportion of coil turns that are included between aerial and earth is least.

**A Limiting Factor**

The third basis of comparison—the capacity thrown into the tuned circuit by the aerial—is presented by emphasising the parts of the curves corresponding to adjustments in which this capacity does not exceed 25 m.mfds. The dotted lines may be regarded as “out of bounds” on this count.

If these curves are carefully studied they show up some useful facts.

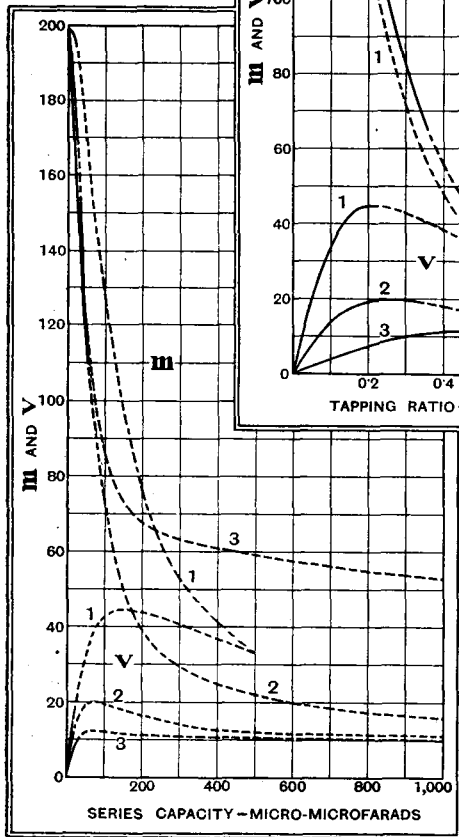


Fig. 2.—The effects of variations in aerial coupling capacity on selectivity (*m*) and sensitivity (*V*). These curves relate to the medium-wave coil G in conjunction with aerials Nos. 1, 2 and 3, as described in the text.

ling efficiency of 20 per cent., it follows that *v* is 24. The third requirement—which later on we shall find has the casting vote—may be brought in by fixing a limit of, say, 25 micro-microfarads for the maximum allowable increase in tuning capacity due to the aerial.

**A Basis for Comparison**

Now we are ready to start. The first difficulty (and this is probably the reason for the prevailing vagueness on the subject) is that there are endless combinations of conditions—good coils, bad coils, lots of wavelengths (long, short and medium), long aerials, outdoor aerials, bad aerials, frame aerials—and so on. All we can do here is to look at a few typical examples.

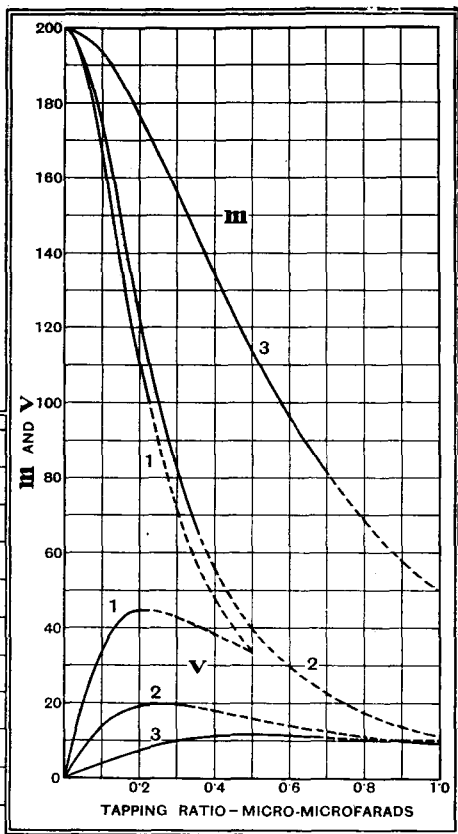


Fig. 3.—Effects of variations in inductive coupling; conditions otherwise as in Fig. 2.

or trees between it and the ground, or by an inferior earth connection. Capacity 200 m.mfds.; resistance 100 ohms on medium wave, 200 on long.

(3) Indoor aerial; with fairly high losses, as are usual when the wire is carried along walls. Capacity, 50 m.mfds.; resistance 300 ohms on medium wave, 800 on long.

It is a mistake to judge the inefficiency of the aerials in proportion to the resist-

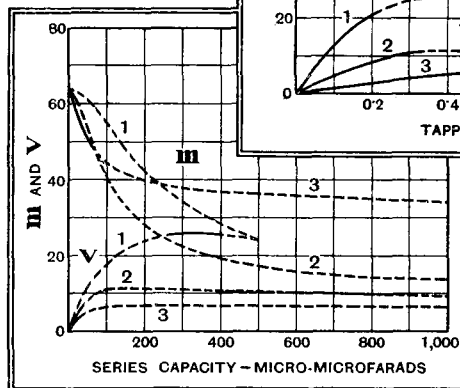


Fig. 5.—(Above) Inductive coupling with coil B on medium waves.

Fig. 4.—(Left) Conditions as for Fig. 2, but with medium-wave coil 3 condenser-coupled to the aerial.

(1) The closer the aerial is coupled, the more it reduces selectivity; and the best tuning circuits are hardest hit.

(2) The efficiency of reception, or “receptivity,” *v*, at first increases rapidly when the coupling is increased, but unless the aerial is small there is an optimum

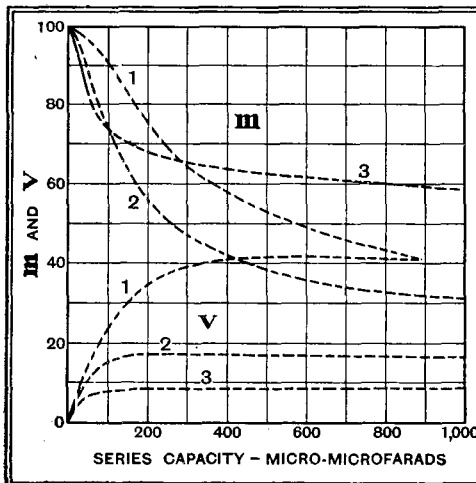


Fig. 6.—Long-wave coil G with condenser coupling.

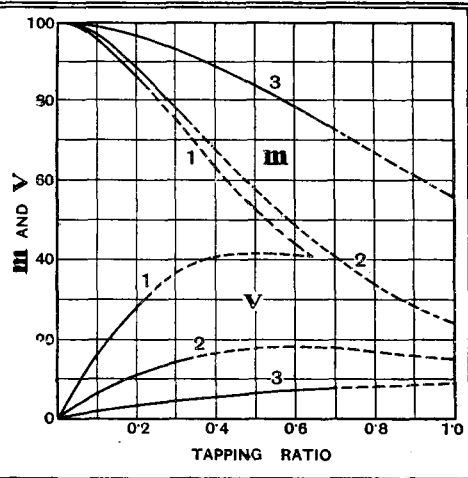


Fig. 7.—Long-wave coil G with inductive coupling.

**The Best Aerial Coupling—**

point, beyond which  $v$  slowly falls. As selectivity is falling, too, this is a very bad state of affairs. Under-coupling, though it sacrifices some signal strength, at least gives compensation in the form of better selectivity. But if a poor coil is used the

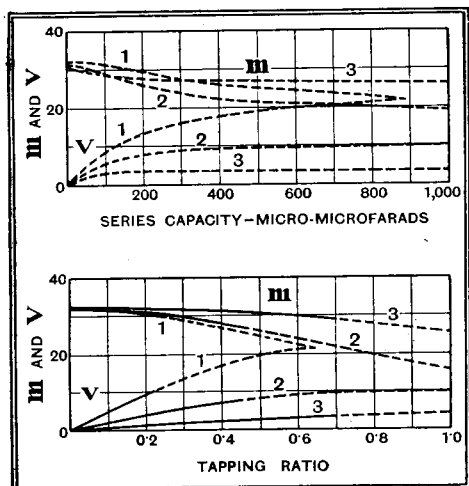


Fig. 8.—(Above) Long-wave coil B with condenser coupling.

Fig. 9.—(Below) Long-wave coil B with inductive coupling.

improvement in selectivity may not be worth it.

(3) For a given receptivity, a large aerial gives most selectivity. Thus, in Fig. 3, when aerial (2) gives a  $v$  of 20, the  $m$  is 100. But with aerial (1) the  $m$  is 192 for the same  $v$ . Added to that, the large aerial picks up more signal, so if desired the coupling can be made still looser without sacrificing any signal strength. This explodes the theory that a small aerial is more selective.

(4) Within the range of coupling possible to both systems, there is nothing to choose between them as regards the best compromise between receptivity and selectivity. Comparing Figs. 2 and 3, for example, each system gives the same maximum receptivity, and for any given receptivity neither can offer a superior selectivity.

**Where Inductive Coupling Scores**

(5) But the capacity effect of the aerial on the tuned circuit is less with the inductive coupling. If, then, a capacity limit is fixed, such as the 25 m.mfds. here chosen, the inductive system offers a wider range of adjustment, and therefore may well give better results. In Fig. 3, aerial (1) permits a receptivity of 45 without exceeding the 25 m.mfd. limit. The capacity coupling (Fig. 2) allows only 20. The necessity for limiting the capacity effect is not only because too high a minimum capacity makes it impossible to tune low enough in wavelength, but also because the effective capacity due to the aerial is not absolutely constant at all wavelengths, and even if "trimmed" at one point on the scale it throws the ganging out elsewhere.

This point is further illustrated in Fig. 10, which shows the measured voltage

across the tuned circuit due to London Regional, and the corresponding change in tuning capacity due to the aerial coupling. This shows clearly how much stronger reception can be obtained with inductive coupling for a restricted amount of capacity disturbance.

(6) When receptivity reaches its maximum, selectivity is reduced to one half that due to the tuned circuit alone. In practice it is nearly always better to work with a lower coupling than this, so as to get better selectivity.

In addition to these interesting conclusions, which favour inductive coupling, there are some practical points that the curves do not reveal.

It is easier and more convenient to arrange to get continuous control over the coupling by means of the variable series condenser. A rotating coupling coil is a little less easy to contrive, and in any case one is usually limited by it to rather low values of coupling. On the other hand, it does reduce the coupling right down to zero, whereas it is difficult to get a series condenser with sufficiently low minimum capacity:

**Double-acting Volume Control**

And the coil tapped low down has two more advantages. It lends itself to a useful method of volume control, using an ordinary type of potentiometer of moderate resistance. This is a particularly good arrangement in battery-driven sets, where a "short-base" variable- $\mu$  valve has to be used, which can handle most degrees of signal strength but is liable to be overloaded by the local station. In that case some form of aerial volume control puts matters right, and one can buy ganged volume controls that serve the purpose nicely.

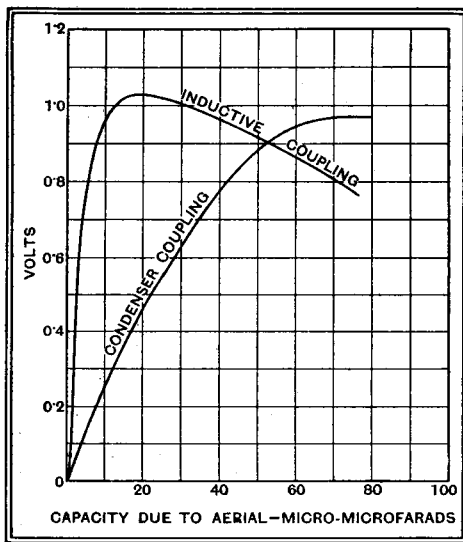


Fig. 10.—Showing how inductive coupling provides greater signal strength for a given transference of aerial capacity to the tuned circuit.

Fig. 11 illustrates this little piece of work. It is estimated that a tap including 10 per cent. of the coil turns is sufficient in most cases; and as a resistance across the aerial turns is equivalent to one across

the whole coil which is larger by the square of the tapping ratio, a 5,000 ohm volume control in this circuit damps the coil no more than 500,000 ohms across the whole coil.

Secondly, when the aerial is tapped low down it is curiously immune from most of the things that one has been brought up to avoid. It can be grasped firmly in the hand, or used with surprisingly slight insulation, or run around the house in a lead covering, or taken through a tubular metal screen in accordance with the latest anti-interference schemes; all without noticeable mistuning or loss of efficiency.

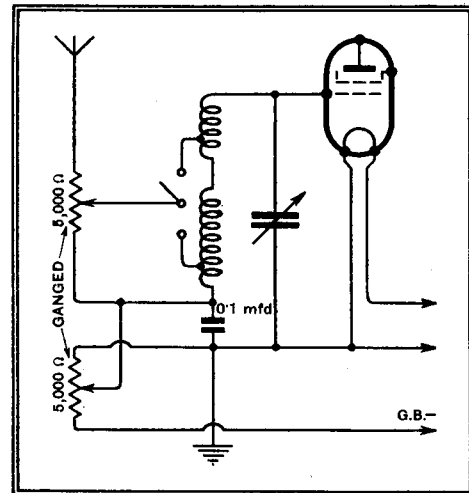


Fig. 11.—Double-acting volume control; negative bias is progressively increased and at the same time a resistance of decreasing value is shunted across the aerial input.

The conclusion of the whole matter, therefore, can be summed up thus briefly: Use a good coil, a large aerial, and a low tapping.

## Twenty Years Ago

Extracts from *The Wireless World* of February, 1914

*A Time-Signal Receiver.*

"It will come as welcome news to a great many readers that there is now available a complete Time-Signal receiving set which is manufactured in the Marconi Works at Chelmsford. . . . These signals (from the Eiffel Tower) will be of great value to clock and watchmakers, while it is hoped that an apparatus for receiving them will become part of the equipment of every village and of many country houses."

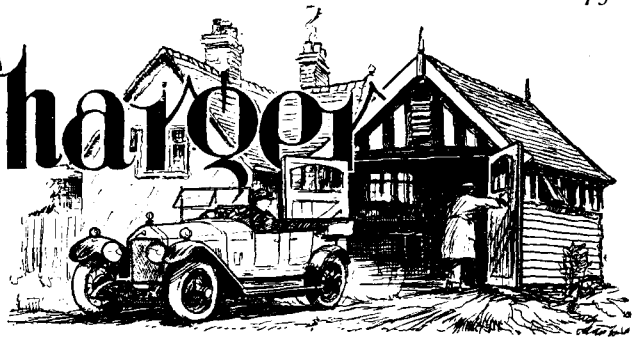
*From "Questions and Answers":—*

"W. V. H. (Shoeburyness).—I have constructed a small wireless station for receiving, the dimensions of which are as follows:—The aerial is a 4-wire, 35 yards long, with an average height of 30 feet above ground, with leads from centre. The earth wire is soldered to the water pipe. The apparatus is a variable inductance, jigger, variable condensers, silicon-gold detector and single 1,000-ohm telephone. I get Paris, Norddeich and Cleethorpes loud, especially Paris, but cannot get Poldhu quite loud enough to read. Can you suggest any additions to my apparatus to make Poldhu readable? It is practically impossible to either lengthen or heighten my aerial. Would adding more wires be of much use?"

*Extract from answer:—*

"We cannot be sure that you are in the habit of getting accurate tuning; can you so adjust to Poldhu that any change—either increasing or decreasing the wavelengths of your receiving circuits will cause a corresponding decrease in the signals?"

# Garage Battery Charger

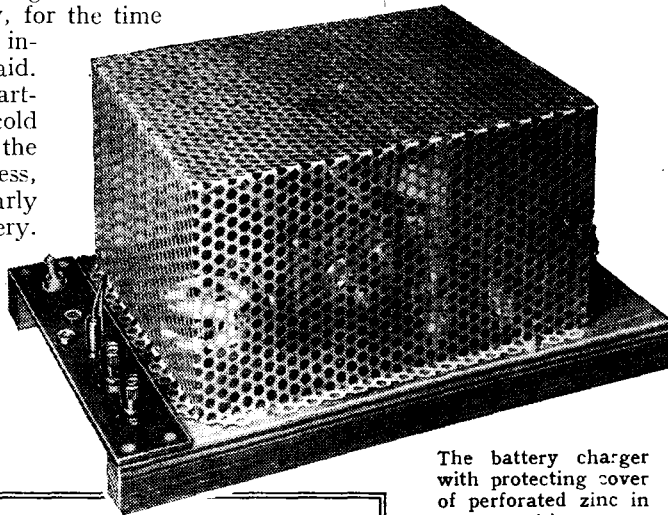


An A.C. Unit for Charging Two-, Six- and Twelve-Volt Batteries

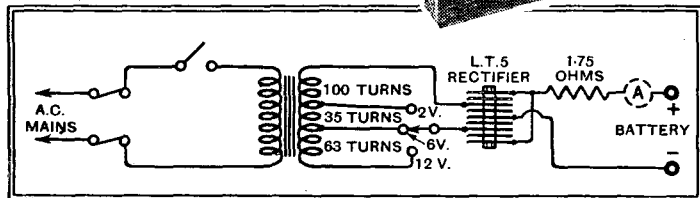
By H. B. DENT

**W**IRELESS listeners who are also motorists might profitably turn their electrical knowledge to good account at this time of the year and give a little attention to the car battery, for the time and any small expense involved will be well repaid. The greater difficulty in starting the engine on these cold mornings, coupled with the extra long hours of darkness, combine to impose particularly heavy loads on the battery. Yet the opportunities for charging at the full rate are less frequent than during the summer months, when the battery is not required to do such heavy work. It is quite understandable,

build himself; the initial cost is small and the work not difficult. Furthermore, there is no reason why the unit should not be made to serve for wireless batteries as well,



The battery charger with protecting cover of perforated zinc in position.



Circuit diagram of the three-purpose battery charger.

therefore, that without some additional help in the way of occasional charging on the bench the battery can hardly be expected to perform its allotted functions in a really satisfactory manner. That many succeed in struggling through the winter is a credit indeed to the battery makers, but the result is an undue strain, and consequently a shortened life of this all-important unit.

Those who have an A.C. electric supply in the garage might with advantage consider installing a small trickle charger, for even one giving a D.C. output of but one ampere will prove adequate to maintain the battery in good order. An over-night charge at this rate will revive the battery sufficiently to enable it to turn over the engine quite vigorously on the following morning. It is even possible to bring the battery up to full charge, although this may take from three to four days, yet it will prove economical, as the charger consumes only about 30 watts per hour, which allows some 33 hours' working on one kW., or unit, of electricity.

The charger illustrated here is one that the home constructor can quite easily

and 20, either two-, six- or twelve-volt batteries can be charged merely by selecting the appropriate A.C. voltage for the Westinghouse rectifier, which, incidentally, is the type L.T.5 rated for 12 volts 1 amp. output. For this purpose a special mains transformer would be needed, but its

for it entails no extra expense.

By using a mains transformer with several tappings on its secondary winding, and giving A.C. output voltages of 10, 14,

could be employed. The secondary A.C. output from these is 15, 18 and 22 volts, these voltages being suitable for charging six-, ten- and twelve-volt batteries. If a resistance of about four ohms is joined in series with the six-volt charging circuit then two-volt wireless batteries would be dealt with as well.

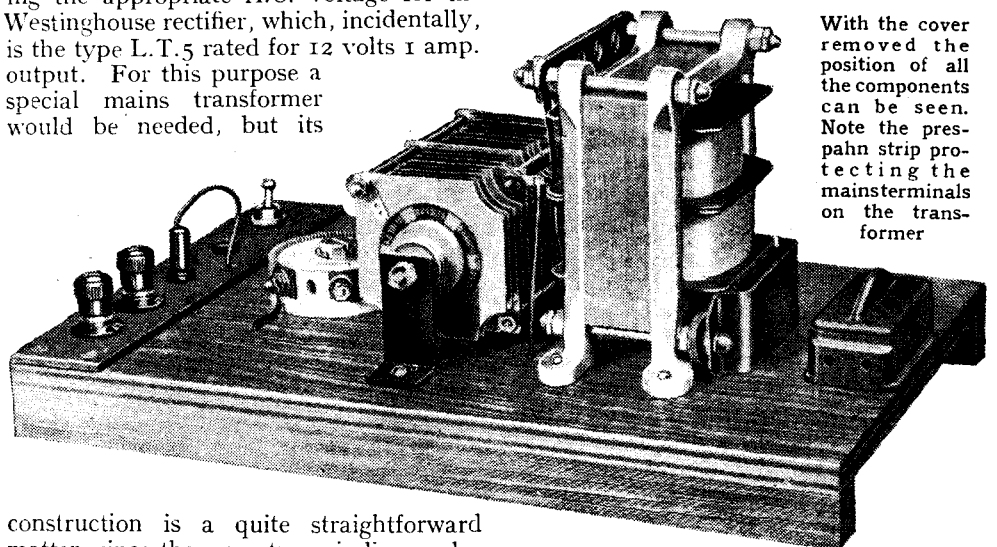
For the benefit of those desiring to construct the transformer themselves the following brief details of the windings may be helpful.

The primary and secondary windings are wound on separate bobbins assembled on Stalloy No. 4 stampings with a core approximately one inch square— $1\frac{1}{8}$  in. x 1 in. to be exact. If the supply is 240 volts 50 cycles, the primary bobbin should be wound with 2,160 turns of No. 30 S.W.G. D.S.C. wire, while for the secondary 198 turns of No. 20 S.W.G. D.C.C. are required. This winding is tapped at the 100th and 135th turns. The correct primary winding for any electric supply of 50 cycles can be found by multiplying the voltage by nine; the gauge of wire specified being suitable for all supplies of from 200 to 250 volts.

The following material is required for the construction of the mains transformer:—

- 60 pairs of No. 4 "Stalloy" stampings.
- 2 half-size No. 4 bobbins, with a 1 in. x 1 in. centre hole.
- 1 pair of aluminium end-clamps, with nuts and bolts.
- 10 oz. of No. 30 S.W.G. D.S.C. wire.
- 10 oz. of No. 20 S.W.G. D.C.C. wire.

With the exception of the wire all this



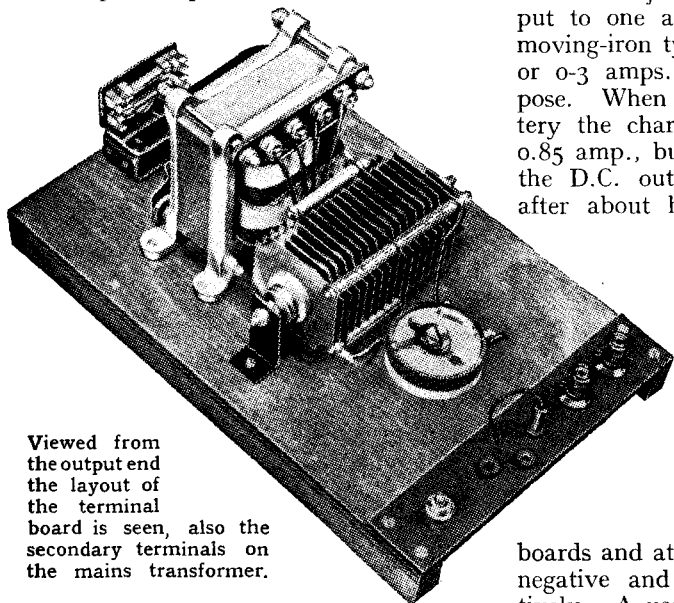
With the cover removed the position of all the components can be seen. Note the brass strip protecting the main terminals on the transformer.

construction is a quite straightforward matter, since there are two windings only, and these are arranged on separate bobbins. Alternatively, a standard commercial transformer, such as the Heayberd, R.I., or Regentone models, for example,

material is obtainable from Sound Sales, Ltd., and possibly this firm would supply the transformer made to specification if required.

**Garage Battery Charger—**

The stampings are assembled in the usual manner for mains transformers; that is to say, with the "T" and the "U" pairs inserted alternatively from opposite sides. Cast-aluminium end-plates are employed to clamp the core, and the leads from the coils may be brought out to terminals mounted on ebonite or Paxolin strip clamped under the core bolts, or they can be left sufficiently long to join direct to their respective points.



Viewed from the output end the layout of the terminal board is seen, also the secondary terminals on the mains transformer.

When the transformer is finished attention can be given to the assembly of the components on the baseboard. This measures 10½ in. long and 7½ in. wide, and can be cut from ¾ in. plywood. It is mounted on battens each 12½ in. long by ¾ in. deep by ½ in. wide. These extend two inches beyond the baseboard and on them is then screwed a small ebonite, or Paxolin, panel, measuring 7½ in. by 2 in. This carries a mains on-off toggle switch, three sockets for adjusting the A.C. input to the rectifier and two terminals for the battery leads.

The other components required consist of a Westinghouse L.T.5 rectifier, a two-ohm pre-set resistance, and a twin fuse-holder. The inclusion of a small resistance—1.75 ohms is the value recommended—is a precautionary measure advised by the makers of the rectifier to safeguard the unit against damage in the event of the battery being connected accidentally with the wrong polarity. The approximate position of the contact arm on the Igranic resistance used to give 1.75 ohms is shown in one of the drawings.

Since some protection is obviously needed for the components, a cover made from perforated zinc would serve as well as any, but there is no objection to

fitting a wooden one, provided some ventilation holes are drilled along the lower and upper edges. If a zinc cover is fitted, and there are terminals on the transformer on the side nearest the cover, these should be protected by a strip of thin prespahn, or other suitable insulating material, as shown in the illustration.

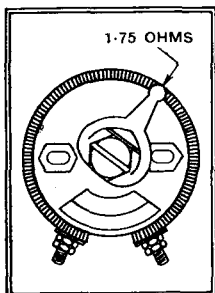
It would be exceedingly helpful if an ammeter were available the first time the charger is used, as it would then be possible to adjust accurately the D.C. output to one ampere. One of the cheap moving-iron type having a range of 0-1.5 or 0-3 amps. would serve for this purpose. When first connected to the battery the charging rate should be about 0.85 amp., but as the rectifier warms up the D.C. output will rise slightly, and after about half an hour the ammeter should read about one ampere. If the output does not quite reach this figure, then an adjustment should be made to the 2-ohm resistance to give the correct output.

It is quite unnecessary, of course, to remove the battery from the car, and it can be charged *in situ* by lifting the floorboards and attaching the two leads to the negative and positive terminals respectively. A useful clip for this purpose is the Goltone Bull-Dog spring connector, made by Ward and Goldstone, Ltd., of Manchester.

Since preparing this article the writer has learnt that there is available a Parmeko transformer giving 11, 15, 18 and 22 volts output, and this model might quite well be regarded as an alternative to the one described in the text. For the voltages 11, 15 and 22 are so near to those specified that only a slight adjustment of the variable resistance would be needed to compensate for the difference.

**LIST OF PARTS**

- 1 Mains transformer, see text
- 1 L.T. rectifier, 12 volts 1 amp. output  
Westinghouse type L.T.5
- 1 2-ohm pre-set resistor Igranic 2241/13
- 1 Mains on-off switch Igranic 2296/61
- 2 Terminals, L.T., L.T.— Igranic 2297/30
- 3 Insulated-headed sockets
- 1 Wander plug. Clix Parallel Socket No. 9
- 1 Twin fuse-holder with 1 amp. fuses Belling-Lee 1033
- Wood for baseboard and battens
- Perforated zinc for cover
- 1 Paxolin or ebonite panel, 7½ in. x 2 in. x ¼ in.
- Quantity of No. 18 S.W.G. tinned copper wire, screws and insulating sleeving



Approximate position of the slider on the 2-ohm resistance to give 1.75 ohms.

**THE RADIO INDUSTRY**

IN the recent article on "Q.A.V.C.," the use of a Weston relay was considered; readers may be interested to know that Electradix Radios, of 218, Upper Thames Street, London, E.C.4, still have a stock of these highly sensitive instruments. Other types of electro-magnetic relays as well are described in a special leaflet.

The new Corsor Station Identification Chart (price 2d.) gives useful information about the Lucerne wavelength allocation, a list of identification signals, and also has spaces for recording dial settings.

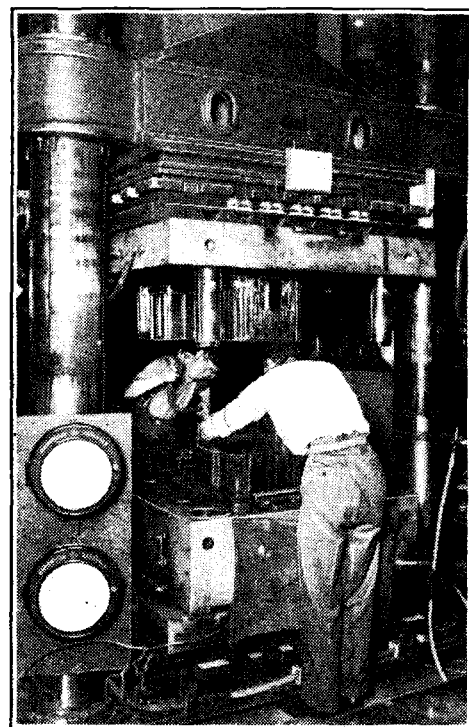
A new style of receiver, essentially designed for remote control, is about to be introduced by Radio Furniture and Fittings, Ltd., of 106, Victoria Street, London, S.W.1. From each

of three remote points the set may be switched on or off, any one of three stations selected, and volume regulated to taste.

Lissen announce that all their receivers and kits will work satisfactorily under the new wavelength plan without any alteration.

Mullard's emphasise the fact that the low-consumption pentode Type PM22A can still be obtained either with a five-pin or a four-pin base, the latter having a side terminal for the auxiliary grid connection. This valve may therefore be used to replace an out-of-date triode in the simplest possible manner, and without disturbing the existing connections of the receiver.

The loose-leaf Dubilier list, No. 933G, contains full details of their condensers and resistances, and is published solely for those professionally or commercially interested in wireless engineering. Apart from information on dimensions, etc., a great deal of useful technical data is included.



**MOULDING EKCO CABINETS.**—One of the 1,500-ton presses installed at the new bakelite factory of Messrs E. K. Cole Ltd., at Southend. The operator in the foreground is removing a Model 75 cabinet from the mould, which is electrically heated.

Ferranti's method of solving the Lucerne wave-change problem is to supply users of the "Arcadia" and 7-valve models with conversion charts, showing the old and new adjustments side by side. This is a temporary measure; when the stations have "settled down," replacement scales will be issued.

Wright and Weaire are manufacturing a commercial version of the second-channel interference suppressor, described in last week's issue.

The latest Trix Amplifier, Model TP.144, is a three-stage instrument giving 10 watts output, and designed primarily for talking-picture reproduction, but can be used for many other purposes where exceptionally high gain and large output are needed.

**Changes of Address**

Atrow Electric Switches, Ltd., from Newton Works, Whitfield Place, London, W.1, to Hanger Lane, Ealing, London, W.5.

Technical and Commercial Radio College, from Lloyd's Place, Blackheath, to Cromwell House, High Holborn, London, W.C.1

# Practical HINTS AND TIPS

THERE is a right and a wrong way of connecting the two terminals of even such a simple device as a semi-variable compression condenser. To avoid disturbing hand-capacity effects while making adjustments, it is necessary that the plate

## Compression Condensers

(or set of plates) which make contact internally with the adjusting screw should be joined to the "earthy" side of the circuit.

When dealing with an unshrouded condenser, the correct connections are easily found by inspection, but the bakelite-cased components bear no indication, and so it is advisable to make a continuity test between the shank of the screw and each terminal, to find which should be earthed.

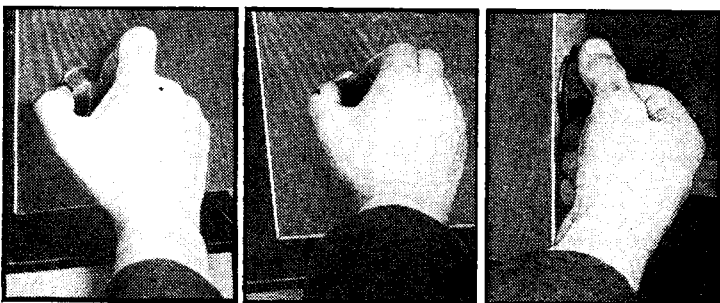
This does not apply to series aerial condensers, in which both sides are at high potential. Such condensers should therefore be adjusted with a long insulated screwdriver.

A GREAT deal of interest has been shown by readers in the question of "the receiver in outward form," particularly from the point of view of convenience in operation. In particular, it seems to be generally agreed that no effort

## "Function-alism"

should be spared to enable the critical and somewhat delicate operation of tuning to be carried out as easily as possible. Criticism directed against the conventional arrangement of the tuning knob—with its spindle at right angles to a vertical panel—has been generally accepted.

The weakness of the ordinary arrangement is that the user's wrist and fore-arm must be in an unnatural position. It may be pointed out, however, that this objection may be largely overcome by setting the control panel at an angle with the vertical—say 45 degrees. With a control panel mounted at this angle, experience shows that the most critical adjustments



The knob controversy: three different positions compared.

may be made with ease and certainty, especially if the fore-arm or under-side of the wrist is supported during the process of tuning.

In spite of the advantages of the sloping

## AIDS TO BETTER RECEPTION

panel, it would seem certain that the best position of all for the tuning knob is at the side of the cabinet, but there is some difficulty in finding suitable condenser drive mechanism for installation in this manner. Of course, the side control must be combined with an indicating scale visible from the front.

ELECTROLYTIC condensers are never perfectly insulated; nor, for that matter, is the average paper condenser. But the point is that the leakage current which flows through an electrolytic condenser is quite considerable, and can be detected easily with ordinary measuring instruments.

## Condenser Leakage

Accordingly, it should be remembered when testing a receiver in which electrolytic smoothing or by-pass condensers are included it will sometimes happen that quite a large fraction of a milliampere is found to be flowing in circuits where normally one would expect to find virtually perfect insulation.

Of course, the small leakage current which normally flows does no harm in a mains-operated receiver, but it is as well to be on one's guard to avoid false conclusions when checking insulation resistance, etc.

WHILE on the subject of electrolytic condensers, it is perhaps wise to point out that the use of this type of condenser for grid-circuit decoupling and by-pass purposes should generally be restricted to true self-bias arrangements,

## Automatic Bias Circuits

where the bias resistor is inserted in the cathode lead. This matter was recently discussed in the "Hints and Tips" section, and we are indebted to a reader who reminds us that, in

a circuit like that shown in Fig. 1, the use of an electrolytic by-pass condenser C would probably have harmful effects.

The diagram re-

with the other resistances in the circuit, will act as one limb of a potentiometer across the source of voltage, and so the voltage actually applied to the grid will not have the value estimated. It may be very much less than calculation would show, and if this point be ignored, there is a real risk of over-running the output valve.

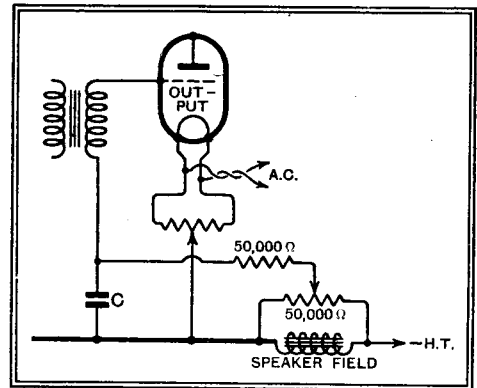


Fig. 1.—It is risky to use an electrolytic decoupling condenser in special bias circuits of this type.

UNCONTROLLABLE instability in H.F. receivers is not nearly so common as it used to be, but, nevertheless, it is a trouble that sometimes arises. In a surprisingly large number of cases it is finally traced to an incorrect method of

## Well Earthed

earthing the metal framework of a ganged tuning condenser. The rule to be remembered here is that a single connection should never be depended upon; at least two connections should be made, preferably from opposite ends of the frame, to the earth line. Similarly, with metal chassis construction, care should be taken to see that a good and clean contact is made between the condenser frame and the metal base-plate at more than one point.

IT would seem that solid valve pins are being largely displaced by those of the split "banana" type; in this matter manufacturers show a tendency to revert to an earlier practice, and it is probable that experience shows that, to ensure good

## Badly Fitting Valves

connections, a certain amount of springiness in the valve pin is desirable.

It will be obvious that, after long use, the diameter of a banana valve pin will tend to decrease, and so it may fit loosely in its holder. The best way of putting matters right is to insert the point of a penknife in each of the slots in turn, and then to give the knife a slight twist. This will have the effect of opening out the slots, and so restoring springiness to the pin.

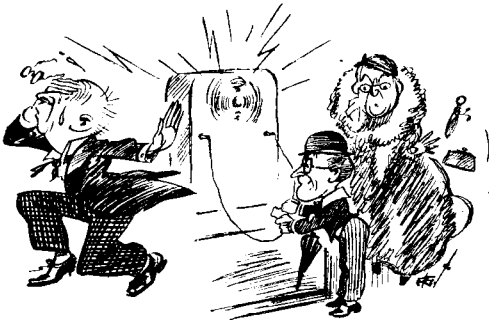
## Jeopardising Ohm's Law

I HAVE never been one to make pretence to knowledge which I do not possess.

It was, therefore, with a due sense of my own inferiority the other day that I took the little Grid Leaks into the tents of an electrical wizard that they might learn from the lips of the savant himself how each of our bodies was an electric battery—or primary cell, as I suppose the pedants would have me say—and have the fact proved by actual demonstration.

Upon entering the booth of the seer we were bidden to be seated among a large and varied assortment of our fellow creatures, both male and female. Before us was an impressive contraption rather reminiscent of Joanna Southcott's box, the leading feature of which was a healthy looking microammeter and a pair of electrodes dangling at the end of a piece of flex.

We were first treated to a highly technical lecture of a medico-legal nature, liberally besprinkled with words and phrases calculated to impress the non-technical members of the audience. The electrodes were then handed to a portly dame, who promptly scored a fifty on the meter. She was quickly outstripped, however, by a clammy handed youth, who sent the needle up to 150.



Broke all the laws of nature.

Even he was put into the shade, however, by a sturdy son of toil who had the foresight to spit on his hands before grasping the electrodes, a fact which seemed to pour cold water on the audience's desire for further experiment. Their ardour was damped to such an extent, in fact, that the lecturer was quite relieved when I nudged one of the little Grid Leaks in the back as a signal for him to get into action.

He scored a modest 100, and all would have gone well had not the lecturer made the fundamental mistake of patronising him with a pat on the head and the sickly look generally described by novelists as an indulgent smile. This, I regret to say, raised in my boy the worst of the instincts which he has inherited from his mother, and he promptly joined the electrodes together, thus short-circuiting not only the meter but himself also. Instead of the meter falling back to zero as might have been expected, it broke all the laws of nature by taking a sudden leap forward.

I immediately rose and called attention to this truly remarkable defiance of Ohm's law, but to my utter astonishment the

## UNBIASED by FREE GRID

lecturer, so far from being abashed by his unexpected unmasking, immediately turned to the audience and pointed out that this happening furnished yet one more proof of the old proverb about strength in unity, and explained that the joining together of the hands increased the strength of the current.

My expostulations were immediately drowned by an indignant clamour from the assembled females who, with their customary readiness to defend anything that appears orthodox and respectable, rushed to the defence of the lecturer. After an unequal battle of words I deemed it wise to withdraw my troops while the going was good, and fall back on the weapon of the pen.

### Something New in A.V.C.

EVERYBODY is familiar with that peculiarly noxious kind of distortion associated with night-fading, from the curse of which A.V.C. does nothing to deliver us. It is, of course, due to the fact that the various musical frequencies are not refracted to the same extent by the Heaviside layer. Thus, at any given moment, we may get the high C of an outsize in sopranos hitting our aerials fair and square, while her accompaniment may miss the mark altogether.

I have long thought that the only way to combat this successfully was to use an entirely separate A.V.C. valve for every frequency, and my recent experiments have been along these lines. Since I have had to use over four thousand valves to cover even the fundamentals of a piano, it can be seen that my A.V.C. attachment will undoubtedly rank as an invention of the first magnitude.

An unexpected difficulty has now delayed publication of my little unit, and the valve manufacturers, who are, of course, financing me, are getting a little petulant about it. The trouble is due to the fact that a wretched colleague, in his efforts to throw cold water on my whole idea, has at last succeeded in getting into my mind a little scintilla of doubt.

Briefly his theory is that the distortion associated with fading is not entirely due to the cause I mentioned; in fact, he alleges that fully ninety-nine per cent. of it is due to unequal refraction, which causes certain notes to lag behind the others.

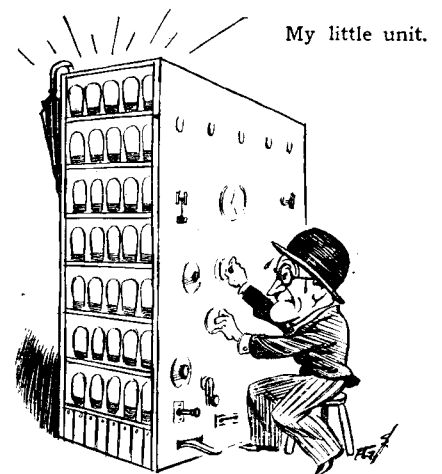
I must, therefore, design an additional unit which will retard the eager first arrivals until their more laggard brethren have caught up. Then, when all are neatly lined up, it must release the lot like horses at the starting gate in the Derby.

What worries me is not so much the designing of the unit as the fact that I am not sure whether my colleague's contentions are true. Perhaps my readers can help? If they decide that the theory is correct perhaps they will suggest some lines along which I ought to work to evolve this delayed action device?

If the problem cannot be solved I shall have several thousand valves to dispose of cheaply.

### Television's Opportunity

THE subject of *pulex irritans* is not one which I altogether care to discuss in my columns, but its appearance in one of the television programmes of a certain continental station the other day leaves me no option. It was perhaps unfortunate that on the particular evening in question I had invited a somewhat select



company to have a look-in through my home-made radioscope, and still more unfortunate, perhaps, that on that occasion the television transmission was unusually clear.

However, it is not about the reactions of people to the efforts of these intelligent little creatures that I wish to speak. No matter if they had searched the whole earth for it, the broadcasting station in question could not have found any entertainment so suited to the technique of television as that of performing fleas. To people unarmed with powerful field glasses, for instance, these miniature antics are invisible in music hall, theatre, or circus. But television makes every detail clear.

I trust, therefore, the B.B.C. will not be content to lag behind their Continental contemporaries in this respect, and that we shall both see and hear more of this kind of performance, which should do more to popularise television than a half a dozen prize fights from the Albert Hall.

In time people would get accustomed to such events and would feel more comfortable in their minds as well as their bodies. At present, the whole thing is a novelty, and so great is the power of suggestion that, on the morning after the recent broadcast, laundry managers in the Continental country concerned were, I hear, at their wits' end to know how to cope with the sudden rush of work.