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## Editorial Comment

# Something Wrong

## Failure to Stress Technical Progress

**I**N spite of the glamour of Radio Olympia and the enthusiasm which the Exhibition invariably kindles, there is something wrong. That something seems at first difficult to define, and we have taken a great deal of trouble during the period of the Show to try to discover why it is that the public visiting the Exhibition walk round with so little enthusiasm for the exhibits and flock to the Radio Theatre as if it were a welcome diversion from the Show itself.

The industry talks of saturation as if we had already reached a stage where few sales were effected to homes without wireless, and yet the attitude of the salesman still seems to be that of selling sets to an uninformed public. We have arrived sufficiently near to the point of saturation to be able to say that in the vast majority of cases where sales of the better class receivers are effected, these are to persons who already own sets and only replace because they want something better. What inducement is there to the public to change a set which is giving reasonable satisfaction at present? Transmission conditions have stabilised so that the argument can no longer be put forward that only this year's model is suitable in the matter of selectivity to cope with present conditions. It may be that the addition of short-wave ranges helps to sell a set to-day, but, if so, not nearly enough prominence is being given to this feature.

### Plenty of Features

As to other inducements, although there are many refinements in the modern set, the prospective purchaser is told little or nothing about them. They are features which require a little technical description before they can be understood and the salesman of to-day knows nothing of technicalities and, judging from our experi-

ence at the Show this year, he seems to try to forget that there is anything inside the cabinet about which any prospective purchaser could possibly want any information.

Unless the salesman is competent to explain to the customer in what respects the set of this season differs from the set which the customer bought last year or the year before, he cannot hope to effect a sale.

### Sales To-day Are Replacements

The visitor to the Radio Show, we can assume, already has a good wireless set. It does not wear out like a car; its external appearance does not change much with fashion; it reproduces with good quality and sufficient selectivity for his needs; the owner has no basis of comparison as he would have with a car every time he took it out. Unless he can be told about the technical improvements in the new sets, the chances of interesting him must be small.

If the industry does not wake up to the importance of maintaining amongst the public a discriminating interest in the technical improvements made in their sets, their prospects of inducing the public to change an existing set for a new one are remote.

The technical refinements introduced from year to year by the manufacturers should be announced with the enthusiasm which these developments justify. A wireless set is not just a musical box in a cabinet, it is a wonderful electrical instrument, the development of which has taken years of work by the best brains in the world. It is the inside which the manufacturer should be proud to discuss with the public, rather than the cabinet which, although it may, in itself, be attractive, is nevertheless no more than a covering intended to house and protect the delicate works within.



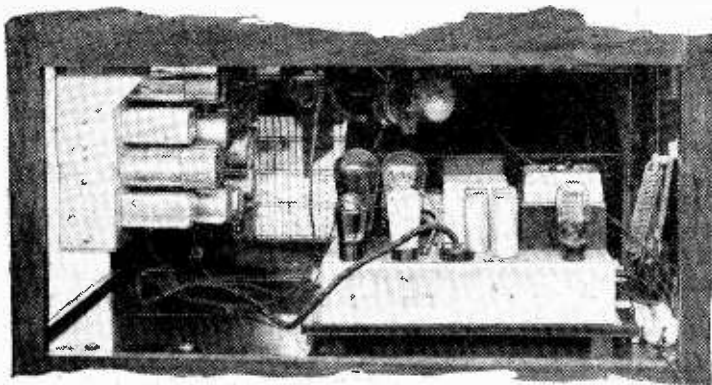
# Tenc in Receiv

REAL PROGRESS FOUND

**W**IDER waveband coverage; greater output power; more valves; greater number of tuned circuits; higher sensitivity: thus the general tendencies of broadcast receiver design for the coming season may be summed up, at least so far as the new mains-driven models are concerned. Considering that every section of a set is affected by these changes, it will be evident that stagnation in design is as far away as ever; indeed, it is probably true to say that the present Exhibition has brought to light more real progress than did its predecessor of 1936.

Last year the so-called all-wave set, covering one or more short-wave bands, was still a novelty—at least to the extent that it was always considered worth while to mention that provision for short-wave reception was included. To-day that feature is standard practice, and the two-band set, covering medium and long broadcast bands, remains only in the lowest price categories and in specialised high-quality equipment. The general tendency is to increase the short-wave coverage by providing more bands; three are by no means uncommon, and in such sets the shortest wavelength receivable is sometimes as low as 5 metres or so. The four-band sets (with two short-wave ranges) generally start at about 12 or 13 metres.

In addition to this downward extension



Volume expansion and automatic frequency control are among the refinements of the R.G.D. 1221 radio-gramophone.

of wave-range, there is a distinct tendency to provide continuous coverage without serious gaps from the lowest wavelength receivable up to about 2,000 metres. In a

number of sets the only missing wavelengths are those between 550 and 800 metres—a band occupied almost exclusively by morse transmissions and so of no interest to the vast majority of listeners.

So far as circuit details are concerned, the means whereby wave-range has been extended are generally straightforward, and the problem of the necessarily complicated waveband switching system seems to have been satisfactorily solved by the almost universal use of the rotary plate type of switch. With regard to valves, however, the need for tuning to shorter wavelengths than hitherto is partly responsible for one important change; the triode-hexode is now very widely used as a frequency-changer, and where other types of "mixer" valves are employed they often operate in conjunction with a separate oscillator valve.

The greater output power of the average medium-priced set has been attained by the use of the recently introduced "beam" tetrodes, by the application of the negative feed-back principle to pentodes, and in a few cases simply by using conventional but more generously planned output stages than were previously to be found in anything but costly "quality" sets.

Beam tetrodes are used in push-pull in the new H.M.V. Model 650, where an output of some 10 watts is obtained. An example of the use of a single valve of the same type is to be found in the new Marconiphone Model 538, of which the output is rated at 5 watts.

In the Philips 837AX there is a pair of parallel-connected pentodes working in a negative feed-back circuit and giving 9 watts. Outputs of 5 to 8 watts

are quite common in relatively low-priced sets.

The "straight" pentode, which has enjoyed such a long reign, tends to dis-

appear from the larger sets, though its use is still almost universal in the cheapest models. Single triodes are to be found in several moderately priced receivers, notably in the Ferranti Model 1737, in which special pains have been taken to provide an unusually wide audio-frequency range. Push-pull triodes are almost universal in specialised "quality" equipment, and a notable example of their use in medium-priced receivers as well is to be found in the G.E.C. "All-wave Quality 8," which has a rated output of 6 watts.

As there is a distinct tendency for sets to include more valves, it is natural enough that there should be a greater number of tuned circuits. In the larger Dynatron models, to be discussed later, the total number amounts to fourteen, while ten circuits are fairly common. Per-



The Ferranti 1737 has variable selectivity and triode output.

haps this tendency is largely due to the slightly greater use of two IF stages (examples of this practice are to be found in some of the more ambitious H.M.V., Marconiphone and K.-B. models), but in the 11-guinea Portadyne set the relatively high total number of eight circuits is accounted for by the fitting of triple-circuit IF couplings. There is, however, no evident tendency to increase the number of signal-frequency circuits, and a tuning condenser with more than three ganged sections is indeed a rarity.

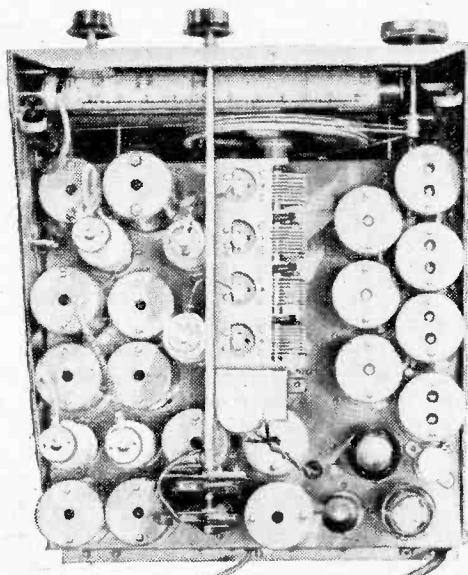
A signal-frequency amplifying stage preceding the superheterodyne frequency-

# encies er Design

## AT THIS YEAR'S SHOW



changer is a refinement that is now to be found in more receivers; this, of course, is part of the general trend towards the more ambitious type of receiver. How-



Satisfying both schools of thought: the TRF and superheterodyne principles are combined in the Dynatron receiver.

ever, such a stage is included in many modestly priced receivers, and it now forms part of all G.E.C. sets costing 14 guineas or over. It now seems to be almost universal practice to tune the signal-frequency stage on all wavebands, including the short-wave ranges.

The "all-wave" idea is now applied to self-contained transportable sets operating with a built-in frame aerial. In the McMichael 374AC, which covers wavelengths down to 16.5 metres, the frame itself is tuned on all three bands. An alternative scheme, exemplified in the battery transportable made by the same firm, is to use the frame, so far as the short waves are concerned, as a kind of capacity aerial, a tuning coil being inserted in the input grid circuit by the action of the wave-change switch. The McMichael AC set in question is an eight-stage superheterodyne with seven tuned circuits.

In the matter of variable selectivity control there has been little change. This re-

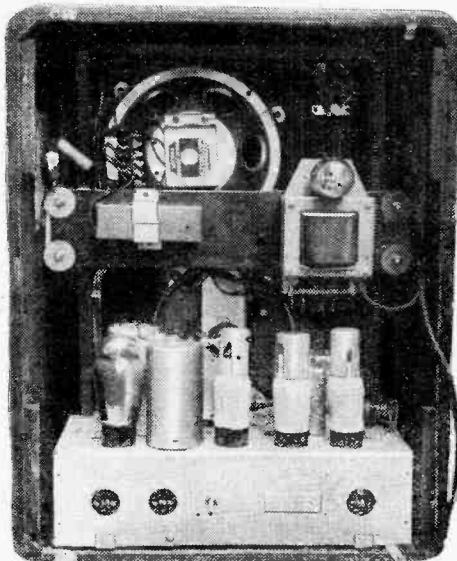
finement is practically universal in the more elaborate sets, and, as before, comparatively rare in inexpensive models. It appears, however, in the Cossor 584, where a simple but ingenious method of altering the magnetic coupling between primary and secondary of the IF transformer is fitted. The 584 is a small superheterodyne with triode-hexode frequency-changer, intermediate AF amplification and pentode output.

It seems that the difficulties in the way of providing a practical system of automatic selectivity control, depending for its action on the strength of the desired signal and perhaps also on the conditions of interference, have not yet been overcome, but in another of the Cossor sets (the 484, an even cheaper model) it is stated that a useful measure of automatic control is obtained. In this set IF amplification is obtained through regeneration, and the

trast amplification, or volume expansion, is provided in the same set by a double diode-triode which acts as one limb of an electronic potentiometer. Volume expansion is obtained in quite a different way in the Philips 787AX; a small metal-filament lamp is employed, but it operates in a manner differing essentially from that of the earlier American system described in this journal. The lamp is inserted in the negative feed-back lead from the parallel output pentodes; its resistance tends to increase on a strong signal, thus reducing the amount of feed-back and consequently of volume. On the incidence of an abnormally weak passage the opposite effect takes place.

Although anti-interference devices are well to the fore in the components and accessories sections of the manufacturers' stands, there are comparatively few sets in which direct provision is made for the use of anti-interference aerials. Among the exceptions are certain new Marconiphone and H.M.V. models, in which built-in impedance-matching transformers for connection to the lower end of a screened aerial line are included. The advantages of this scheme, as against the ordinary method of using an external matching transformer, were recently discussed in this journal. Kolster-Brandes receivers are also designed for use with the K.-B. Rejectostat all-wave aerials.

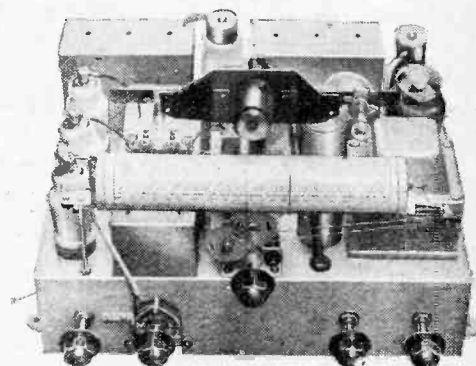
Before going on to discuss more specialised tendencies, a word or two should be devoted to the basic circuit arrangement of the 1937-1938 receiver. It is hardly necessary to say that the circuit remains



An example of the all-wave transportable: the McMichael 374.

"broadness" of the IF channel is increased by the application of a strong signal.

Automatic frequency control is one of the refinements of the R.G.D. Model 122T radiogramophone, in which the discriminator is a double-diode with separate cathodes which provides differential DC voltages. The control is applied across the oscillator padding condenser. Con-

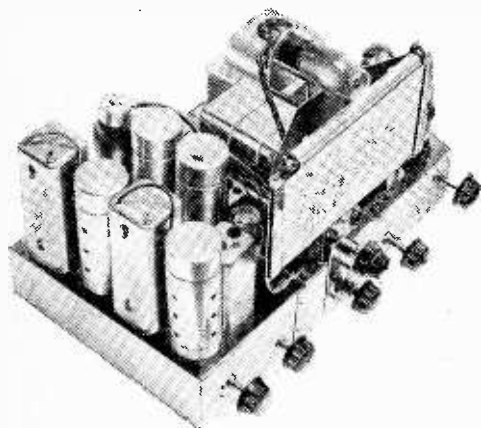


The Eddystone ERA7, supplied in chassis form, is notable for its die-cast construction and "professional" rotary tuning scale.

**Tendencies in Receiver Design—**

a superheterodyne; the few important detail changes in it have already been enumerated. Although the attractions of the TRF circuit, even under the most exacting modern conditions, have been set forth by recent contributors to our pages, there is hardly an example of the "straight" set to be seen except among the more specialised productions. Even Dynatron, hitherto the firmest of supporters of the TRF principle, have this year effected a compromise. The receivers shown by this firm operate as superheterodynes for long-range work and as "straights" for local-station quality reception. The changeover is effected by the variable selectivity control knob; in the "high-fidelity" position the hexode section of the frequency-changing valve becomes an RF amplifier. Contrary to what might be expected, the switching arrangements for effecting the change-over are not unduly complicated.

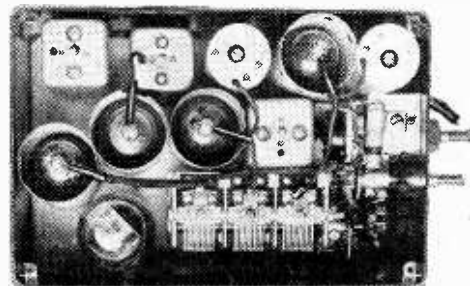
An example of the purely straight set is the newly introduced Haynes Model A4,



The B.T.S. 12-valve chassis has separate valves for QAVC and noise suppression; the amount of AVC is under the control of the user.

which, unlike most of the productions of this firm, is a single-unit set. It embodies a single-stage RF amplifier with three tuned circuits, diode detector (no reaction), and a 6-watt duophase amplifier. In fact, the design is essentially similar to higher-priced Haynes equipment, but economies have been effected by eliminating certain details which have no direct influence on quality of reproduction.

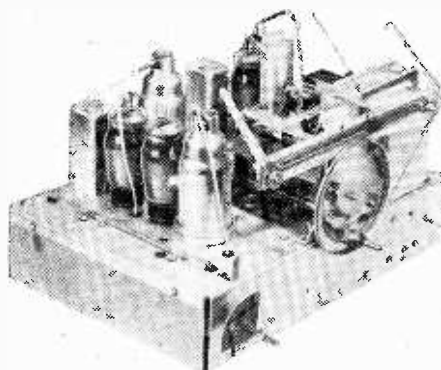
Another straight set is the B.T.S. version of *The Wireless World* Straight Six, which retains the circuit arrangement of its prototype, but has been modified for factory production.



Top and underside views of the Ferranti car set (main unit). Components are more accessible than in many domestic receivers.

Iron-cored coils have continued to gain ground steadily, and are now used more widely than ever before in both radio-frequency and IF circuits. In one set at least (Cossor) IF trimming is effected by movement of the cores instead of by the usual adjustable trimming condenser. An intermediate frequency of 465 kc/s is now the most widely used, though examples of a much lower value are not lacking. The use of two distinct intermediate frequencies in another Cossor set is a distinct innovation. The values are 465 kc/s on medium and long waves, and 1,363 kc/s on short waves.

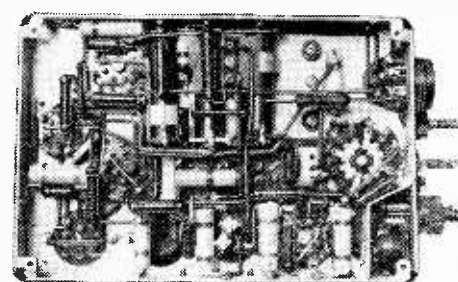
One swallow does not make a summer, and so the use of Harries "all-stage" valves in the Gambrell all-wave superheterodyne can hardly be represented as a technical trend; it is, however, an interesting innovation. All six valves are of the same seven-electrode type, being adapted for their functions in the various stages of the receiver by suitable external



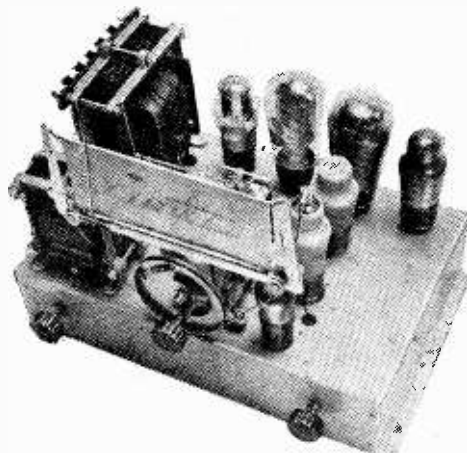
The same type of multi-electrode valve is used in each stage of the Gambrell all-wave superhet.

connection to the electrodes. The set, which covers four wavebands, has a signal frequency stage and a separate oscillator. The power rectifying valve alone is conventional.

Modern tendencies in car radio are well exemplified in the new Ferranti set. It would seem that the average motorist does not take kindly to the idea of fitting a suppressor resistance in series with each sparking plug, and so means for increasing the immunity of the set itself to ignition interference are highly desirable. In the Ferranti set the principal defence is put up by a low-pass filter in the aerial circuit, which renders innocuous interference of sub-broadcast wavelength which is usually responsible for much of the trouble. With regard to its circuit arrangement, the set is a superhetero-



dyne with a signal-frequency stage, HT supply being obtained from a vibratory generator through a full-wave rectifying valve. Double-polarised electrolytic condensers are used, and the receiver can be



Quality reception without "frills"; the Haynes Model A4.

used with car electrical equipment having either a negative or positive earth connection. Thanks to its compactness and two-unit construction, the receiver is particularly well adapted for fitting on the smaller type of British car.

Although figures for the sensitivity of domestic receivers are not yet available from the majority of manufacturers, it seems fairly certain that the overall gain of the average set is higher than last year; this can probably be attributed to the rather regrettable unpopularity, among both dealers and the general public, of effective aerials. There is a distinct tendency to provide more AF amplification, and although many of the larger firms adhere to their cheaper models to the arrangement of a diode detector feeding directly into an output pentode, an intermediate AF stage figures in a very large number of quite small sets.

## BATTERY SETS

DEVELOPMENTS in battery receiver design have been, and presumably always will be, circumscribed by considerations of battery economy. There seems little doubt that the so-called "standard" size of HT battery with a capacity of the order of 1.5 watt/hours per cell is the one which best satisfies the requirements of producer and consumer. The current of 8 to 10 mA., which is the average maximum economical discharge rate for batteries of this type, represents a fixed capital, the distribution of which to give the best return in overall performance is the battery set designer's special problem.

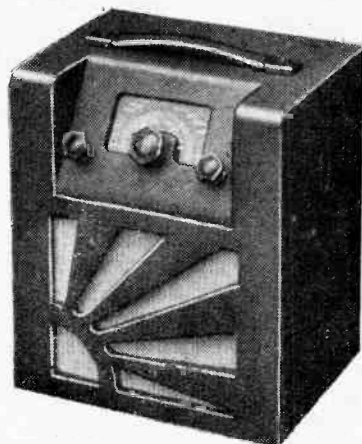
Until quite recently the output stage has claimed a very large percentage of the total HT consumption, but now that outputs of 5 watts and over from single mains pentodes or tetrodes are quite common, some relaxation of the efforts to catch up with the mains receiver in the matter of volume output is to be noted. It is probably for this reason that this year push-

**Tendencies in Receiver Design—**

pull output stages in battery sets are in the minority. They are, in fact, outnumbered by single pentode or tetrode output stages roughly in the ratio of 2:1. The average rated undistorted output from the single-valve output stages is between 400 and 500 mW., but it must not be thought that there has been any sudden drop in the output level from battery receivers in general, as the introduction of improved magnetic alloys has resulted in a marked increase in the sensitivity of small permanent-magnet loud-speakers.

In the more expensive sets, which still use QPP output stages, it will be noticed that in most cases the rated output of the set has been reduced from the possible 1.2 watt to a figure in the region of 600 or 700 mW. For this level alterations in the value of the standing current and the reduction in the fluctuations of the mean current make the use of automatic biasing arrangements quite practicable. Thus we find that in battery sets of all types this year automatic bias is the rule, and there can be no doubt that from the general return to this method a big im-

and increased coil efficiency in conjunction with the use of a high intermediate frequency has solved the problem of second-channel interference. At all



Aerodyne Model 296 portable with automatic bias.

events, the omission of the RF stage in conjunction with economies already made in the output stage has ensured that HT batteries this year will be able to give of their best at a discharge rate which gives a reasonable chance for the internal chemical processes to function properly.

Conservation of LT current, although not so important, has also received attention. A larger proportion of sets this year are fitted with illumination for the tuning scale and various methods have been devised for finger-tip control of the dial lamps so that the scale is illuminated only so long as the tuning knob is being used.

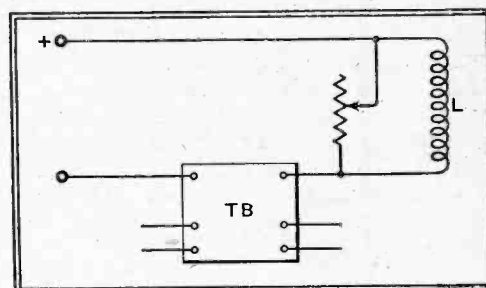
Among portable receivers, which constitute probably the most important sec-

20 lb. The other is the introduction of a short-wave band in the larger battery transportables. Here, if anywhere, is the proof of the general improvement in short-wave technique which has taken place during the year, for in the majority of cases standard short-wave coils are used for the lowest waveband with the frame aerial turns acting as a very abbreviated elevated aerial.

## Safeguarding the Screen

### A Device to Protect the Cathode-ray Tube

**I**N certain circumstances the fluorescent screen of a cathode-ray tube is liable to be burnt by the scanning-beam from the gun part of the tube. The risk does not arise so long as the beam is kept moving, but if for any reason it is allowed to "rest" for some time on one spot on the screen, then damage may be done. As a safeguard, it is usually made impossible to switch on the stream until after the

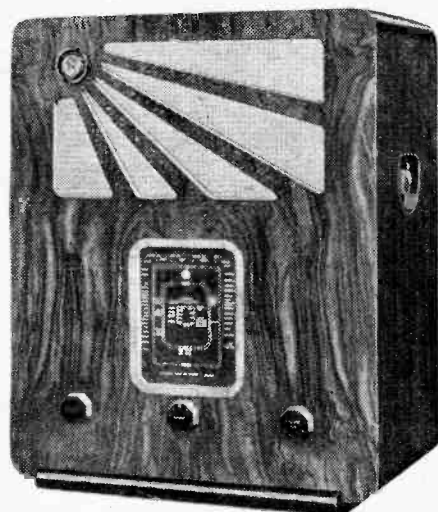


Safety circuit for cathode-ray tubes.

oscillators of the time-base circuit have been brought into action.

But it may happen that the timing circuits will suddenly fail, and so leave the scanning spot stationary on the screen, in which case prompt steps must be taken either to shift it, or otherwise make it harmless. For instance, a "buffer" valve can be inserted across the anode and cathode of the tube, with a negative bias so large that its resistance is practically infinite so long as all goes well. But if the timing circuit should break down, then the bias is automatically reduced so that the valve effectively short-circuits the tube. This, of course, reduces the intensity of the scanning beam to a level at which it cannot burn the screen.

The figure shows another ingenious way of tackling the same problem by arranging the magnet coil L, used for focusing the electron stream, in series with the high-tension supply to the time-base circuits T B. Should the latter fail when the receiver is in operation, the coil L at once goes out of action, and the electron stream instead of being concentrated on a particular spot is promptly "scattered" over the whole screen and so becomes comparatively harmless.

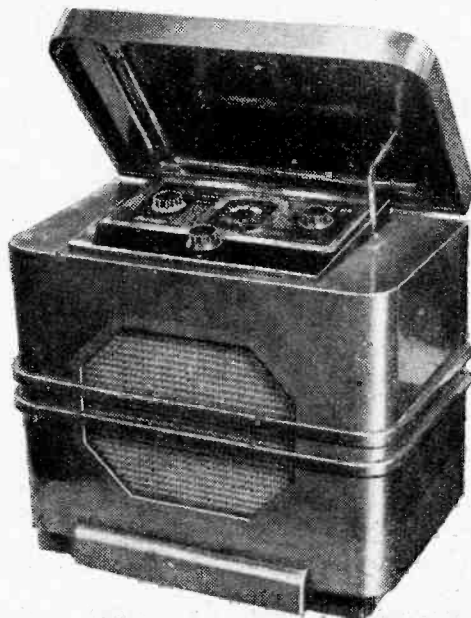


McMichael Model 373 battery transportable with short-wave range.

provement in quality of reproduction throughout the life of a battery will result in the hands of the general public.

Most of the redesigned QPP output stages also incorporate reverse feed-back. Not the least important advantage of this new development is the reduction of the usually high effective resistance of valves of this type. Better results may, therefore, be expected from the small output transformers usually employed and from the increased electrical damping of the loud speaker.

A few two-waveband three-valve "straight" receivers have been carried over from last year, but without exception the new season's table model battery receivers are superheterodynes incorporating at least one short-wave range. Only one in ten employs an RF stage before the frequency-changer, a much lower proportion than last year, so presumably improvements in valves have ensured the achievement of the required sensitivity,



Beethoven Model B848 all-wave superhet battery transportable.

tion of the battery market, two clearly defined tendencies are to be noted. One is the phenomenal increase in the popularity of the miniature portable contained in a case much less than a cubic foot in volume and weighing anything from 10-

# Olympia by Night

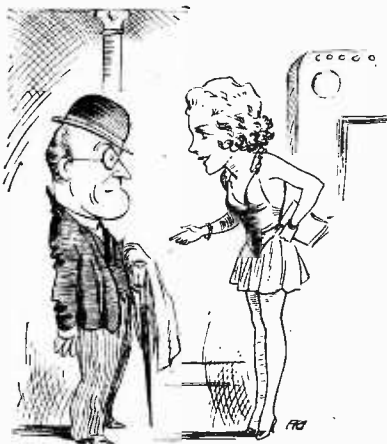
## NOCTURNAL RADIO RAMBLES

**I**N spite of the weariness which I mentioned last week, I fully made up my mind to stick out to the bitter end my determination to pass all my nights in Olympia during the exhibition. After all, it is only in the peaceful stillness of the night watches, when all the garish and distracting activities of the day have ceased to exercise their malignant influence, that you can seriously devote your mind to radio, and examine the exhibits at leisure. I strongly advise all of you fellows to follow my example next year and do likewise; in fact, I should recommend you not to bother to come in until just before the closing hour. You will, of course, have to enter the place not later than this, as people are so confoundedly fussy and if you tried to get in after the lights are out, they are apt to become suspicious.

I must confess, though, that after my experiences on the first two nights of being relentlessly hunted from pillar to post by night watchmen, I nearly gave the job up. It was only because, by pure chance, I fell in with a beautiful girl who took compassion on me that I persisted in my efforts, and very glad I am now that I did so.

### *I Was Low*

It was on the third morning of the Show when I was lingering by a certain stand feeling famished and utterly worn-out as the result of my two previous nights out that my attention was distracted by this vision of female loveliness



Beauty and the Beast.

who was deeply engrossed in the pages of *The Wireless World*. Happening to look up she chanced to catch my eye, and, in spite of my dishevelled and washed-

out appearance, immediately came across with hand extended and with a charming smile, saying that she had just been reading in her copy of *The Wireless World* what I had written concerning the lack of accommodation for repose in Olympia, and she asked if she could help me in this matter.

She was, it appeared, employed on the stand at which I had chanced to linger, and after a little further conversation, made an appointment to meet me in the vestibule at closing time. This appointment I duly kept, and she thereupon conducted me to a temporary office on her stand, the various night watchmen whom we met on our way thither giving us beaming smiles in place of the surly and suspicious looks which I had received on the previous evening. My guide left me to my own devices, refusing an invitation

By

## FREE GRID

to accompany me on my nocturnal prowlings, for, as she rightly said, you must draw the line somewhere, and people might think we were engaged on a joint pilfering expedition.

### *Remarkable Antiques*

Deep in an armchair, I slept soundly for a couple of hours and then prepared to set out on my tour of investigation. I must confess that on the whole I was distinctly disappointed in the show. In spite of the widely advertised glories of the television section, I failed to get any of the sets to give me a presentable picture, and only succeeded in receiving a severe shock for my pains, this being due to my plunging my arm into the works to tighten up a loose nut without first taking the precaution of switching off.

It is true, of course, that the London television transmitter was officially closed down, but, needless to say, I had previously taken the precaution of sending a note to an individual of my acquaintance in the publicity department of the B.B.C. Television section, pointing out that an impromptu performance at 1 a.m. would probably result in far more of the commodity in which he deals, namely publicity, than all the rest of the prearranged shows put together. Once again, however, the B.B.C. let me down, as there

was absolutely nothing doing. I was no luckier on subsequent nights, and eventually gave up in disgust and turned my attention to the other exhibits.

There is, I am sorry to say, little I can add to the description of this year's sets beyond that which appears in other sections of this journal. Not, mind you, that there is nothing I could say, or should like to say, but, after all, the Editor is legally responsible for all that appears in the journal and far be it for me, of all people, to embarrass him in any way. No



A Severe Shock.

doubt most of you know me sufficiently well by now to guess at what is in my mind.

By far the most interesting part of the show was the wireless museum, and I spent two nights very happily examining the exhibits. I was very greatly impressed not only with the excessive antiquity of many of them, but also by their remarkable state of preservation. It said much for the shrewd foresight of their owners—or, rather of the present owners' grandfathers who must have designed them—that they realised that one day they would be interesting museum pieces of great value, and had taken most elaborate pains to protect them from wear and tear.

I am, of course, casting no aspersions on the genuineness of any of them or of the marine-like acceptance factor of the particular R.M.A. official responsible for organising this section of the exhibition. Nevertheless, by the mental process which psychologists call association of ideas, or some such foolishness, my mind could not help harking back to a similar exhibition organised by a certain great emporium up North last year, when the prize for antiquity was awarded to a remarkably fine specimen of a coherer-type receiver which, although of 1899 vintage, bore a couple of terminals labelled LS. Regular readers of *W.W.* will probably recollect that I commented somewhat forcibly about this at the time. (Vide *W.W.*, 22/5/36.)

All the same, I could not help regretting that although no prize was offered, I had not put in an entry myself. After all, woman is, I suppose, the oldest and still the most breakdown-free form of loud speaker, and I could have sent along several remarkably fine specimens of unimpeachable antiquity.

# Remote Tuning Control

By J. F. RAMSAY, M.A.  
(Research Dept., Marconi's Wireless Telegraph Co., Ltd.)

A SATISFACTORY remote control system has many applications in broadcast reception even when this is carried out only for domestic purposes. A small tuning unit can be placed alongside the armchair or bed and the receiver operated with the same facility as if one were actually at its controls. This leads to the possibility of the receiver itself being mounted in a cellar or loft with control units and loud speakers only in the living rooms.

Many attempts at remote control have been made in the past along two main lines of attack. The most widely known system is probably that in which a remotely controlled electric motor is used to drive the tuning condenser, and this is usually most successful when the receiver is fitted with automatic frequency control. The other system involves the location of the frequency-changer in the control unit and the receiver then consists merely of the IF amplifier and succeeding circuits.

An entirely new method of obtaining remote control has been developed by Marconi's Wireless Telegraph Co., Ltd., and it is one which by its neatness makes a particular appeal to the engineer. The control unit forms a link in the aerial lead and aerial tuning is carried out within it. The oscillator of the frequency-changer is fitted to the receiver but is tuned by a condenser in the

## NEW ELECTRICAL SYSTEM USING COAXIAL CABLES

control unit, use being made of the impedance-transforming properties of a resonant line.

Signal-frequency tuning is carried out by the network shown in Fig. 1, in which T1 is the coupling link between the aerial and cable and T3 the link between cable and receiver. T2 is the tuning system, and these components are mounted in the control box which is thus interposed in the cable between aerial and receiver.

Both T1 and T2 are tapered artificial lines and function as impedance-matching transformers. If desired they can be replaced by actual transformers. The function of T1 is to match the aerial impedance

A general view of a pedestal-mounted control box.

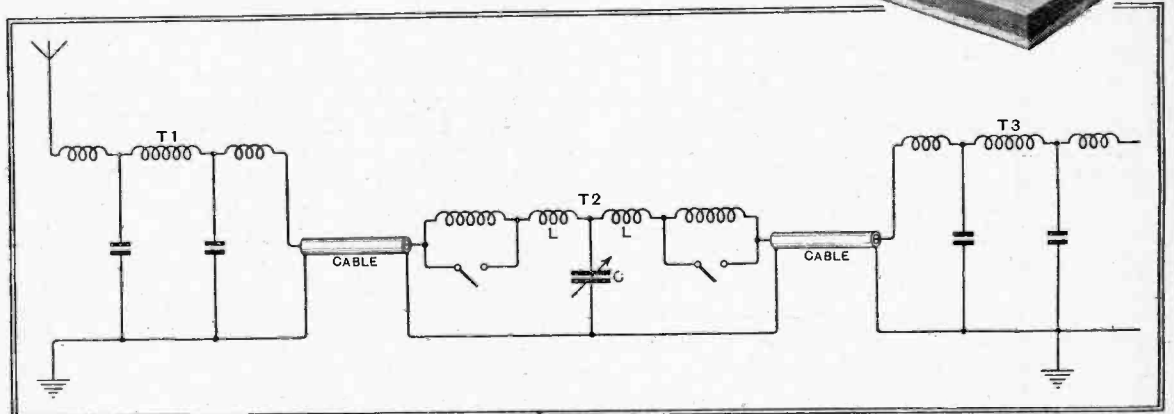


Fig. 1.—The signal-frequency tuning system is shown here. T1 and T3 are the aerial-to-line and line-to-receiver matching sections, and T2 is the tuning circuit in the control unit.



This close-up of the control unit shows the tuning knob T, the wave-change switch S1, the on-off switch S2, and the volume control V.

to the characteristic impedance of the coaxial cable, about 100 ohms resistive over the range of 150-1,500 kc/s, while T3 matches the cable to the receiver.

As the cable is terminated at each end by its characteristic impedance it can be of any length and the tuning unit T2 can be inserted at any point. Moreover, the calibration of the tuner will be independent of the length of cable.

The tuner is of simple type and its operation is most easily visualised by considering it as bisected into two similar circuits of inductance L and capacity C/2. The resonance frequency of each circuit is the same and the voltage developed across the capacity of the primary circuit is transferred directly to the secondary.

Switches are arranged to increase the inductances for the long waveband. The oscillator tuning is equally simple in circuit, Fig. 2, but the mode of operation is somewhat more difficult to understand. The valve is fitted at the receiver and functions as an oscillator in the normal manner. In order to carry out tuning the frequency of oscillation must be varied by altering the effective capacity across the grid coil. This is done by varying Cr in the remote tuning unit.

The operation depends on the properties of a resonant line and the cable acts as a reactance transformer. This means that an alteration in the reactance terminating one end of the cable changes the effective capacity at the other. By suitable design a capacity transfer can be realised in practice over a frequency range which is sufficiently great for frequency-changing purposes.

**Remote Tuning Control—**

The length of cable employed is important and cannot be changed without affecting the performance. It is, however, possible to adopt any desired length if the cable is loaded artificially so that it still has the correct electrical length.

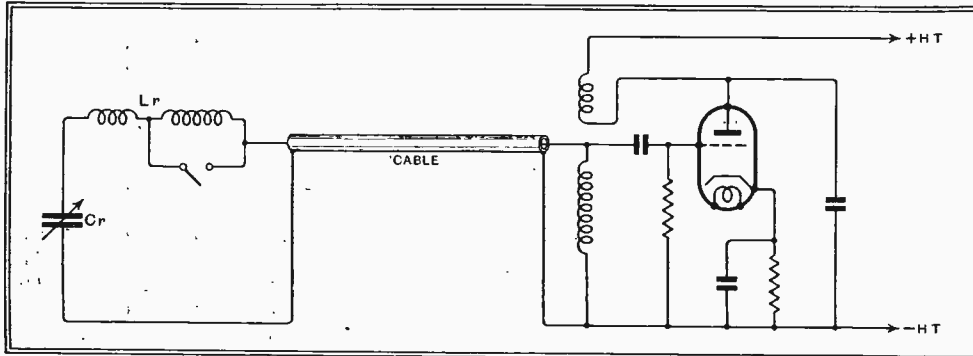


Fig. 2.—The oscillator connections are illustrated in this diagram; Cr and Lr are mounted in the remote control unit.

The components T2 of Fig. 1, together with Lr and Cr of Fig. 2, are mounted in the control unit, together with a volume control which is usually easy to arrange. A variable resistance network in the remote loud speaker speech coil circuit gives effective control in a modern receiver equipped with good AVC. The condensers C and Cr can be ganged.

When a receiver is designed from the start for this tuning system the intermediate frequency adopted is fairly high—about 2.0 Mc/s for medium- and long-wave reception. All signals are thus transferred up in frequency just as in the case of a single-span receiver. In order to obtain high selectivity this high fixed frequency can feed into a second fixed frequency-changer converting it into a comparatively low frequency, such as 450 kc/s, at which selectivity is readily obtainable.

**Push-Button Tuning**

For use with existing receivers a converter unit can be made to precede the set. Such a unit would consist of a frequency-changer giving an intermediate frequency output which is within the tuning range of the set. If the receiver will tune to 2.0 Mc/s this is probably the best frequency to adopt, but with an all-wave set 6.0 Mc/s can be used. When the receiver covers medium and long waves only it is possible to employ 1,500 kc/s. It will be seen that the technique is rather like that of a short-wave converter, but the process is reversed and the incoming signals are changed to a higher, instead of a lower, frequency.

The system of control is one which is particularly pleasing to the technically minded, for it involves no mechanical couplings which can cause backlash and consequent uncertainty of tuning. The tuning is as much electrical, and can be carried out as accurately, as if one were operating the controls of a conventional receiver.

"Push-Button Tuning," now rapidly

growing in popularity, can conveniently be fitted to the remote control unit, the gang condenser being dispensed with, and preset condensers substituted. It will be seen from the oscillator control circuit that the tuning circuit is a series LC circuit. By using a small coil Lr and large

advantage of switching on one station after another "fully tuned in" amply compensates for the restriction of stations available to the number of buttons.

Push-button control also allows fresh originality in station name presentation. One particular example has been designed to offer stations on a geographical basis, a country first being selected and then a particular station in that country. Alphabetical arrangement of the names is also feasible, or if the listener has preferred or favourite stations, these can be set up on the buttons on installation of the apparatus.

It is safe to say that push-button tuning will in time become standard owing to its great advantages and attractions. In combination with remote control it makes for the acme of simplified radio reception.

**Trouble-Shooters**

TWO pocket trouble-shooters, one for ordinary receivers and the other for car sets, have been received from the Radio and Technical Publishing Co., of 45, Astor Place, New York, U.S.A. Each consists of a bundle of cards, one for each symptom, upon which are tabulated possible faults, their tracing and remedy. The price is 50 cents.

**NOTES AND NEWS****How it is Done in Denmark**

THE governing board of the Danish Broadcasting Organisation contains a certain number of members elected by listeners' clubs and associations. Danish listeners in general are, however, complaining that the system is unfair, since the ordinary listeners who belong to no organisation represent about two-thirds of the total number of wireless licence payers and yet they cannot elect any members to the Board. An amendment to the Radio Act is therefore contemplated, and one suggestion is that all licences should be furnished with a detachable voting coupon.

**Swedish B.B.C. Attacked**

THE B.B.C. is evidently not the only broadcasting authority which is accused of making its programmes too high-brow. Listeners in the Swedish province of Scania have sent a protest to the broadcasting authorities expressing their disapproval of the large amount of time devoted to classical music and high-brow lectures. They add that they are compelled, most of the time, to listen to the Danish programmes from Copenhagen, which are of a more popular kind.

**Safety at Sea**

IT is a far cry from the days when a liner's wireless equipment consisted of a spark transmitter and a magnetic detector, as we are reminded when reading of the radio installation fitted on board the newly completed "Orient" liner *Orcaades*. Apart from the normal equipment, consisting of a CW/ICW outfit and an emergency set, the ship carries a SW installation for long-distance work and DF equipment. There is also a special broadcast receiver together with a PA system for distributing programmes to the various public rooms. Two of the lifeboats are fitted with wireless

transmitters and receivers. Another interesting instrument carried by the ship is a Marconi Echometer sounding device. The whole of the installation has been carried out by the Marconi International Marine Communication Co.

**Germany and Free Licences**

ACCORDING to an announcement recently made by the German G.P.O., a total of 800,000 free wireless licences will be granted to unemployed or necessitous persons.

**Radio and Television Course**

THE Borough Polytechnic has arranged a special course in radio communication. The ground covered is equivalent to the City and Guilds examination syllabus; the course will also deal with television. Enrolments are being made on September 20th, 22nd and 24th and the course will commence on September 27th. Full particulars may be had by writing to the Principal, The Borough Polytechnic, Borough Road, London, S.E.1, quoting Reference No. 301.

**Danish "Hams" Celebrate**

THE Danish Amateurs' Association celebrates its tenth birthday on Sunday next (September 5th), and a special convention is being held in Copenhagen to mark the occasion. Several foreign amateurs are expected to attend. Membership has risen from 29 to 306 during the last ten years.

**Australian SW Transmissions for September**

SYDNEY, VK2ME, 9,590 kc/s (31.28 metres).—Sundays: 05.00-07.00, 09.30-13.30, 15.30-17.30 (G.M.T.).  
Melbourne, VK3ME, 9,510 kc/s (31.5 metres).—Week-days: 09.00-12.00 (G.M.T.).  
Perth, VK6ME, 9,590 kc/s (31.28 metres).—Week-days: 11.00-13.00 (G.M.T.).



# Television Receivers

## A Record of Development

**N**O definite trend in development is as yet observable in television apparatus, for there is but little uniformity in the products of the different manufacturers. There is possibly a greater tendency towards the use of cathode-ray tubes with electro-magnetic deflection and focusing, but there are so many examples of electrostatic control that one dare not prophecy the universal adoption of either. Superheterodynes, however, seem to find greater favour with the set maker than the straight set, although there are quite a number of the latter. Single-sideband operation, too, is widely used in view of the considerable increase in stage gain which is possible through the reduced band-width.

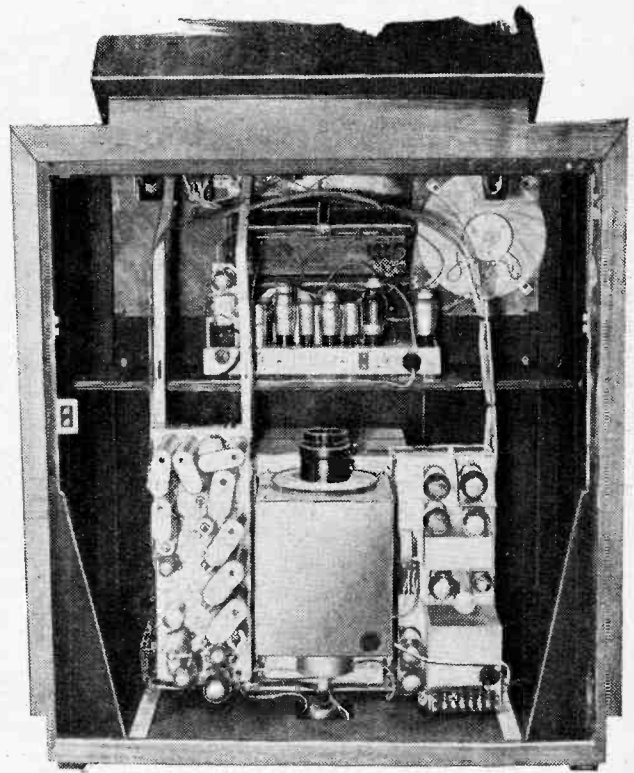
The Ferranti receiver is of this type, and the IF circuits have a pass-band extending from 11 Mc/s to 13 Mc/s. The receiver is tuned so that the carrier falls at 13 Mc/s, and the sound intermediate frequency is consequently 9.5 Mc/s. The radio-frequency stage and frequency-changer are common to both sound and vision, and the signals are separated in the FC anode circuit and fed to their respective IF amplifiers. It is interesting to note that a two-valve frequency-changer is used, a separate triode oscillator being coupled to the grid circuit of an RF pentode mixer.

The sound receiver has two IF stages feeding into a duo-diode-output pentode. The vision receiver, however, has three IF

stages, a diode detector, and one vision-frequency amplifier which feeds the cathode-ray tube directly, the DC component being retained. The output of the VF valve is also fed to a phase-reversing stage, and thence to an anode-bend sync separator. Owing to the removal of the DC component in the intervalve couplings following the VF stage, restoration is necessary for proper sync separation, and this is effected by grid current in the sync separator itself.

A 15in. cathode-ray tube is used, giving a picture of 11½in. by 9in., with magnetic deflection and focusing. The line time-base has two valves—a back-coupled triode saw-tooth oscillator with an amplifier. The frame time-base, however, has only a single valve! The complete equipment is priced at 70 guineas, and is noteworthy for its compact arrangement and for the accessibility of its parts. Everything is mounted on a double-deck chassis which can be removed as a whole from the cabinet. After taking off the tube, the top deck can be hinged back, giving easy access to the under side of the top and the whole of the lower shelves.

Philips are another firm who adopt single-sideband reception with the superheterodyne. An RF stage is used, and feeds into two triode-hexodes having their control grids commoded. A single oscillator is employed, and the resulting sound and vision intermediate frequencies are taken one from each anode circuit. The vision IF is 11.6 Mc/s, and there are four IF stages, a diode detector, and one VF amplifier. DC restoration and sync separation follow this stage. The sound receiver consists of one IF stage and a diode detector, and the output of this valve feeds into the pick-up terminals of a standard all-wave broadcast set mounted in the same cabinet.



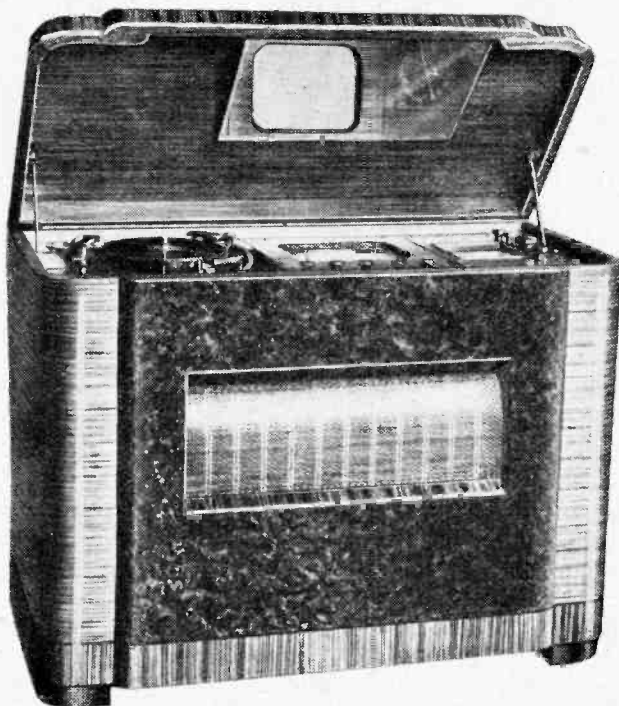
The Philips projection receiver; the tube is in the centre screen with the lens above.

Magnetic deflection is employed, and for the frame time-base there is a gas-triode saw-tooth oscillator followed by a Pen A4 pentode amplifier. The line time-base employs a hard valve oscillator and an amplifier with two Pen 428 valves in parallel, and a diode is connected across the deflector coils to reduce the fly-back time.

The great feature of this receiver, however, is the small tube employed and the large picture obtained. The tube has a diameter of 4in., and operates at 25,000 volts, the picture being projected through a lens with an aperture of  $f/1.9$  and an inclined mirror on to an etched glass screen. The picture size is about 20in. by 16in. A total of 23 valves is used in the television part and five in the broadcast set; the apparatus costs 165 guineas.

Marconiphone adopt a straight set for vision, and use no fewer than six RF stages preceding the diode detector which feeds the cathode-ray tube directly and also the sync separator. Both line and frame time-bases include hard-valve saw-tooth oscillators and pentode amplifiers. Magnetic deflection is used but electrostatic focusing.

The sound signal is picked out of the second RF stage and fed to a triode-hexode frequency-changer; thereafter, there is a single IF stage followed by a duo-diode-triode and an output pentode. A 12in. diameter tube is used and mounted



The R.G.D. apparatus includes an all-wave receiver and automatic record-changer.

**Television Receivers—**

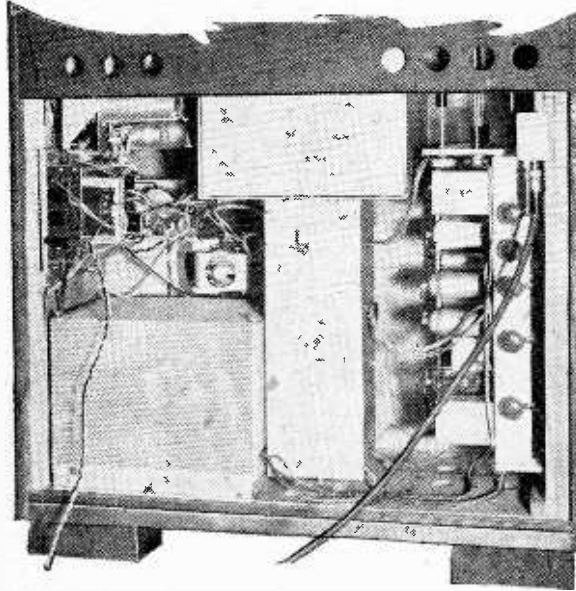
vertically, the picture being viewed through an inclined mirror. This model is the 702 at 60 guineas. The 701 at 80 guineas is similar, but contains an all-wave sound receiver, and a 9in. tube is used and viewed through a lens; the effective picture size is 10in. by 8in. The model 703 is similar to the 701, but has a 12in. tube and an automatic record changer; it is priced at 120 guineas.

The H.M.V. apparatus is very similar, and here again there are three models to choose from. Model 901 (60 guineas) is for television only, but model 900 (80 guineas) includes an all-wave receiver, and Model 902 (120 guineas) has in addition an automatic record changer. The picture size is 10in. by 8in., and the tube is mounted vertically, mirror viewing being adopted.

The vision receiver is a straight set with six RF stages and a diode detector feeding directly into the CR tube. A three-valve sync separator is adopted, and in the hard-valve time-bases back-coupled tetrodes are employed. Magnetic deflection is used but electrostatic focusing.

Another adherent to the straight set is Pye. In the model 4045 at 80 guineas six RF stages are used, and the push-pull diode detector feeds directly into the 12in. CR tube. Two valves are employed for sync separation and four in the double time-base; a gas-triode is used for the frame scanning and followed by a pentode ampli-

fier. The line-scan generator, however, is a hard valve. Magnetic deflection is adopted with electrostatic focusing, the tube being operated at 4,000 volts. A vertical mounting with mirror viewing is adopted.



The interior of the Pye model 4045 receiver.

The sound receiver is also a straight set, and is fed from the anode of the first RF valve. It contains one further RF stage, the detector and a pentode output valve. A separate all-wave broadcast set is included.

A smaller set marketed by this firm is the model 4046 at 42 guineas. This has a 9in. tube giving a picture of about 7½in. by 5½in., and the vision receiver has one RF stage less.

The superheterodyne system is employed by R.G.D. in their receiver which is priced at 175 guineas. There is one RF stage preceding a triode-hexode frequency-changer which feeds both sound and vision IF amplifiers. Two stages are used for sound and four for vision, the operating frequency being 13.5 Mc/s and the bandwidth 4 Mc/s. Double side-band reception is thus adopted. The last IF valve feeds into a diode detector, which is followed by one VF amplifier. Then comes a diode DC restorer, and the signal is fed to the tube and the sync separator, which contains two diodes and two pentodes.

Gas-triode saw-tooth oscillators are employed, and each is followed by a two-valve triode amplifier of the balanced type. Electrostatic deflection and focusing are used, and the tube is mounted vertically. The sound equipment includes an all-wave broadcast set with a push-pull triode output stage.

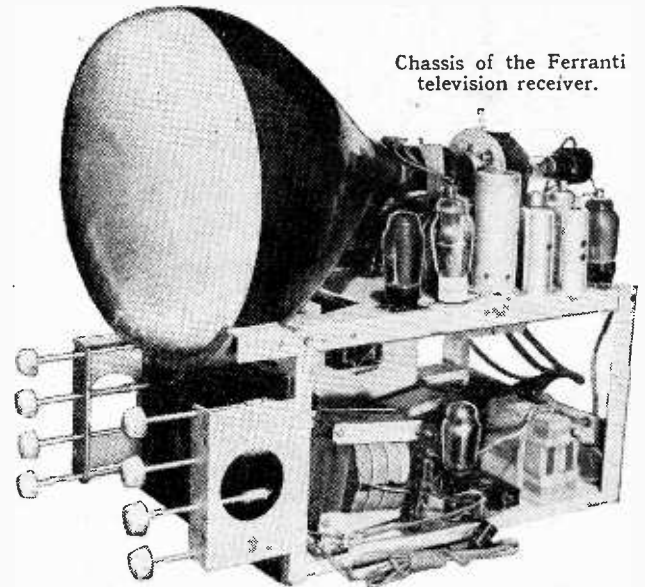
In the case of the Haynes Radio Vi-

ceiver the vision and sound equipment is entirely separate. The vision receiver is a superheterodyne with an RF stage, a triode-hexode frequency-changer, and four IF stages in which both sidebands are retained. A push-pull diode detector is employed and followed by one VF stage, after which comes a diode DC restorer and the sync separator. The 12in. tube is viewed directly and magnetic deflection with electrostatic focusing is adopted. Gas-triodes are used for both line and frame scanning oscillators and followed by tetrode amplifiers. The complete apparatus is priced at 120 guineas.

Ultra Electric are also adherents of the superheterodyne, and the vision receiver has one RF, frequency-changer, and two IF stages. The vision and sound signals are then separated, and each goes through a further IF stage tuned to 6.1 Mc/s and 2.6 Mc/s respectively. A diode detector followed by one VF stage concludes the vision receiver, and a duo-diode output pentode forms the termination of the sound set.

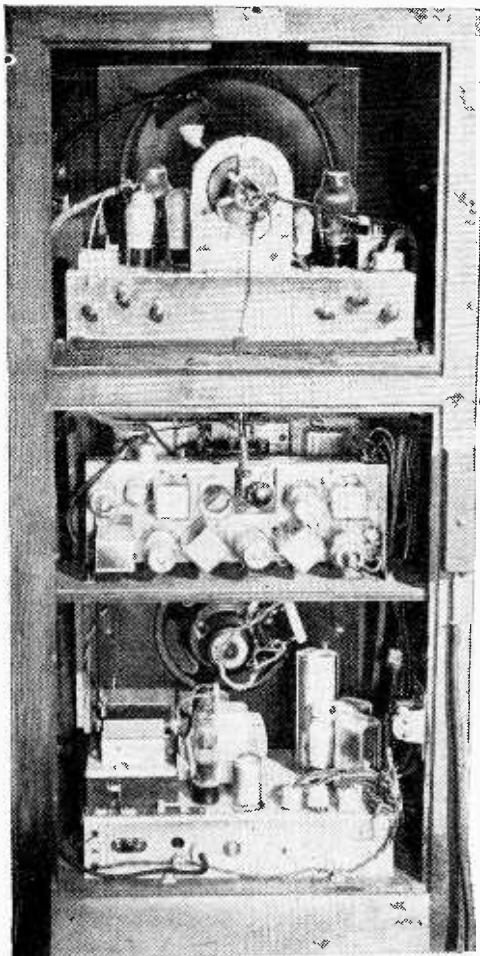
Magnetic deflection is adopted with pentode output valves in the time-base.

Three models are available; the T20 and T30 AW have a picture size of 7½in. by 6½in., and the tube is viewed directly. The former is for television only, but the latter includes an all-wave broadcast set, as also does the T40 AW, which has a larger tube viewed through a mirror and giving a 10in. by 8in. picture.



Chassis of the Ferranti television receiver.

Halcyon adopt two separate superheterodynes for sound and vision. The former starts with the frequency-changer, and has one IF stage with a band-width of 100 kc/s. A duo-diode-triode follows and feeds the output pentode; pre-set tuning is used. The vision receiver has an RF stage before the frequency-changer and four IF stages. The detector is a diode, and there is one VF stage. Gas-



The Baird T11 equipment; the vision receiver is in the centre.

**Television Receivers—**

triodes with pentode amplifiers are used in the time-base, and magnetic deflection is employed in the 12in. tube. Three valves are used for sync separation. The model T100 costs 55 guineas, and the T101, which includes an all-wave receiver, is listed at 70 guineas.

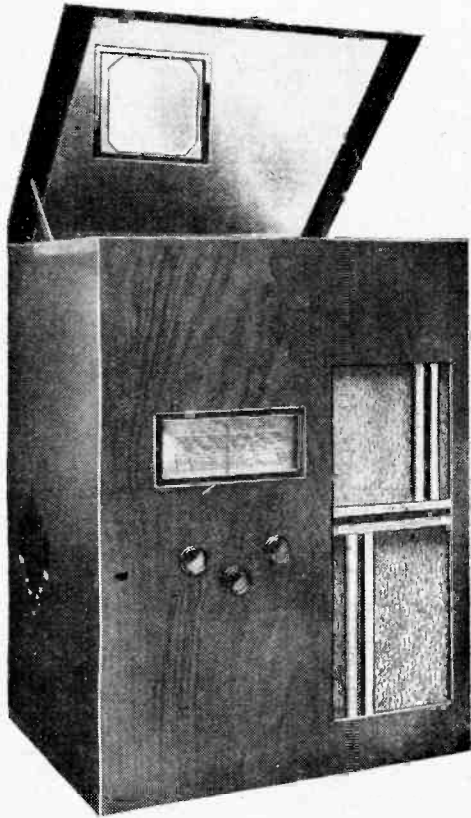
Probably the smallest receiver shown is the G.E.C. model at only £35. It is a table model, and is a superheterodyne commencing with a frequency-changer. It contains essentially only the vision equipment, and must be used with a standard broadcast set for reception of the sound accompaniment. This is done by arranging matters so that the frequency-changer converts the sound signal

while the latter is a table model for television only, giving a picture 8in. by 6½in.

The vision receiver is a superheterodyne with two RF and three IF stages and a

a 15in. tube mounted vertically and viewed through a mirror; the picture size is 13½in. by 10½in. Here again an all-wave sound receiver is included. The T13 is similar, but is fitted with an automatic record-changer. A similar range of receivers is marketed by Bush Radio.

Cossor showed two models, the 137T at 70 guineas and the 237T at 90 guineas; electrically these two are the same, but the latter has gramophone equipment, including an automatic record-changer. The sound receiver covers medium and long wavelengths as well as the television sound.

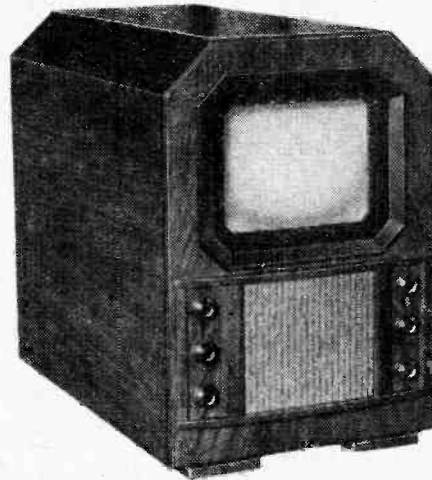


Vertical tube mounting is adopted in this Halcyon receiver.

to a frequency within the medium wave-band so that it can be fed to the broadcast set. A 7in. tube is used and viewed directly.

Several larger receivers are shown. One at 60 guineas gives a picture 10in. by 8in. in size, and the tube is viewed directly. It is a superheterodyne with one RF stage, frequency-changer, and five IF stages; the detector is followed by a VF amplifier, and a diode is used for sync separation. In the case of a larger model at 80 guineas the tube is mounted vertically and viewed through a mirror, while an all-wave broadcast set is included. The largest set of all costs 95 guineas, and has a 16in. tube. In all cases electrostatic deflection and focusing are used.

Ekco have two models, the TC101 and TC102 at 80 guineas and 45 guineas respectively. The former has an all-wave sound receiver and gives a 10in. by 8in. picture,



The Cossor Table Model 437T.

band-width of 4.5 Mc/s. The sensitivity is given as 0.5 mV. Sync separation is effected with the aid of a split-anode valve, and hard valves are used throughout the time-base. Direct viewing of the tube is adopted.

There are four models in the Baird range, the T5C at 47 guineas, the T11 at 70 guineas, the T12 at 85 guineas, and the T13 at 130 guineas. The T11 has a 12in. tube viewed directly and an all-wave sound receiver. The T12, however, has



G.E.C. table model vision receiver.

## Television Programmes

From Monday, September 6th, a special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Sound 45 Mc/s. Vision 41.5 Mc/s.

### FRIDAY, SEPTEMBER 3rd.

11.30 a.m.-12.30, Special demonstration film. 4, 4.20 and 4.45, O.B. from the Pets' Corner, Regent's Park Zoo. 4.5 and 4.50, A display of fashions. 4.25, Claude Dampier and Billie Carlyle. 9 and 9.40, A display of fashions. 9.10, British Movietonews. 9.20, Claude Dampier and Billie Carlyle. 9.50, Film cartoon "Goode Knighte."

### SATURDAY, SEPTEMBER 4th.

11.30 a.m.-12.30, Special demonstration film. 4 and 4.45, Demonstrations by The Women's League of Health and Beauty on Alexandra Palace Golf course. 4.5 and 4.50, Jane Carr, impressions. 4.10 and 4.55, Albert Sandler, violin. 4.20, O.B. from the Pets' Corner. 4.25, Variety Show. 9 and 9.40, Jane Carr. 9.5 and 9.45, Albert Sandler. 9.10, Gaumont-British News. 9.20, Variety Show. 9.50, Film cartoon "Mickey's Good Deed."

### MONDAY, SEPTEMBER 6th.

3, Wilfrid Walter as the Highgate Fisherman. 3.10, British Movietonews. 3.20, Siesta and Portsmouth Point by William Walton. 9, Music Makers: Beatrice Harrison, cello. 9.10, Topiary: a demonstration by Mr. G. A. E. Marshall. 9.25, Gaumont-British News. 9.35, "Risotto."

### TUESDAY, SEPTEMBER 7th.

3, Merryl and Foster, two pianos. 3.10, Gaumont-British News. 3.20, Operetta "Midsummer Madness." 9, Wilfrid Walter as the man who sold his shadow. 9.10, British Movietonews. 9.20, "Midsummer Madness."

### WEDNESDAY, SEPTEMBER 8th.

3, Play Parade. 3.30, British Movietonews. 3.40, Seventy-fifth edition of Picture Page. 9, "James Simpson": a play by Nino Bartholomew. Action takes place at Queen Street, Edinburgh in 1847. 9.20, Gaumont-British News. 9.30, Seventy-sixth edition of Picture Page.

### THURSDAY, SEPTEMBER 9th.

3, King's Cup Air Race. O.B. from Hatfield Aerodrome of competing machines. 3.20, Charles Heslop in "Vamp till Ready." 3.40, Gaumont-British News. 3.50, King's Cup Air Race; another O.B. 9, "Vamp till Ready." 9.20, "Read to-day—Buy to-morrow"—a talk on the methods of present-day advertising. 9.30, British Movietonews. 9.40, The King's Musick: a chronicle of music composed by English monarchs.

# PA Amplifiers

By W. T. COCKING

*PUBLIC address apparatus differs from domestic equipment in two main features—it must have a much larger output and it should have a flexible tone-control and mixing system. In this article the various principles underlying the design of such equipment are discussed.*

**T**RUE public address equipment must have an output of at least 20 watts, for smaller apparatus is limited in its scope and comes more within the classification of domestic equipment. It is true that much indoor PA work can be done with 12-watt amplifiers, particularly when only small halls are involved, but to anyone seriously interested in such work 20 watts should be considered a minimum.

When an output of this order is needed the cost of the necessary equipment may depend to quite a large degree on the mains unit. An output stage embodying triodes operating under Class A conditions will consume some 100/125 watts for HT for an output of about 25 watts. By operating the valves under Class AB conditions the quiescent consumption can be greatly reduced, but the mains equipment must be carefully designed for good voltage regulation, and it is usually necessary to provide a separate rectifier and smoothing equipment for grid bias. Moreover, triodes require a very large signal input so that quite a large amount of amplification is needed.

Pentodes offer the advantage of a considerably greater efficiency in the sense that the anode dissipation is lower for a given output, and they also require a smaller signal input. It is, furthermore, possible to use a pair in Class AB push-pull without running into grid current and yet to retain automatic bias. This is because the operating conditions can be such that the anode current does not fluctuate to any large extent under operating conditions.

A pentode output stage, however, has the disadvantage of a high output impedance with consequent poor damping of the speakers. This effect is quite important and is responsible for much of the dislike which pentodes have incurred. It can,

however, be removed by the use of negative feed-back, but at the expense of amplification. By suitable design an amplifier can be obtained which has about the same gain and the same output impedance as if triodes were used, but which retains the power efficiency of the pentodes.

Feed-back is extremely important in modern amplifier design and its effects are quite easy to estimate. If the voltage gain between the input and output terminals without feed-back is  $A$  and the attenuation of the feed-back path from output to input is  $B$ , then in most aspects the performance is modified by the factor  $(1+AB)$ . The gain is divided by  $(1+AB)$  and the range of frequencies over which the amplification does not fall below a given figure is multiplied by this factor. The variations in gain with changes in supply voltages and component values are reduced, as also is the amount of amplitude distortion. With the proper circuit the output impedance is divided by a factor which is usually somewhat greater than  $(1+AB)$ . It should be noted that  $A$  and  $B$  may be, and usually are, complex numbers.

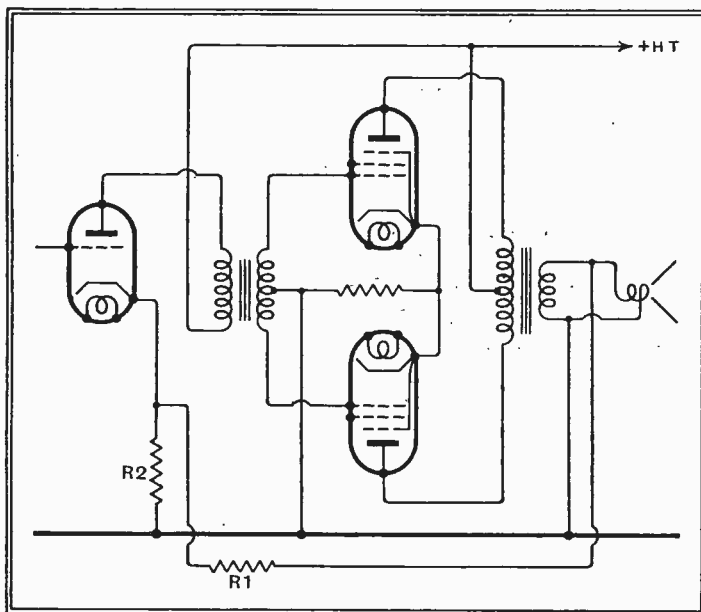


Fig. 1.—The basic circuit of a push-pull pentode output stage with negative feed-back.

No difficulty is experienced in applying feed-back over a single stage, for phase-shifts cannot normally exceed 90 degrees. The full advantages are not obtained

## CONSIDERATIONS AFFECTING THE DESIGN OF EQUIPMENT FOR LARGE OUTPUTS

when it is applied over only one stage, however, for the reduction in gain in the case of an output stage necessitates a large output from the penultimate valve, and there is often a risk of overloading at this point. In general, therefore, it is best to apply the feed-back from the output to the grid circuit of the penultimate stage. When the output stage is of the push-pull type, we are almost forced to derive the output from the secondary of the output transformer.

The amplifier is then likely to take the

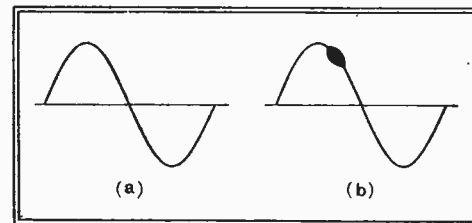


Fig. 2.—With a sine wave input (a) the output wave form may be as shown at (b) when the operation is incorrect. The blister on the curve is due to oscillation at a particular input voltage and causes serious distortion.

form shown in Fig. 1, and quite large phase-shifts can occur in both transformers. With two transformers it is inevitable that at some frequencies outside the normal working range the phase-shift should reach 180 degrees, and the feed-back is then not negative but positive. In other words, there is regeneration at these frequencies. This does not matter provided that the amplification is not great enough for instability to occur. For the avoidance of oscillation it is imperative that the product  $AB$  be less than unity at any frequency for which the phase-shift reaches 180 degrees.

### The Intervalle Coupling

It is found in practice that if an amplifier is built to the circuit of Fig. 1 with ordinary components self-oscillation occurs at a frequency above audibility. It is the writer's experience that most of the trouble occurs in the intervalle transformer and that it is not possible successfully to employ an unloaded transformer. The primary must be damped, either by means

**PA Amplifiers—**

of a shunt resistance, or, better, by the use of a low-resistance valve, and the secondary must be loaded with a shunt resistance preferably equal to the valve resistance multiplied by the square of the transformer ratio.

Under these conditions, the phase-shift in the transformer is greatly reduced and it is usually possible to secure stable operation. Stable operation in the quiescent condition, however, does not necessarily mean that it will be stable with a signal input. Investigation with the cathode-ray oscillograph has shown that oscillation over a portion of the signal wave may occur, so that with an input wave of the form shown at (a) in Fig. 2 the output may be like (b). This will obviously result in very serious distortion indeed.

With suitable loading on the transformer this effect is very small and can be avoided by introducing a suitable phase-shift in the feed-back path at high frequencies. An experimental amplifier with a high-resistance shunt to the transformer secondary and a low-resistance shunt to the primary proved quite stable with normal input voltages, but the effect shown in Fig. 2 appeared with a large input. An investigation of the frequency response curve showed a gradual rise with frequency until at 20,000 c/s, the highest frequency used, the response was +14 db. Change in the transformer loading reduced the response to about +4 db. and considerably improved the stability.

Matters were greatly improved, however, by introducing a phase-shift in the feed-back circuit by the simple expedient of shunting R1 in Fig. 1 by a condenser. This increases the feed-back at high frequencies and so tends to reduce the gain, and it also introduces a phase-shift in the

performance than this could not be desired.

The input/output curve proved to be nearly straight up to about 18 watts output, indicating negligible harmonic content. Examined with an oscillograph the waveform showed no serious distortion until an output of 28 watts was reached.

Turning now to the early stages of the equipment, PA apparatus differs from ordinary gear in necessitating an effective tone-control system and the ability to mix two input channels. In the reproduction of music, it is often desirable to increase the bass response, if only to compensate for the deficiencies of recordings, while it may also be desirable to reduce the treble

response to prevent excessive needle scratch. On speech, however, maximum intelligibility is often obtained with a reduced bass response and sometimes with an accentuated treble.

Two tone-controls are desirable, therefore—one which permits the bass response to be increased or reduced at will and the other to give the same effect on the treble.

As regards the input, it is thought that three input channels meet most requirements. Two channels with a fade-over control permit the use of two pick-ups, while the third channel with its own gain control enables the output of a microphone to be mixed with either pick-up.

## Olympia's "Sideshow"

Television Booths — The G.P.O. — Museum — B.B.C.

**A**S has been the case since 1933, when the R.M.A. introduced the idea of a Theatre at the Radio Exhibition, the theatre was again the most sought-after sideshow at Olympia. This year it is larger than before, seating nearly 6,000. The stage backcloth arranged as the interior of a studio is very effectively carried out.

The arrangements for the viewing of television receivers this year are excellent. Intending viewers, on application to a box office, are given tickets with a stated time for them to view the receiver of their choice. They can then see a show sitting in comfort in one of the fourteen booths.

There have been continuous queues at the offices waiting for tickets throughout each day. After viewing a few receivers ranging in price from £35 to 120 gns., it was apparent from the remarks of the general public that, whilst being impressed, they are of the opinion that television is as yet a luxury of the few. The question on the lips of many was, "Are sets likely to be consider-

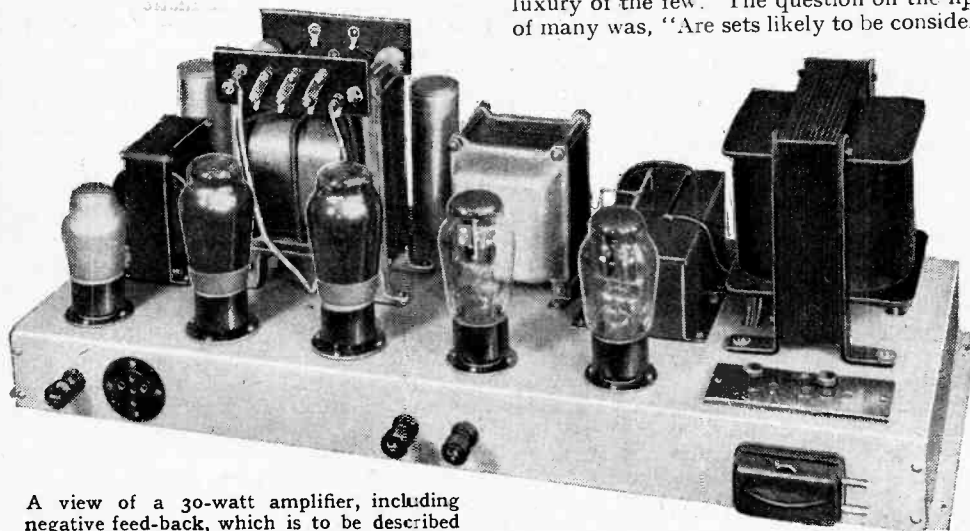
greatly increased. Among the many antiquities shown is the apparatus used by the British Broadcasting Company at the old 2LO transmitter. Many receivers of yester-year are to be seen, among them being the first commercial single-dial super-het marketed by Marconiphone and the famous *Wireless World* Everyman Four (a straight set).

The trend in the design of microphones as used by the B.B.C. from the time of the old hand model is represented in the museum. The museum is certainly well worth a visit if one has the time to sort out the material and eventually read the inscriptions—if they can be found.

The B.B.C. are not presenting anything very spectacular. One wonders why more was not made of television by something such as a miniature studio and transmitter, but on putting the question to an official the answer came, "Where is the money coming from?" The Empire Broadcasting Service is the main display of the B.B.C. This shows, by six maps illuminated successively, the various times at which the six transmissions from Daventry take place and the areas covered by them.

The G.P.O. stand is devoted to the means of suppressing man-made static. One half of the stand is given to radio interference and the other to television interference. The latter, during the hours of B.B.C. transmissions, shows a television receiver the picture of which is spoiled by interference from an adjacent motor, which when completely screened results in a marked improvement.

The theme of the Show, "The world is yours with modern radio," is effectively portrayed at one end of the hall. It depicts aerials flashing out messages, while the globe, surrounded by a cloud, with, below, the names of ten countries, is intermittently lit by hundreds of lights.



A view of a 30-watt amplifier, including negative feed-back, which is to be described in a forthcoming issue of *The Wireless World*.

opposite sense to the changes in the amplifier, thus increasing stability. With suitable component values the amplifier had an overall response curve measured between the input terminals and the output transformer secondary (loaded with a resistance of 16 ohms), flat within ±0.7 db. from 20 c/s to 20,000 c/s. A better

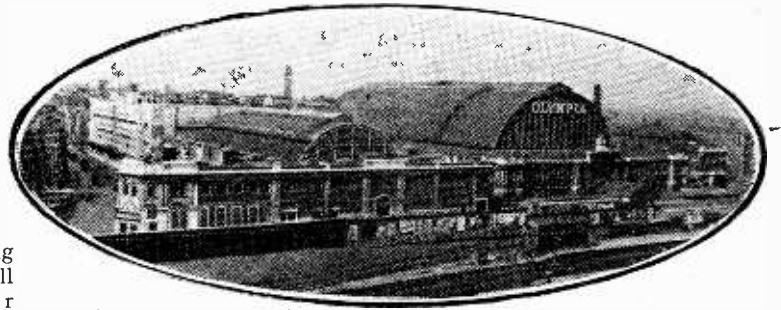
ably reduced in the near future?" and the answer invariably was in the negative.

An innovation of this year's Show is the inclusion of the Radio Museum. There is no dearth of interesting exhibits, but the pity is that they are not displayed in a more orderly and gracious way, for by so doing the value of the museum would have been

## Osram Valve Guide

**A** NEW edition of the Osram Valve Guide has been produced by the General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C.2. This gives details of all modern valves manufactured by this firm, including the new International range. Valve base connections and a number of circuit diagrams are included. The guide is available free from the G.E.C.

# "Diallist" at the Wireless Show



**F**RANKLY, I went to Radiolympia this year expecting to be rather bored. I anticipated that there would be row upon row of cheap and rather nasty little sets with just here and there something bigger and better to show up the others. I hadn't been inside Olympia for more than a few minutes when I realised how utterly wrong my mental forecast had been.

Cheap sets there certainly were, lashings of them. But with very few exceptions they were far from being nasty. Two things impressed me straight away. The first was that, taking them by and large, sets were far easier to look at than in previous years. There were, of course, a certain number of cabinets of the artful and crafty type and a few whose design a friend accompanying me described as "sixpence-ha'penny bizarre." But in the great majority of instances both the design and workmanship of the cabinets displayed were genuinely pleasing. Of last year's Show I wrote that wireless sets still looked too much like wireless sets. This year they've become attractive pieces of household furniture and designs are such that they will fit in happily with the arrangement of almost any kind of room.

Appearances mean a good deal; to your real wireless enthusiast, however, the true beauty of a set is to be found not in its externals but in the internals of the cabinet. And this is the second point that impressed me: the sets of 1937, low-priced though many of them may be, show distinct advances in design, in layout and in make-up. Quality has certainly not been sacrificed to cheapness by reputable firms, and there's not a doubt that this year the listening public is going to have better value for its money than ever before.

## Short Waves.

The slogan of Radiolympia was "The World Is Yours With Modern Radio." It's a good slogan, though I hope it won't lead to the making of wild claims for the smaller sets. With a first-rate three-valve straight set, whose short-wave range is designed with the utmost care, your expert can do pretty well in the way of short-wave reception. But tuning, except in the case of the most strongly received stations, can be by no means a simple business. And I don't see much of the world being mine were I the user of a low-priced set of this kind with fierce and ploppy reaction, or a rough and not very slow-motion condenser drive!

Really it's rather curious that the straight three-valve set should linger on at all, for small superhets for either mains or battery operation can be purchased for a very little more. I suppose that such sets retain a certain popularity, particularly in battery-operated form, because the man in the street thinks that they are a good deal more economical to run than the superhet. Actually, that needn't necessarily be so; several of this year's battery superhets draw 10 milliamperes or less from the high-tension battery, whilst three-valve receivers seldom need much less and sometimes take more. When it comes to mains sets the cost of

current for running purposes is so small that it's neither here nor there.

I have never cared much about the three-valve straight as a broadcast receiver; its performances depend too much on the critical use of reaction for my liking. The big straight set, on the other hand, is a very different affair, and I'd hoped that there might be several on view. Except, however, on *The Wireless World* stand they were rarities except as a combination. I think we'll see more of them later on.

When the 1937 Radiolympia comes to be summed up in a word or two in future lists of historic dates it will probably be known as the show, at which the "all-wave" receiver first became really popular and the televisor was no longer relegated as much as possible to the background by an industry which feared that it might be the big bad wolf of radio. Television I'll leave for the moment. I want to deal now with the "all-wave" receiver of 1937.

There's not much point really in dealing with any other kind of radio set seen at the Exhibition, for these were in a very small minority. It is realised in this country today that the up-to-date receiving set must be of the "all-wave" kind. Last year there were a good many of them, though only those priced at something about the £15 limit could be taken—I speak generally—at all seriously as short-wave performers. There were less costly "all-wave" sets, but in August, 1936, many of these were really two-waveband sets with a short-wave range tacked on by harassed designers, who did their best in the circumstances and hoped for the best. Soon after last year's Exhibition some much better cheap "all-wave" receivers made their appearance, but many of them had one serious defect from the user's point of view.

In designing a small "all-wave" receiving set it may not be difficult to evolve circuits and valve combinations which, beside being able to bring in all of the worth-while stations on the medium and the long waves, will also be capable, both in theory and on the laboratory test bench, of receiving an impressive number of short-wave stations.

But such sets when produced in commercial form will not enable the man in the street to get much out of his short-wave range unless the tuning arrangements are simple and straightforward.

Give the aforesaid man in the street a tiny dial, whose short-wave portion is so cramped that the whole of the 19-metre band may be represented by a thick pointer making a movement of, perhaps, a quarter of an inch, and you needn't be surprised if he soon gives up short-wave reception as something much too chancy and too difficult for him.

But discard the idea, as this year's set designers have happily done, that the appearance of a wireless set as a piece of furniture is spoilt unless the dial is minute and unobtrusive; give your man in the street a large, easy-to-read dial with a positive slow motion drive to his tuning knob, and he realises quickly that there's nothing so

very difficult after all about short-wave reception.

Should I be exaggerating if I said that small "all-wave" sets are very much like one another as regards *potential* performance, but as regards *actual* performance the receiver with a big clear dial and the smooth genuine slow motion drive will enable the short-wave beginner to put up nearly as good a show as the expert? I don't think I should, do you?

And that's just one way in which these small "all-wave" sets of the present year are so good and such value for money. The bigger dial, the clearer dial, the finer movement of the condenser vanes are outstanding features of the lower-priced sets of 1937.

## Good Big Sets.

The rather bigger sets, those costing roughly from 12 to 16 guineas have many interesting features. In particular I noticed a tendency to return to the visual tuning indicator, that almost essential device for getting the best out of a sensitive superhet, and to split the short waves covered into two or more ranges. Few of the smallest short-wave sets tune down to below about 15.5 metres; a good many of the bigger ones take in the 13-metre band. One interesting receiver covers the short waves between 12.5 and 51 metres in no less than six full-scale bands.

There were rather fewer really big sets than I had expected, though probably more will make their appearance this autumn. One nine-valve set with many attractive features was priced at only 18 guineas. Others containing from 10 to 12 valves and incorporating the majority of the more useful refinements of modern radio reception ranged in price from 24 to 30 guineas. They are beautiful instruments, tuning down to 7 metres or below, and there should be a ready sale for them if only manufacturers will help the public to appreciate their great advantages over the smaller kind of receiver.

There wasn't much doubt about the general interest in television. There were crowds around the stands where televisors were displayed and outside the demonstration rooms before each programme began.

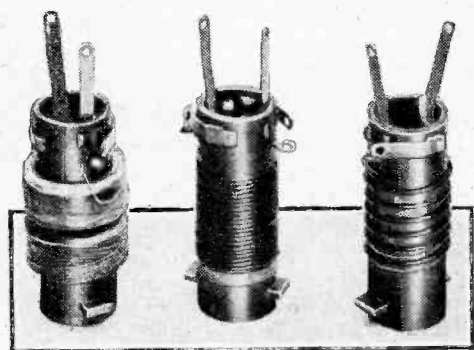
I found opinions sharply divided over prospects of the low-priced small screen instruments which have made a surprise appearance. Some were emphatic that a receiver giving so small an image would not sell; others held just as strongly that it would go like the proverbial hot cakes and would serve to give television its long-delayed "boost" into popular favour. Those expressing this view believed that people would readily put down £40 or less for a miniature televisor and later would go on to a bigger instrument.

On the whole, a first-rate show—quite the best that we've had for several years. My only regret was that I could not pay half as many visits as I should have liked!

# Components and Accessories

## What the Show Reveals of the New Season's Products

IN order to appreciate fully the improvement effected in components this year it is necessary to pay close attention to small details, for it was not expected that any drastic changes would be revealed by the new season's products. It is, as yet, a little too early for television to have had a very marked influence in this direction, though everywhere there is evidence that the requirements of this new aspect of wireless is receiving close attention.

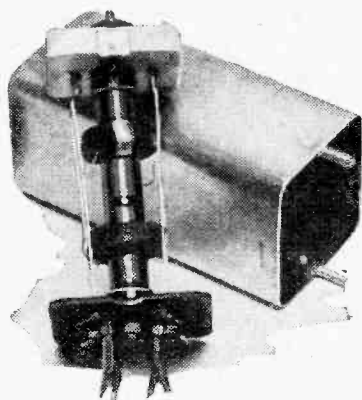


Wearite Type P unscreened coils.

The most marked of all changes is, perhaps, the newer additions to coils and coil units to take in the short waves. All-wave reception, a prominent feature of the new season's sets, is provided for in coil units, examples of which are the Bulgin five-range coils, Models C.64 and C.66, the Wearite Triogen coil and the Varley three-band superhet coil unit, Model BP120.

The first-mentioned is of particular interest in view of the wide wave-range covered, as it takes in the ultra-short, as well as the short-, the medium- and the long-wave bands. In the Varley and Wearite coil assemblies one short-wave range is provided.

Attractively finished components housed in expensive cases are undoubtedly a joy to behold, but many home constructors will agree that these attributes could well be dispensed with and parts more in keeping with those customarily employed by set makers be made available to them. The products



Varley skeleton-type IF transformer, Model BP122.

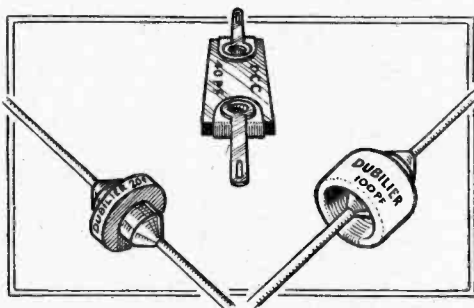
of some makers, such as Bulgin, for example, have been obtainable for some time in what is described as "skeleton" form.

Such components could, of course, be supplied at prices appreciably lower than hitherto.

Wearite has introduced a range of coils typical in every respect to those used by set makers and which are described as the "P" type. They are wound on bakelite tubes  $\frac{5}{8}$  in. in diameter and  $1\frac{1}{2}$  in. long, and fitted with soldering tags. Fourteen coils in the series cover practically all requirements of all-wave reception, for the smallest tunes down to 12 metres and largest is a long-wave coil. Prices range from 1s. 4d. to 1s. 9d. each.

Bulgin has a long range of two-band coils in screening cases and with soldering tags, also IF transformers in a variety of patterns for 465 kc/s and 110 kc/s, including some variable selectivity models. A new series of "Square-Can" coils, signal and IF pattern, is now available and all requirements are catered for, while their prices are quite reasonable.

A new Varley product is a series of IF transformers with loose leads brought through the base and for mounting on metal chassis. They are described as Skeleton Type and are available for both 465 kc/s and 110 kc/s amplifiers. One, the Model BP124, is a variable-coupling type and costs 8s. 6d.



Dubilier ceramic and metalised-mica condensers.

There are many applications for a solid-dielectric condenser which can be made in very small capacities, providing a high degree of stability under varying atmospheric conditions and frequency can be assured. These special requirements are being met by Dubilier with a range of condensers in which ceramic material is employed as the dielectric. They are quite unlike the familiar pattern of fixed condenser, being made in the form of discs, cups and tubes. Some of the very small capacities, of the order of a few m-mfds, consist of very small tubes no thicker than a matchstick.

The plates actually consist of metal deposited on the ceramic in such a way that it penetrates into the pores of the material so that no film of air exists between the plate and the dielectric. With this method of construction extremely high stability is

achieved; furthermore, it is possible to produce condensers within very narrow tolerances to the required values. About 2 m-mfds. is the smallest size made, and 1,200 m-mfds. is the largest in this series.



T.C.C. high-voltage condensers for use in television apparatus.

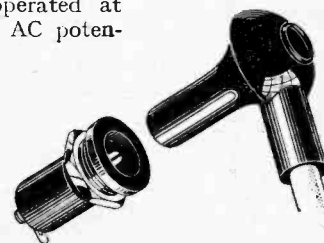
Another form possessing many of the aforementioned features employs mica as the dielectric, the plates being metal deposited on both sides and some suitable protecting plates are fitted on the outside. Alternatively, the condenser element is enclosed in a ceramic case or in a moulded bakelite case, this form of assembly being used mainly for the larger capacities, as this style can be made in sizes up to 0.1 mfd.

Polar-N.S.F. has a range of silvered-mica condensers, and T.C.C. are producing condensers with ceramic material as the base. Other condenser developments take the form of new models designed especially for the high operation potentials met with in CR tube work and in television sets, and both Dubilier and T.C.C. have a comprehensive series which includes all the normal capacity values required for this purpose.

Some high-voltage condensers in tubular containers and in capacities of from 0.001 to 0.1 mfd. are made by Bulgin, the working voltages ranging from 2,000 to 5,000 DC.

There is to be found among the Bulgin products many small items designed especially for use in television sets and other apparatus operated at high DC or AC poten-

Belling-Lee 6,000-volt HT plug and socket connector.



tials. For example, there is a flexible coupler fitted with a porcelain insulator, stand-off porcelain insulators, special high-voltage plugs and sockets in multi-way types to withstand 6,000 volts DC between contacts, and CR tube holders, to mention but a few of the many special parts produced by this firm.

Belling and Lee has also developed a

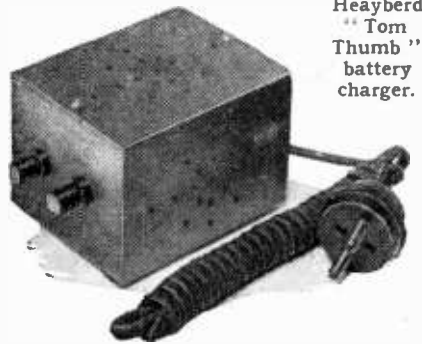
**Components and Accessories—**

long range of connectors, plugs and sockets and insulated parts for use in high-voltage circuits. One such item is a valve-holder designed for use in circuits of 11,000 volts, yet it costs only 1s. Then there is a shrouded plug and socket completely insulated and for use as a connector in 6,000-volt circuits. This costs 4s. 6d.

This firm has designed a range of television di-pole aerials, with and without reflectors, and a special 80-ohm impedance transmission cable, No. 344, which has very small loss at all radio frequencies up to about 60 Mc/s. Television di-pole aerials are made also by Bulgin.

The high DC voltages required for CR tube equipment and for television are only economically obtainable from an AC source, so that several firms are including the

accumulator from the gas supply, and it is claimed to be very economical in use. The output is 3A and it consumes 3 cubic feet of gas per hour.



Heayberd "Tom Thumb" battery charger.

Though a thermo-electric generator is not a new innovation, it is claimed that in the new Milnes model all the difficulties and troubles associated with the earlier devices of this kind have now been overcome.

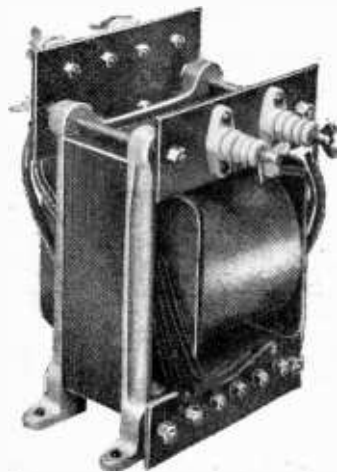
Though the carbon microphone is still very largely used, and as a general-purpose instrument satisfies many requirements, its erstwhile popularity is being challenged by

types, the former having Frequentite insulation, while the latter is insulated with DL9 material. Prices are quite reasonable and range from 14s. 6d. to 35s.

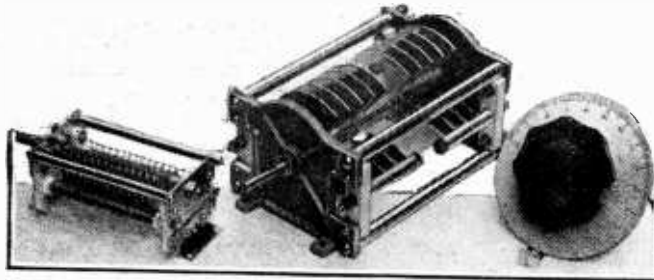
Stratton also has some new dials; one is a precision style for instrument use and incorporating a slow-motion drive, while the other is identical but is a direct-drive pattern.

There is also a new condenser drive among the Polar products of Wingrove and Rogers. Its principal feature of interest is that whilst two reduction ratios, viz., 10 to 1 and 50 to 1, are provided, only a single knob is employed.

Normally, the dial is driven at a 10 to 1



Sound Sales high-voltage mains transformer.



Eddystone transmitting condensers and new precision dial.

A miniature valve-holder for the Mazda D1 Midget diode valve has been produced by Belling and Lee. The valve and holder are shown standing on a half-crown piece to afford easy contrast in size.



reduction, but the vernier control can be brought into use at any moment merely by reversing the direction of rotation. It maintains the higher ratio for about three divisions of the 0-100 scale. Known as the New Horizontal Micro Drive, it has station names engraved in their correct order on the dial as well as a 0-100 division scale, and the price is 9s. 6d.

In addition to producing the most extensive and varied range of components it is possible to conceive Bulgin has introduced a new deaf-aid pocket amplifier which measures only 7 1/2 in. x 3 in. x 2 in. It is a single-valve model, has a built-in carbon microphone, self-contained batteries, and, complete with headphone, costs £5 10s.

Ardente has for long specialised in the

special mains transformers and rectifiers needed for this purpose. Sound Sales and All-Power Transformers are interested in the production of the first-mentioned class of component, while metal rectifiers of high-voltage and low-current output are made in various patterns by Westinghouse.

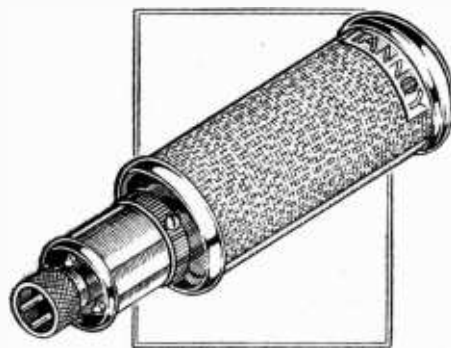
Westinghouse has this year introduced a new series of rectifiers which, though giving output voltages and currents of the same order as the models they replace, is now supplied without cases and at a reduced price. This applies to both HT and LT types.

In connection with LT supplies from an AC source, it is of interest to record that a bijou trickle charger for 2-volt cells and giving 0.5 amp. output has been designed by Heayberd. Known as the "Tom Thumb" charger, it measures 3 1/2 in. x 2 1/2 in. x 2 1/2 in. overall and costs 12s. 6d. only.

There is no lack of battery-charging equipment, but what must surely be a unique type is the new Milnes Thermo-Charger. Its purpose is to charge an LT

other patterns, viz., the moving coil, the ribbon and the crystal microphone.

Reslo has introduced a new moving coil, or dynamic, microphone, and Ardente, Grampian, Shaftesbury Microphones and Tannoy sponsor the new ribbon velocity

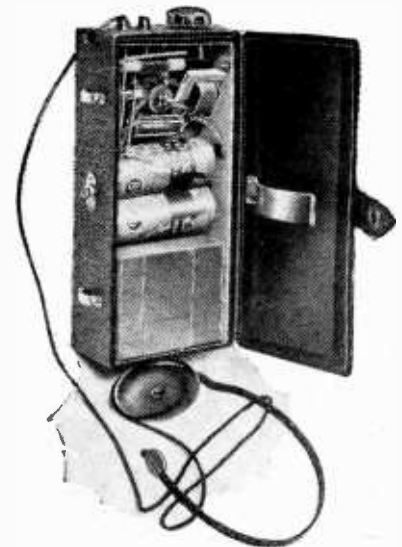


Tannoy Ribbon velocity microphone.

pattern. The Tannoy model is new and has uni-directional properties.

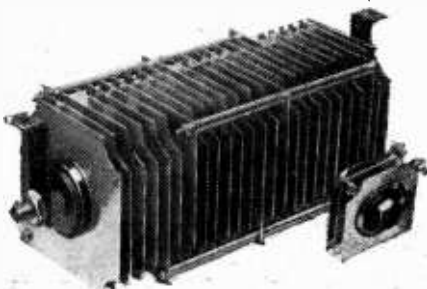
Telsen has developed two sound-cell crystal pattern microphones, one of which is fitted with a spherical head and has an all-round response, the other is directional.

There is very little to record in connection with new developments in short-wave components. Perhaps the most interesting is the new range of Eddystone transmitting condensers introduced by Stratton and Co. Rigid construction, thick vanes, with wide spacing to withstand high operating potentials constitute some of the main features. They are made in high- and low-voltage



Bulgin pocket deaf-aid unit.

design of this type of equipment, and hearing aids of every description, with or without frequency correction to suit individual requirements, are available.



Westinghouse uncased metal rectifiers.



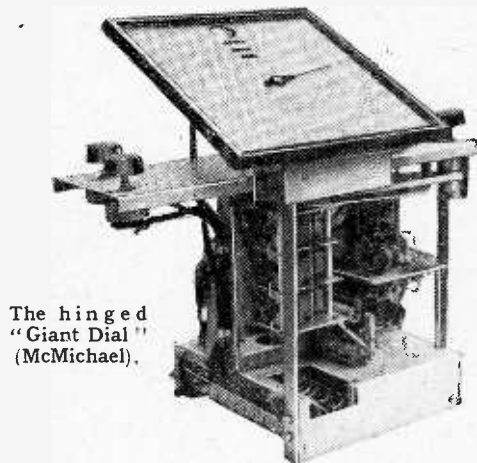
# Mechanical Features

## Non-electrical Details of the New Sets

**I**N the essentials of their construction well over 99 per cent. of the new season's sets are basically similar to their forerunners of 1936—the same shallow box metal chassis with the larger components on top and the smaller parts

worm drive, and the neatness of the edge-wise operating discs helps the cabinet designer to attain cleanness of line. Switch levers are mounted on axes concentric with the edgewise discs.

Another tuning device is the Ferranti "Magnascopic" auxiliary dial, an optical device for the accurate "logging" of short-wave stations which this year appears in improved form. In the Haynes receiver the meter which serves as a tuning indicator is mounted in the centre of the tuning dial, and so a large ball-bearing axis for the pointer is provided; this confers the advantage of an exceptionally open wide-angle scale of about 300 degrees.

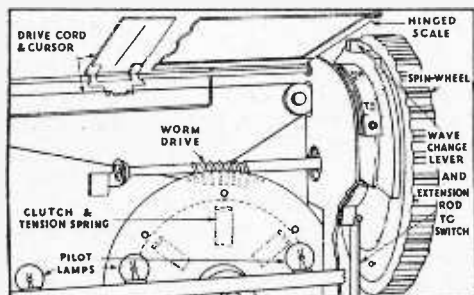


The hinged "Giant Dial" (McMichael).

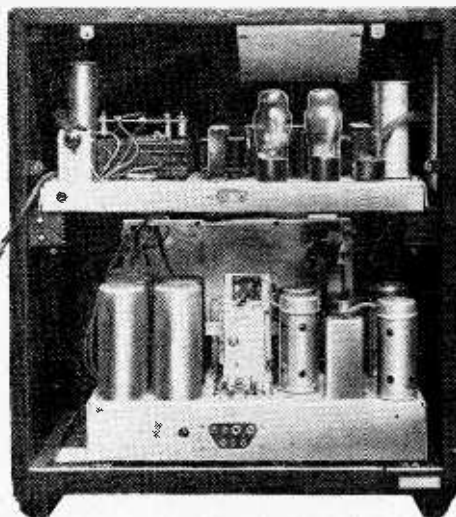
and wiring below. Among the very few exceptions to the general rule are the Philips and Mullard low-priced super-heterodynes, where economies in material have been effected by securing components to the inner surface of the bakelite cabinet. Another exception that should be mentioned is the Eddystone ERA7, where the chassis and coil box are rigid die-castings.

With regard to details, there are many improvements, most of which are, as usual, in the tuning dials and controls. Although some of the innovations are perhaps of little fundamental importance, one should hasten to add that the majority of condenser drives work wonderfully smoothly even in cheap sets; this is as it should be, as nothing is more exasperating than a "rough" drive—unless it be one with backlash.

The flywheel idea has been elaborated this year. Halcyon, pioneers of this system, retain it in the form of a heavy flywheel, rotation being transmitted to the condenser pulley through a cord drive; the vertical pointer traverses a particularly large horizontal scale. In the Ekco "spin wheel" system there is a



Details of the Ekco "spin wheel" tuning drive.

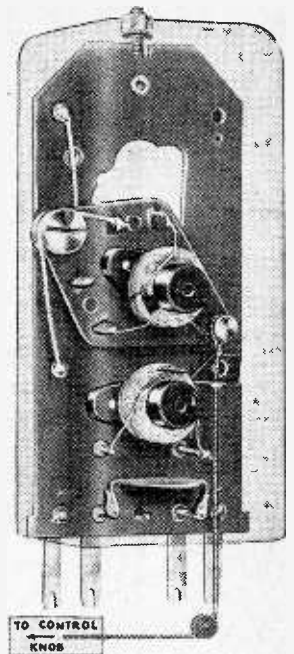


There is an increased tendency towards subdivision in the larger sets; in the H.M.V. 650, RF and IF components are mounted below the AF and output sections.

A refreshing change from the somewhat stereotyped method of wave-changing is to be seen in certain Pye receivers, which embody what is described as a "planetary selector unit," in which the coils for each waveband are wound on separate formers and soldered directly to contacts on the periphery of the rotary switch cradle.

To judge by comments made by visitors to Olympia, the general neatness and freedom from florid decoration of the new receiver cabinets is meeting with approval, and the clarity of tuning scales has certainly been improved by the general avoidance

Adjustment of IF coupling in the Cossor Model 584.

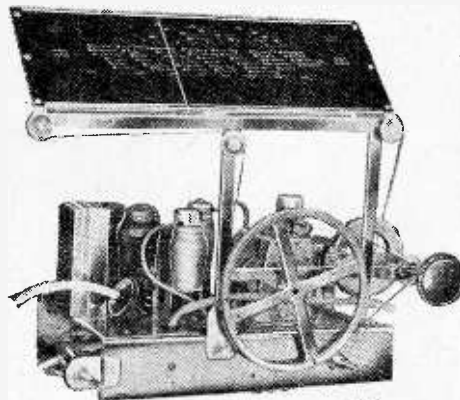


of fancy lettering, and, above all, by the wide use of separate scales for each waveband.

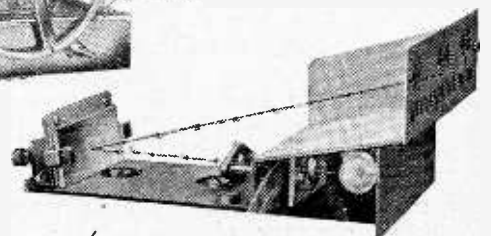
So far as the general outward form of the domestic broadcast receiver is concerned, the only basic innovation is the introduction of several "chair-side" models planned for tuning in comfort. In the H.M.V. model the control panel is vertical; in the Alba and Pye models it is horizontally mounted on the top, while in the Gilbert "Kumfe" a compromise has been struck by fitting the dial and control knobs on a sloping top panel.

As a general rule, those who prefer a loud speaker separated from the receiver must buy the latter in chassis form and arrange for its housing according to their own tastes; fortunately, this type of listener is now well catered for, as many sets are available in chassis form. It should be added, however, that the large Pye and Dynatron radiogramophones are supplied with external loud speakers as standard; the latter instrument works with a Voigt corner cabinet speaker.

Perhaps the most highly developed mechanical device of all is the vibratory HT generator, which now seems to have reached a high state of reliability. It figures in car sets, in the Ekco "No HT" receiver and in various HT supply units.



Heavy flywheel and tuning drive in the Halcyon receiver.

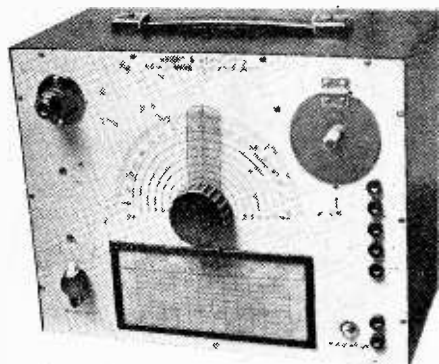


Arrangement of lenses and mirror in the Ferranti Magnascopic scale.

# Testing Equipment

## NEW DEVELOPMENTS IN SERVICING GEAR

A SECTION of the wireless industry that has steadily grown in importance in recent years is that devoted to the design and production of equipment for testing and servicing radio receivers. Under this heading is included all kinds of measuring instruments, valve-testing sets and apparatus for generating an arti-



Wearite A.C. All-wave Signal Generator.

ficial signal. The last-mentioned are described either as test oscillators or as signal generators.

At one time there was a very marked difference between oscillators and signal generators, the latter being a much more elaborate instrument and having a specification that placed it in the laboratory class of instruments.

The popular type of signal generator now produced for the use of service men embodies most of the essential features of the high-grade signal generator, but since price must of necessity be taken into account, a laboratory standard cannot be adopted. It is, however, of interest to record that the main features are reproduced.

In most of the new models the frequency range extends well down into the short-wave region, while some even go further and cover the television wavelengths as well. Furthermore, the short-wave signals are now being provided as fundamental frequencies and not as harmonics of the medium waveband, which was a common practice a few years ago. Owing to the lesser importance of the ultra-short waves harmonics are generally being utilised for this band.

A signal generator with a very wide wave-range is the new Avo All-wave Model. It has six ranges using fundamental frequencies and covering 100 kc/s to 30 Mc/s, while, by using the harmonics of range six, a seventh band is provided extending from 30 to 60 Mc/s.

The new Wearite Signal Generator is also an all-wave model, in that it has a frequency coverage of 100 kc/s to 20 Mc/s, this band being covered in seven ranges. Plug-in coils are used, the spare

coils being contained in a compartment accessible from the front. The internal modulation is at 1,000 c/s; it is AC operated and costs £11 11s.

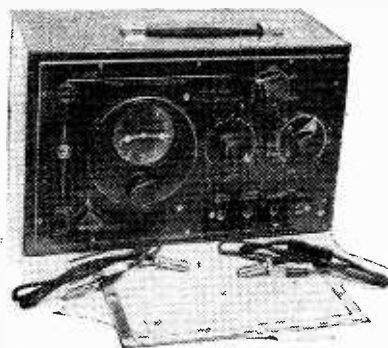
The upper frequency limit of the new Bulgin test oscillator is also 20 Mc/s. This is an improved version of their Model VT16, the latest unit embodying two short-wave bands which together cover a range of 3.5 to 20 Mc/s on fundamental frequencies, whereas the short-wave signals were hitherto obtained by harmonics.

Everett Edgcombe have an all-wave test oscillator covering 30 Mc/s to 100 kc/s on fundamental frequencies and fitted with a calibrated attenuator which on all ranges reduces the output to one microvolt.

As all these modulated test oscillators are intended to obtain a reasonably accurate measurement of sensitivity, the correct functioning of the attenuator is of vital importance, and it is for this reason that so much stress is laid by the makers on the accuracy of the attenuation over the whole range of frequencies provided.

A signal generator that embodies some novel features is made by Cossor. Described as the Cossor Ganging Oscillator it has been designed for use in conjunction with their portable Oscilloscopes. For the examination of the response curve of a receiver, or of a tuned circuit, the sweep voltage from the Oscilloscope is utilised to vary the RF output from the oscillator in a linear manner from 15 kc/s below to 15 kc/s above its fundamental frequency. There is thus traced on the Oscilloscope screen a curve showing the true response of the circuit or receiver at any frequency within the range of the oscillator.

Calibration charts for five frequency bands are supplied, the range being 20 Mc/s to 90 kc/s. A 400 c/s internal



Pye Trimeasy All-wave Signal Generator.

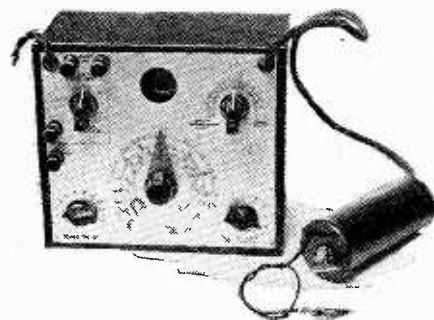
modulator is included and provision is made for applying modulation from an external source.

The new Telsen signal generator is another example of an all-wave model which on fundamentals covers a frequency band of 22 Mc/s to 150 kc/s.

Weston include in their range of servicing equipment an all-wave oscillator,

the Model E692, which has a short-wave range covering 25 to 50 metres.

A signal generator for servicing use and which embodies many interesting features is the Pye de Luxe All-wave Trimeasy Signal Generator. It is a battery-operated portable instrument having five frequency ranges using separate coils with switching and covering the wide range of 100 kc/s to 50 Mc/s. The type of dial fitted enables very small changes to be made in the frequency. It is a dual-pointer clock-face model which, in effect, provides 5,000 marked divisions; a change of one division on the dial is equivalent to 0.25 kc. change at the low radio fre-



Radiolab Workshop Testing Set.

quencies and to 2.5 kc/s on the medium waveband. Internal modulation at 400 c/s, at 10 kc/s, or at 150 kc/s, is provided. A fixed RF output of about one volt can be obtained, as well as a variable output controlled by an attenuator.

The recently introduced miniature cathode-ray tubes are being used extensively in resistances and capacity measuring bridges as an indication of balance. With this device the bridge can be operated from the AC mains and it is thus possible to produce a comprehensive test set of this nature at a reasonable price.

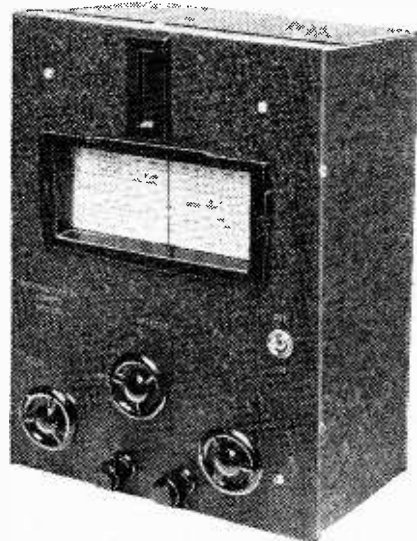
The new Wearite Condenser Analyser is an example of this type of tester. It has three ranges for capacity and two for resistance. Values are read off from calibrated scales and the ranges are 10 m-mfds. to 80 mfds. and 50 ohms to 4 megohms respectively. The power factor of condensers within certain limits can be measured and provision is made for testing condensers and other components for leakage at potentials ranging from 100 to 500 volts. This test set costs £9 9s.

Hunt's Capacity Analyzer and Resistance Bridge is a similar type of instru-

**Testing Equipment—**

ment, being AC operated at 50 c/s and having a visual indicator in the form of a miniature CR tube.

A low-frequency excited bridge for capacity and resistance measurements, also with visual indicator, is made by Radiometers, and it is described as the Faradohmeter.

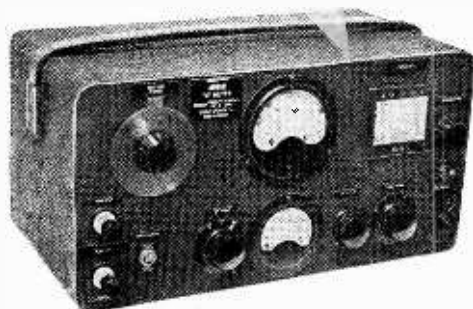


Radiometers Faradohmeter, a resistance and capacity test set.

The Pye Component Analyser, falls in the same category, and scales calibrated in microfarads and resistance are provided. Everett Edgumbe have a new test instrument, described as the Radiolab Workshop Testing Set. Resistance, capacity and insulation tests at various potentials can be effected, but it is also a high-impedance rectifier-type peak voltmeter. The input impedance is 5 megohms and it can be used on all frequencies up to 40 Mc/s.

With the Avo Capacity Tester measurements are carried out by a resonance method and at a radio frequency of about 230 kc/s. It provides six ranges, and all have very open scales, enabling a high order of accuracy to be obtained. The lowest range is calibrated in steps of 5 m-mfds. and extends from 0 to 0.0005 mfd. The remaining five scales extend the scope of the instrument to cover all capacities up to 0.1 mfd. This is a battery-operated unit and costs £23.

The Salford "C" Meter is another example of this type of instrument and it covers all capacities from 0 to 0.1 mfd.



Salford "Q" meter for measurement of coil efficiency.

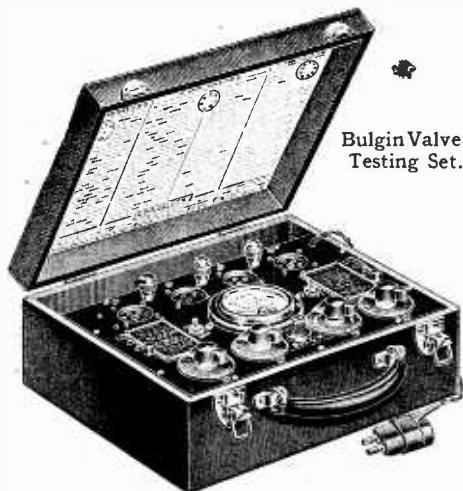
This firm also make several other test sets of a similar kind for measuring inductance and also the efficiency of tuning coils. The former is described as an "L" meter and the latter as a "Q" meter.

Some changes and improvements have been made in the design of valve-testing equipment, and though many still only test valves for emission the test set is so arranged that the emission values can be interpreted to tell whether a valve is in good condition or slightly below standard, or so far deteriorated that a replacement is essential.

The Radiometers All-valve Tester provides this information, and all tests are effected at two different values of grid bias. Several different types are made by Everett Edgumbe; one, the Valve Gauge, is an inexpensive model costing £5 15s. 6d., while the Service Valve Tester is of more ambitious design and enables a complete series of tests, including the measurement of mutual conductance, to be carried out.

Valve-testing equipment is included among the range of test gear made by Bulgin, Wearite, Weston and Telsen.

The Avo Valve Tester differs from the majority in that it gives a direct reading of mutual conductance. It is an easily handled test set, is mains-operated and will accommodate any valve in general use. An additional scale with coloured sections and marked Good, Bad and Doubtful, is provided for the benefit of



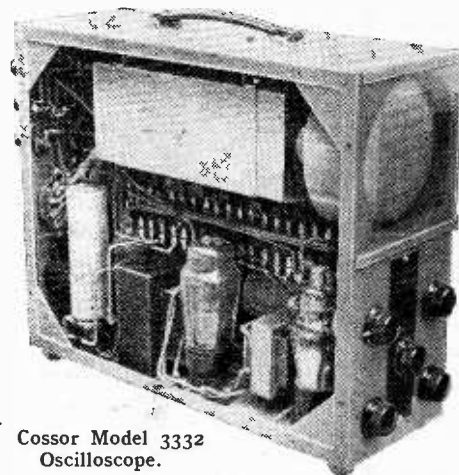
Bulgin Valve-Testing Set.

non-technical users who may not, perhaps, fully appreciate the significance of a mutual conductance reading. The price of this useful test set is £11 11s.

Multi-range meters which only a few years ago were merely combined volt and milliammeters have now developed into quite comprehensive test sets, and not only will they measure all the voltages and currents, whether AC or DC, in a wireless set, but facilities are provided for resistance measurements and often for measuring capacities as well.

The Model 7 Avometer is an outstanding example of an instrument of this kind, for it has 46 ranges. These cover all voltage measurements up to 1,000, AC and DC, current measurements up to 10 amps., as well as resistance, capacity, power output, and gain or loss in decibels. Its price is £16 16s.

Very high sensitivity has been achieved in the new Weston Model E772 Analyzer, for it has the exceptionally high resistance of 20,000 ohms per volt on all voltage ranges. Accurate measurements of voltage in circuits with high resistance networks are possible with this instrument,



Cossor Model 3332 Oscilloscope.

for the meter requires 50 microamps. only for a full scale deflection.

It is a very versatile instrument, for resistance, capacity and output measurements can be made and the price is £22 8s.

Multi-range meters and test sets are made also by Bulgin, Everett Edgumbe, Ferranti, Wearite and Telsen, and each of these possesses many features of interest.

Some new rectifier instruments have been developed by Salford Electrical Instruments for the measurement of current and voltage at very high radio frequencies. The ammeter is suitable for use on frequencies up to 10 Mc/s, while the voltmeter has a range of 30 c/s to 1.6 Mc/s. Thermo-couple ammeters are included in the Ferranti range, which firm also has a series of electro-static voltmeters.

Everett Edgumbe has also introduced an electrostatic voltmeter with three ranges for measuring the voltages in CR tube apparatus. Full scale readings of 1,500, 3,000 and 6,000 volts, or of 2,000, 4,000 and 8,000 volts, can be provided.

The Pye Service Department has developed an interesting piece of apparatus for testing wireless sets. It is described as the Pye Life Test Alarm, and its function is to give audible warning when the output from a receiver under test drops by a predetermined amount. The price of this unit, which is AC operated, is £3 15s.

Cathode-Ray Oscilloscopes in portable form for wireless receiver testing, as well as for general experimental use, have been introduced by A. C. Cossor. The Model 3332 is the smallest self-contained unit in the range. It includes a 4½ in. diameter CR tube, power pack, amplifier, time-base and synchronising circuits. The whole is assembled in a portable metal case and the price is £20 complete.

There are several other models for laboratory work, as well as a range of amplifiers and camera units for recording purposes.



# G.E.C.

## BATTERY ALL-WAVE 4

**FEATURES.** *Type.* — Table model superheterodyne for operation from batteries. *Waveranges.* — (1) 16-50 metres. (2) 200-550 metres. (3) 1,000-2,000 metres. *Circuit.* — Heptode frequency-changer — var.mu pentode IF amplifier — double - diode - triode second detector—pentode or tetrode output valve. *Controls.* — (1) Tuning. (2) Volume and on-off switch. (3) Waverange. *Price.* — 10 guineas (including batteries). *Makers.*—General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

### A Superheterodyne with Many Constructional Refinements

It is generally agreed that as far as range and selectivity are concerned the modern battery set is every bit the match of its mains equivalent. Only in the matter of power output do we find the mains receiver in possession of a fundamental advantage, for it is always possible to improve the power-handling capacity at small expense as far as current consumption is concerned. In the case of the battery set there is an economic limit to the current which may be drawn from the HT battery of standard capacity, and although QPP output stages have brought the battery set on the same footing with the cheaper mains receivers, there are many designers who consider that the battery receiver should recognise its limitations and be content with the output which a single "economy" pentode will give.

A census of the volume levels at which sets are actually worked would show the average to be very close to the 500 milliwatts which is the rated output of the valve used in this set. The volume level which this expenditure of power gives may seem a little subdued in the midst of the many activities of a testing laboratory, but in the quiet surroundings of the home it will be more than adequate.

#### Low Background Noise

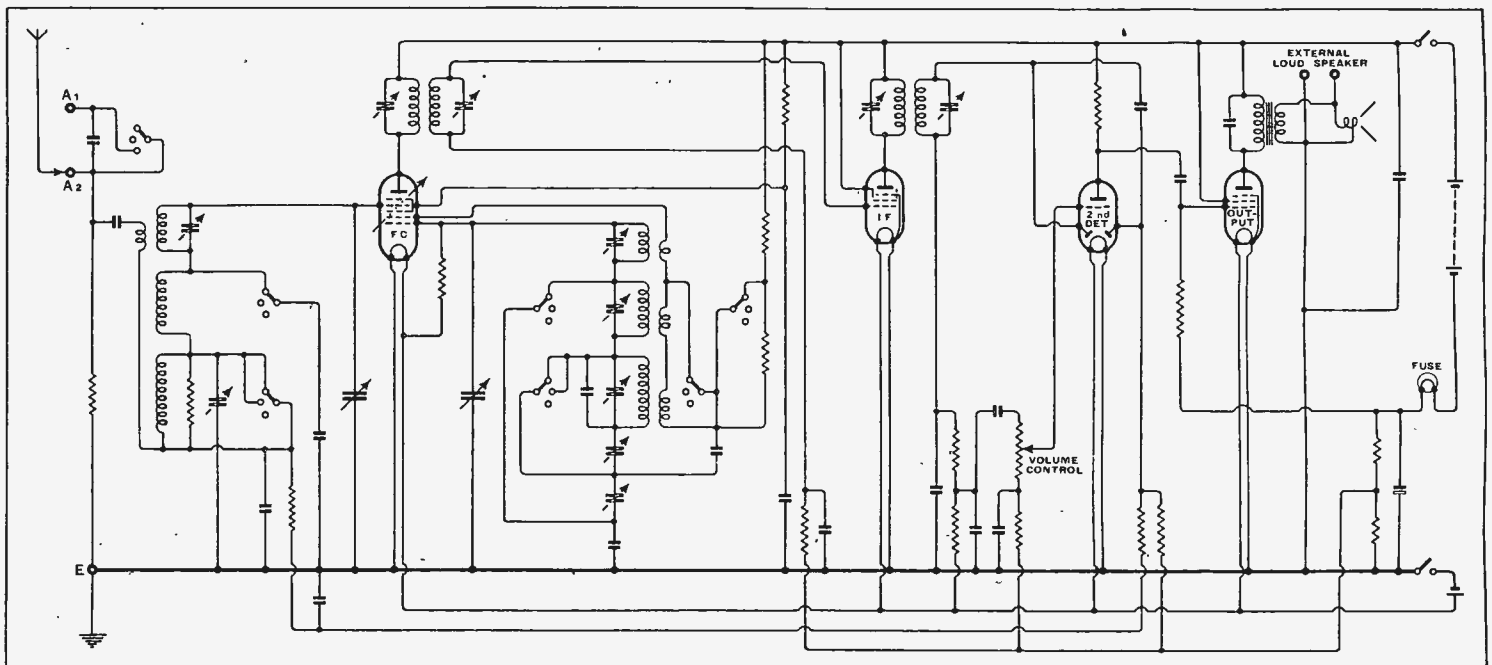
Under these conditions the low background noise of a battery set will also be appreciated to the full. In the case of the set under review this applies not only to the conditions when the sensitivity is reduced under the action of AVC on a powerful station but also to the noise be-

tween stations when sensitivity is at its maximum. It follows that better results from a programme point of view will be obtained in a set of this character from weak stations, and in order to take advantage of this a degree of sensitivity has been provided which is capable of overloading the output stage in spite of a measure of AVC provided by the control on the frequency-changer valve. Care is necessary, therefore, in handling the volume control, but given this condition undistorted and really well-balanced quality is obtained.

The bass in particular is surprisingly good for such a moderate volume level, and for the cause of this we must look to the construction of the loud speaker. Instead of the usual mass-produced one-piece moulded cone we find a composite diaphragm consisting of a hard paper cone with a surround of more flexible material. Not only does this permit the development of wider amplitudes at low frequency but the fundamental resonance of the system as a whole is dropped below the region which so often gives rise to "boomy" quality.

The loud speaker is by no means an isolated case of the trouble which the makers have taken to ensure that in every single detail of construction the receiver shall be just right. For instance, users need have no fear of trouble from acid creeping from the LT accumulator, as this is isolated from the chassis by a moulded rubber tray which is instantly detachable for cleaning.

Full dial illumination is also provided without any excessive drain on the LT



Grid bias is automatic, no separate battery being required, and AVC is supplied to the frequency-changer valve only.

**G.E.C. Battery All-wave 4—**

battery by the inclusion of a feature described as "Touch Lighting." This consists of a spring-loaded bakelite flange which is provided with suitable contacts and mounted behind the tuning knob. When the tuning control is handled in the normal way it will be found that the finger tips automatically depress this flange and so bring into operation the pilot lamps of the indirectly illuminated dial.

If further evidence of attention to detail were required one need only draw attention to the felt strips covering the stiffening batons at the back of the cabinet to prevent possible chattering between these and the perforated fibre back panel.

**Ease of Control**

The "Chromoscopic" dial which has been fitted in this receiver is common to many of the receivers in the new G.E.C. range, and consists of an edgewise illuminated glass scale mounted over a black background. The station names are printed in distinctive colours according to their various waveranges. The settings of the waverange switch and volume control are also indicated on this dial by separate pointers. A two-speed drive is fitted to the main tuning pointer, and it is of the type which combines rapid movement from one part of the scale to another with slow motion over a limited range.

A preliminary run through the three waveranges gave the impression that the sensitivity increased from the short waves through medium to the long-wave range. That is not to say that the short-wave sensitivity is below normal, for no difficulty was experienced in tuning in American broadcasting (Schenectady and Bound Brook) during the afternoon. The sensitivity on the medium-wave band is excellent if the aerial terminal A2 is used, and under these conditions approximately 2½ channels are lost on either side of the local station. Using terminal A1, the spread is reduced to 1 channel on either side of the normal setting of the local, but the sensitivity is considerably reduced and with this aerial tapping the set must be regarded virtually as a local station receiver.

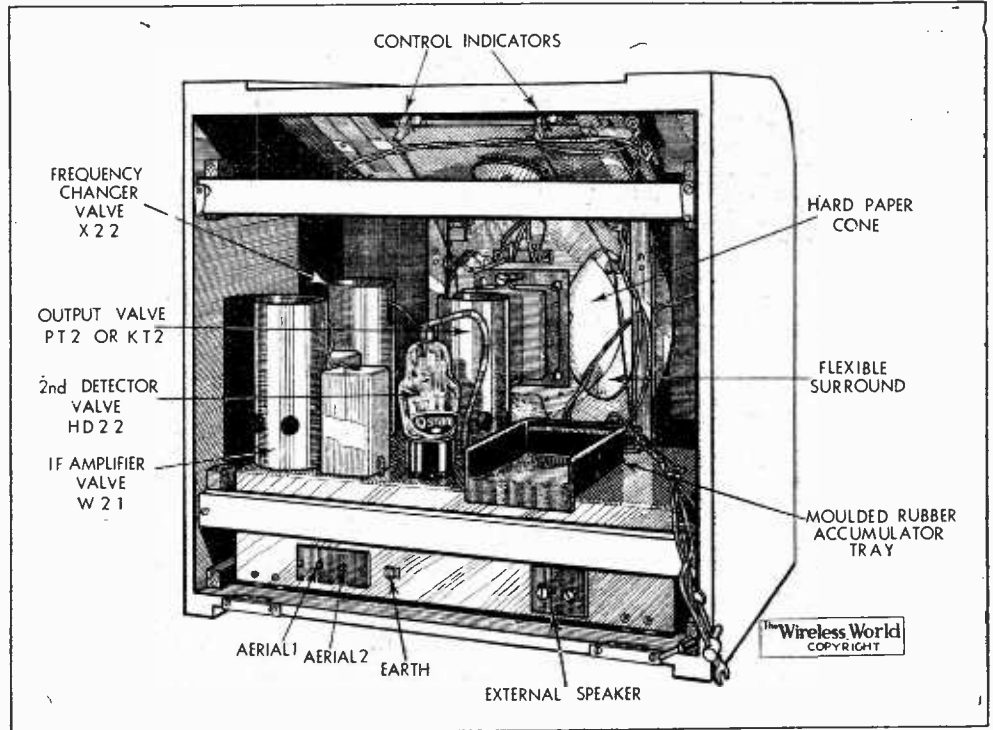
On long waves the series aerial condenser which is introduced by using terminal A1 is short-circuited by a contact on the waverange switch so that as far as the long-wave range is concerned it does not matter to which terminal the aerial happens to be connected. Both as regards sensitivity and selectivity the performance on this range is undoubtedly well above the standard which one normally expects. Care must be taken to avoid overloading the output valve on all stations, including the Deutschlandsender, and the slight background on this station from Droitwich and Radio-Paris is not sufficient to detract from its programme value.

Iron dust cored coils are used in the coupling transformers for the IF stage and also for the medium-wave section of the single tuned aerial circuit. The first valve, the frequency-changer, is a heptode. This is the only valve controlled by AVC which is provided with a delay

voltage derived from the potentiometer which supplies automatic bias to other valves in the circuit. The IF amplifier functions at a frequency of 456 kc/s, and although not controlled is of the variable-mu type. Separate diodes in the double-diode-triode second detector are used for signal rectification and AVC supply. The rectified AF voltage is passed to the triode amplifying portion of the valve through a volume control resistance, and it should be noted there is no provision for a pick-

that the extra expense involved in going to a patent agent will almost invariably turn out to be a sound investment.

An inventor who applies for Letters Patent must not expect to get them for nothing. The aim of the State is to encourage invention, because it stimulates trade and industry, and it accordingly offers the inventor a privileged position for a certain period of years. In return the latter is required to pay certain fees, and to establish the fact that he has really evolved something which is both useful and novel, by filing at the



Interior view with batteries removed to show constructional details of loud speaker and arrangement of control indicators.

up usually introduced at this point. Resistance coupling follows the second detector and the pentode output valve has a fixed degree of tone correction by virtue of the condenser connected across the primary of the output transformer. It is understood that in some sets an output tetrode type of valve is used instead of the pentode actually fitted in the set reviewed.

Terminals are provided at the back of the set for the addition of an extension loud speaker of the low-impedance type (2—4 ohms). Tests of current consumption showed the average HT current to be just under 11½ mA. and the LT 0.55 amp.

The set is supplied complete with batteries and is from every point of view a "finished product."

**Patents for Inventions.** By Reginald Haddon, Fellow of the Chartered Institute of Patent Agents. 99 pages. Published by Sir Isaac Pitman and Sons, Ltd., London, W.C.2. Price 3s. 6d.

THERE is an inventive streak in most of us, but few of those who set about the task of taking out Letters Patent realise all that is involved in the process. Mr. Haddon's book gives a short and clear account of the principles on which patent practice is based, though it does not encourage an inventor to tackle the Patent Office in person. On the principle of not spoiling the ship for a ha'porth of tar, the author argues

Patent Office such a clear, full, and precise description of his invention as will allow an ordinary workman, skilled in the art, to build the new machine or to carry out the new process without difficulty. The intention here is also to ensure that, at the expiration of the patent grant, the public at large shall be able to acquire the free use and benefit of the invention. That is part of the bargain which the State makes with the inventor, and it is the duty of the Patent Office to see that all these conditions are properly carried out before the grant of Letters Patent is made.

Mr. Haddon explains the conditions which determine the validity of a patent after it has been issued, and describes the procedure for enforcing it against infringers. The book also contains a useful section dealing with patent practice in foreign countries and in the Dominions and Colonies, and gives a short account of designs and trade marks.

The author is disposed to gird at the Patent Office because it does not make a search into the novelty of every application that is filed for provisional protection. We have always understood that the Patent Office is supposed to be self-supporting, and the stamp fee of £1 would be quite inadequate to meet the expense of an official search. It is common knowledge that the cost of testing the novelty of a complete application—which carries a stamp fee of £5—is not covered by that sum, but by the heavy renewal fees that are paid to keep existing patents alive.

# BROADCAST BREVITIES

## NEWS FROM PORTLAND PLACE

### Physical Jerks Soon

THE lives of those hypothetical retired colonels who would risk apoplexy if the B.B.C. broadcast "physical jerks" are seriously threatened. Indeed, the betting is even that breakfast broadcasts of this kind will be given by the B.B.C. before the daffodils bloom again.

### Beginning with Talks

The first step is an understanding just arrived at between the Corporation and the National Advisory Council for Physical Training and Recreation whereby the aims of the Council will be fostered in a series of talks beginning in November.

It is understood that if the talks are well received the B.B.C. will meet in conclave to consider whether instruction in physical training could begin early in the new year.

It is possible, of course, that such lessons might be broadcast at any time of the day, but everybody at Broadcasting House assumes that the only fitting period would be between 7 and 8 a.m.

### Droitwich First

At first physical jerks would be broadcast from Droitwich only, as this would entail the minimum number of extra staff on duty. Music for rhythmic purposes would be provided by gramophone records, and the only additional studio staff required would be an announcer.

Thousands of listeners would tune in the broadcasts without any intention of partaking in the exercises. In fact, to hear an instructor giving orders which one need not carry out would be a grand mental tonic at the start of the day.

### Questions and Answers

A QUESTIONNAIRE drawn up by the International Broadcasting Union invited members of the Union to describe such of their activities as aimed at the creation of a better understanding between peoples. The questionnaire comprised twenty-nine sectional headings.

In its reply the B.B.C. has made it clear that part of its duty is first and foremost to enlighten and inform its own listeners, and this has been attempted ever since the formation of the Corporation.

### English Essential!

The success of programmes with an "international" angle

depends upon their being given in English, as the use of a foreign language is always a difficulty. It has been found that the most successful programmes have been those concerned with experience; i.e., conditions of life and eye-witness accounts of contemporary events.

From time to time there have been talks on the Far East, American Half-Hour, Plans for To-morrow, the Zuyder Zee Scheme, Tennessee Valley Authority, and the new German public schools, while nationals from China, Czechoslovakia, Denmark, France, Germany, Japan and Turkey have been brought to the studio.

### Introducing Foreign Art

The architecture and painting of various countries, generally in connection with an important international exhibition, have been dealt with at the microphone. Music talks, broadcast on an average three times a fortnight, have been devoted to contemporary foreign composers, and descriptions have been broadcast of foreign musical festivals, such as the International Society of Contemporary Music, Barcelona and the summer opera festival, Salzburg.

### Foreign Plays in English

The broadcast production of foreign classic plays has formed part of the B.B.C.'s regular dramatic schedules for the past ten years.

It is one of the principles of B.B.C. dramatic policy not only regularly to broadcast British classics, but also representative works of foreign classic authors. The same principle applies, with certain qualifications, to modern radio plays. Several of the most successful radio-dramatic productions have been translations of foreign radio dramas, as, for instance, "Flags on the Matterhorn," "Brigade Exchange," "Autumn Violets" and "Squaring the Circle."

For "European Exchange" a member of the B.B.C. staff was sent to Paris, Rome, Vienna, Warsaw, Berlin and Copenhagen, to bring to the microphone there a national of the country who could speak English to talk about his work and conditions of life.

### Why Language Lessons Have Ceased

French, German, Italian and Spanish have been taught. Recently, for programme reasons, it was decided to substitute for a definite lesson a programme in the foreign language about foreign art, literature and affairs, including talks by nationals on a visit to this country. During the present year French has been the language; this is being changed in October next to German.

### Television "on Location"

SCENES on the "Empress of Britain," including the radio room, are to be televised in a new type of programme from Alexandra Palace on September 28th. This is the first time that the television staff have gone "on location," to use film parlance, to obtain outside material

for incorporation in a studio show.

### A Visit to Southampton

The programme, entitled "Turn Round," gives a complete story of the arrival and departure of the liner at Southampton. Producer Eric Crozier and camera men visited the port a few days ago, "picked up" the liner at Calshot, and took pictures from the bridge showing the landing of passengers and the unloading of cargo, as well as views of the liner being manoeuvred round in the dock.

All these scenes will be linked together in an amusing story, some of the acts being filmed in the ship. The others will be performed in the studio with scenery designed to dovetail into the ship pictures. Joan Miller, the "Picture Page Girl," takes the leading part.

This programme will probably mark the beginning of a new television technique.

### Thirteen Hours of Television

THE trade was getting good value for money, according to the caption card televised from Alexandra Palace on Monday of last week. It read: "Trade Demonstration, 11.30 a.m. to 12.30 a.m."

### HIGHLIGHTS OF THE WEEK

#### FRIDAY, SEPTEMBER 3rd.

Nat., 7.30, Five Hours Back.

8, Beethoven Prom.

Reg., 8, Al Collins and his dance orchestra. 8.40, "Come Along Liza": Cockney radio play.

Abroad.

Rome, 9, "Mlle. Nitouche," operetta by Hervé.

#### SATURDAY, SEPTEMBER 4th.

Nat., 11.50 a.m., Early stages of the T.T. Race at Donington Park.

3.40, London Schoolboys v. Welsh Schoolboys cricket match at Lord's.

4.45, Closing stages of T.T. race.

8, Variety from Radiolympia.

9, Discussion: What is Wrong with the Cinema.

Reg., 8, Promenade concert.

9, Jack White and his Collegians.

Abroad.

Kalundborg, 7.30, Gershwin music including selections from "Tip-toes" and "Rhapsody in Blue."

#### SUNDAY, SEPTEMBER 5th.

Nat., 7, In a Gondola: A Venetian silhouette.

7.55, Service from Wesley's Chapel, City Road.

9.5, "Phoebus and Pan": a dramatic cantata by J. S. Bach.

Reg., 6.50, Gaby Vallé and the London Wind Quintet.

9.5, Folkestone Municipal orchestra.

Abroad.

Paris PTT, 9, German Lieder evening for German Art Week in Paris.

#### MONDAY, SEPTEMBER 6th.

Nat., 7, Monday at Seven; including Hildergarde.

8, Wagner Prom.

Reg., 7, Recital: Sophie Wyss.

9, "The Giddiest Girl in the Coll.": burlesque by Arthur Marshall.

#### Abroad.

Strasbourg, 9, Richard Strauss conducting his opera "Der Rosenkavalier" from the Théâtre des Champs Elysées.

#### TUESDAY, SEPTEMBER 7th.

Nat., 8, "The Giddiest Girl in the Coll."

Reg., 8, "The Dream of Gerontius" from the Three Choirs Festival at Gloucester Cathedral.

9.55, Variety including Annette Mills and Bill Barr.

Abroad.

Radio Paris, 9, German concert from the Salle Pleyel, soloists include Erna Berger and Walter Ludwig.

#### WEDNESDAY, SEPTEMBER 8th.

Nat., 6.20, Shows from the Seaside.

X.—From the Wellington Pier Pavilion, Gt. Yarmouth.

8.25, Bach Prom.

Reg., 3.5, Commentary on the St. Leger.

9, Variety from the New Theatre, Oxford.

9.45, Songs of Percy Grainger.

Abroad.

Strasbourg, 8.30, "Madame Pompadour" (Fall) from the Casino, Vichy.

#### THURSDAY, SEPTEMBER 9th.

Nat., 6.40, Reginald Foort at the theatre organ with Vera Guilaroff (Canada's melody girl).

8, Favourites of the Famous—Jack Payne and his band.

Reg., 8, Sibelius Prom.

9.30, Courtney Hope in character impressions.

Abroad.

Radio Paris, 9, "Tristan and Isolde" (Wagner) by the Berlin Opera Company from the Théâtre des Champs Elysées.

# Listeners' Guide for the Week

## Outstanding Broadcasts at Home and Abroad

**A**S was announced some time ago, Mr. B. Walton O'Donnell, the well-known conductor and friend of the B.B.C. Military Band, is to go to Ireland to succeed Mr. E. Godfrey Brown as Music Director at Belfast. His successor as conductor of the Military Band will be his brother, Major P. S. G. O'Donnell, who has been Director of Music with the Royal Marines since 1916, which post he is leaving to join the B.B.C. During the visit of H.R.H. the Duke of Windsor (then Prince of Wales) to America in 1919, and again during his visit to Australia the following year, Major O'Donnell was Director of Music in H.M.S. *Renown*.

The first time he will be heard with the B.B.C. Military Band will be on Tuesday in the National programme at 6.25. The band will again be heard under his direction Regionally on Thursday at 9.45.

### T.T. RACE

**R**UNNING commentaries on the 16th International Tourist Trophy Race organised by the R.A.C. will be heard by National listeners on Saturday morning and again in the afternoon. The commentators will be F. G. Findon, Graham Walker and R. Glendenning. During the first relay at 11.50, John Howell, Birmingham District Manager of the R.A.C., will describe the extended track. Nearly a mile has been added to the part of the course known as Starkey's Straight, which will admit of speeds up to 130 m.p.h., and a

corner with a sharp degradant has also been added. The early stages of the race, which consists of one hundred laps, making three hundred and twelve and a half miles in all, will be described at 11.50, whilst the closing stages and finish will be commented upon at 4.45.

This is the first time that the race has been run in England. It has changed this year from the Ards Circuit, Northern Ireland, to Donington Park, which is seven miles from Derby.

### RADIOLYMPIA

**T**HE last relay from the theatre at Radiolympia will be heard by listeners on Saturday at 8 (Nat.). This will be the last show to be given in the theatre, for the exhibition closes its doors at 10 o'clock.

Besides Bobby Howell and his orchestra, Paula Green, the Dagenham Girl Pipers and Drummers, and Louis Levy and his Symphony, who were heard during last Monday's relay, Leonard Henry, Mamie Soutter and the Heron Sisters are also billed.

### FROM THE QUEEN'S HALL

**M**ENTION of the promenade concerts must this week again be confined to the outstanding items to be broadcast.

That remarkable fourteen-year-old Polish violinist, Ida Haendel, playing the solo part in Beethoven's Violin Concerto, will be heard during to-night's (Friday) relay at 8 (Nat.).

One of the highlights of Saturday's relay at 8 (Reg.) will be Louis Kentner's playing of Liszt's Pianoforte Concerto No. 2. Although comparatively new to London, Mr. Kentner has shown himself to be a great virtuoso and a particularly revealing interpreter of Liszt. The relay concludes with Handel's "Largo."

Monday's Wagner

**I**NSPECTOR HORNLEIGH continues to interrogate witnesses in this week's programme in the "Monday at Seven" series. S. J. Warington (left) who plays the part, is seen with Douglas Moody who, with Harry Pepper, produces these shows.

concert provides two relays, 8 (Nat.) and 9.40 (Reg.). The first brings the Prelude to "Die Meistersinger." The second includes the first concert performance in London of Frederic Austin's overture "The Sea Venturers"; this will be conducted by the composer. Tuesday is a "Promless" night for listeners.

From the Bach concert on Wednesday at 8.25 (Nat.) will be heard his Concerto No. 2 in C for two pianos and strings and his Concerto in A minor for four pianos and strings.

### THREE CHOIRS FESTIVAL

**L**ISTENERS to the Regional programme on Tuesday at 8 will hear Elgar's "The Dream of Gerontius" from the Three Choirs Festival which is being held at Gloucester Cathedral from September 5th to 10th. This will be the 217th annual meeting of the choirs of Worcester, Gloucester and Hereford Cathedrals. The principals will be Heddle Nash as Gerontius, Harold Williams and Astra Desmond. The festival chorus and the London Symphony Orchestra will be conducted by Herbert Sumsion, Organist and Master of the Choristers of Gloucester Cathedral. "The Dream of Gerontius" was Elgar's first major work to be given at the Birmingham festival, that was in 1900, and two years later it was given at the Lower Rhine Festival.

### GIRLS' SCHOOL BURLESQUE

**A**RTHUR MARSHALL has completed a burlesque on life in a girls' school, and given it the title "The Giddiest Girl in the Coll." This will be heard Regionally on Monday at 9 and Nationally on Tuesday at 8. He, in the way that has made him so popular as a radio artiste, will play the part of the headmistress, and with him in the cast will be Doris Hare, Hermione Gingold, Sheila Kaye, and Adeline Hook.

### OPERA AND ORATORIO

**T**HE listener is offered a varied choice of opera broadcasts this week. On Saturday Rome gives a studio performance of "Lohengrin" at 9.

Richard Strauss enthusiasts may hear the veteran composer conducting his own perennially popular "Der Rosenkavalier," of which our own George Bernard Shaw provided the



**GLoucester Cathedral**, where the Three Choirs Festival is being held. Regional listeners will hear Elgar's "The Dream of Gerontius" from here on Tuesday.

libretto, at the Théâtre des Champs Elysées, Paris, on Monday. This will be relayed by Strasbourg and Rennes at 9. The programme unfortunately clashes with the great German performance by the Munich National Opera Orchestra of "Siegfried" at the Casino, Vichy, which Radio Paris relays at 8.45.

On Thursday at 9.15, from Stuttgart, will be heard one of the most discussed and remarkable symphonic poems of Richard Strauss, "Ein Heldenleben." Curiously enough, this received its first performance not in Germany but in England, at a Queen's Hall Symphony Concert under the composer's baton on December 6th, 1902, three years after it had been written.

Toulouse PTT is giving Mendelssohn's great oratorio, "St. Paul," on Monday at 8.30, with the National Orchestra and the Raugel Choir. This beautiful work was composed more than a hundred years ago, and received its first performance at Düsseldorf in 1836. Monday's performance is followed by Eric Satie's "Socrate." This work consists of fragments of Platonic dialogue in music. The melody, which consists of a very simple theme, rises clear above an accompaniment which is obstinately repeated. Satie, who is now 71, is one of the most original characters in modern music.

THE AUDITOR.

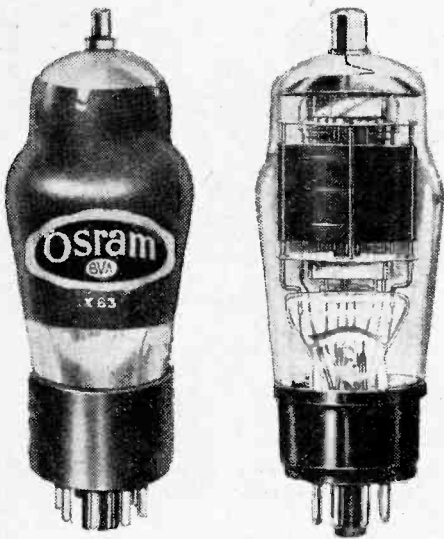
The weekly list of Highlights will be found on the previous page.



# Valves and Cathode-Ray Tubes

## A YEAR'S DEVELOPMENT IN "GLASSWARE"

**T**HE days of spectacular innovations in receiving valves have to all appearances gone, and progress is now represented by improvements in the details of design and manufacture. No longer do we find startling claims of efficiency beyond anything previously realised. Development is chiefly in details which do not show in the paper characteristics. Such development, however, is really important, and in the long run is of more value than a continual struggle to "improve" a valve, in what has come to be the accepted meaning of the word.



The Osram X63 (left) and Hivac-Harries A15 All-Stage (right) Octal-base valves are shown here.

Valves are already so good that in ordinary receivers little or no advantage could be taken of types with still higher values of mutual conductance. In most cases the gain of an RF stage is limited by considerations of stability, and full use cannot be made of the capabilities of present types. It is only in television receivers that this does not hold good, for in these the enormous band-width required makes it impossible to obtain high gain per stage. For such receivers, therefore, valves of very high mutual conductance are wanted and they are being produced.

For ordinary broadcast sets, however, these special valves are not needed, and there is actually a definite tendency towards the production of valves of considerably lower mutual conductance than we have been accustomed to in the last few years. Instead of figures of 3.0-4.0 mA/v., RF pentodes with a mutual conductance of about 1.5 mA/v. are being produced.

With modern circuit technique it is readily possible to obtain all the gain required with such valves, and they offer important advantages in regard to the uniformity of different samples and the lower

heater power. Uniformity is of particular importance, for a receiver is designed around its valves; when different specimens vary considerably in their characteristics allowance must be made for this in the receiver design, and the result is usually a somewhat lower average performance. A tightening up of the permissible valve tolerances, however, enables a more exact design of receiver to be made, and results not only in a more consistent performance but also in a better set.

The reduction in heater power is of less importance, but in the case of a multi-valve set may enable an appreciable saving in the cost of the mains transformer to be made, and it also makes it possible to use lighter gauge conductors for the heater wiring. The average indirectly-heated valve consumes 1.0 ampere at 4.0 volts, or 4 watts. A year ago Marconi and Osram brought out the 42-series of valves with heaters taking only 0.6 ampere, or 2.4 watts. These valves have lower mutual conductances; for instance, the W42 RF pentode has  $g=1.5$  mA/v. as compared with  $g=2.2$  mA/v. for the VMP4G.

The latest valves produced by Marconi and Osram have still lower heater consumption, taking 0.3 ampere at 6.3 volts or 1.89 watts. The RF pentode is the W63 with a mutual conductance of 1.5 mA/v. The adoption of 6.3 volts for the heater rating is at first sight peculiar, but it is done largely for uniformity with American practice which originated in the car-set. American cars usually have a 6-volt accumulator which in practice gives an average potential of 6.3 volts, hence the adoption of this peculiar figure. Since British cars generally have a 12-volt accumulator, the valves developed primarily for car-radio in this country are rated at 13 volts.

The adoption of a different rating for every condition of use is not economic, however, and leads to considerable inconvenience. Efforts are thus being made to adopt a standard which is suitable for all purposes, and for this the 6.3-volt rating seems highly satisfactory. The valves can be used for car-sets where only a 6-volt battery is available, and for 12-volt supplies the series connection of heaters can be adopted or a voltage-dropping resistance inserted. The voltage rating is low enough for AC operation in the conventional manner with parallel heaters, and the uniformity of heater current permits series operation for AC/DC sets.

In addition to the adoption of the American heater rating these valves are fitted with the American Octal-base, and their characteristics are such that they are interchangeable with American valves. The Octal-base is a considerable improvement on other types, for the use of uni-

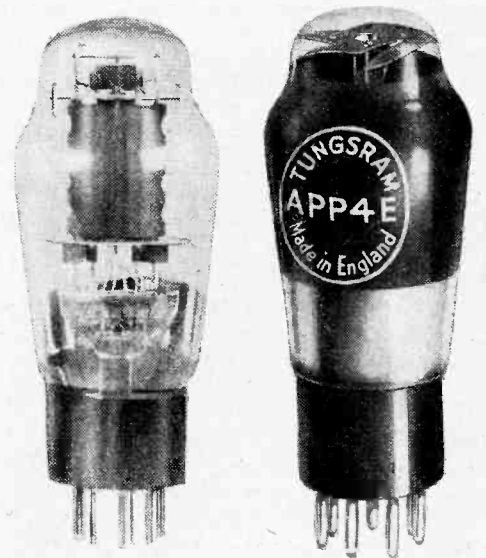
formly spaced pins with a keyed centre-pin fitting into a locating slot in the holder makes it much easier to insert a valve into its socket, particularly when this is located in an awkward position.

Valves of this type are being produced by several firms, usually under American type numbers. In some cases, however, there are exceptions, and Tungram have a triode-hexode frequency-changer, for which there is no American counterpart.

The second development of the year lies in a tendency for the output pentode to be replaced by a tetrode. The only reason for the pentode, of course, has lain in the inability until recently to produce a tetrode having flat anode-volts-anode-current characteristics with an abrupt "knee" and an absence of a negative-resistance bend. Methods of obtaining the requisite performance with only four electrodes have now been found, however, and tetrodes are now claimed to be superior to the pentode.

Some of the first valves of this type to be produced were the Hivac series, among which are the AC/Y, AC/YY, and AC/Q. These depend for the attainment of their characteristics upon the adoption of a critical anode spacing. Other valves, however, are of the type known in America as the beam-power tube and contain earthed plates for the purpose of confining the electron stream to a beam.

Marconi and Osram have now adopted



On the left is the Mazda AC/4 Pen power tetrode and on the right the Tungram APP4E pentode.

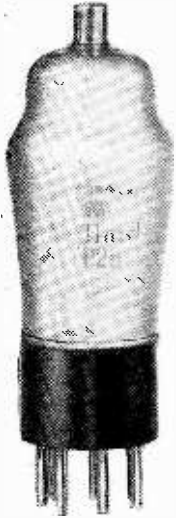
tetrodes, and all their output pentodes, both battery and mains types, are being replaced by tetrodes of equivalent characteristics. In the International range there is a large type, the KT66, from a pair of



**Valves and Cathode-ray Tubes—**

which in push-pull an output of some 30 watts can be obtained.

The Mazda AC/4 Pen is, in spite of its name, a tetrode capable of a large output. This valve is of the 4-volt type. Cossor also have changed to the tetrode. Mullard remain faithful to the pentode, however, and have the Pen 428, from a pair of which 28 watts can be obtained. A similar output is given by the Tungfram APP4E and PP6E types.



The Mullard VP2B battery RF pentode.

Used singly these valves are capable of an output of 5-8 watts only, and the 30-watts is obtainable only from a pair in push-pull. Class AB operating conditions are adopted; in view of the consequent increase in grid bias a higher anode voltage can safely be used, and the output is considerably greater than twice that of one valve. Grid current is not permitted, so that no difficulties arise in the input circuit, and a very high standard of quality is obtainable with such stages, especially if negative feed-back is adopted.

Turning from standard valves to the special types, quite a number of high-efficiency RF pentodes are to be found now, and they are intended for RF or IF stages in television receivers. Mullard have had the TSP4 with  $g=6.0$  mA/v. for some time, and now Mazda have produced the AC/SP3 with a mutual conductance of 7.6 mA/v. but slightly higher interelectrode capacities, while Cossor have the 42MPT with  $g=7.0$  mA/v. Mazda also have a low-resistance diode which is unbased to keep capacity at a minimum, and Cossor have a special duo-diode, the DDL4. Marconi and Osram have a single diode, the D42.

For use in the output stages of time-bases for electrostatically-deflected CR tubes, Mazda have produced the AC/P4. It has characteristics similar to those of the AC/P, but has a top-anode connector, and is rated for 600 volts anode potential. Cossor, too, have produced special triodes for time-base use; these are the 41 MTA and 41 MTB. The former is intended for use as a discharge valve and the latter as a push-pull amplifier. Another triode introduced by this firm is the 41 MTL; it is a valve with a resistance of 15,000 ohms and a mutual conductance of 3.0 mA/v., and is specially designed to operate as an ultra-short-wave oscillator without undue heating of the electrodes.

Cossor also have a special pentode with a split anode. This is the 41 MTS, and it is intended for use as a sync separator in television receivers, the line sync pulses being taken from one anode and the frame

pulses from the other. 362 have a valve with a split anode, but this is intended for operation as a split-anode magnetron.

Mullard, of course, have the Acorn triode and pentode introduced last year, and Marconi and Osram have added an RF pentode to their valves of this type. It is the ZA1 with a 4-volt 0.25 amp. heater and a mutual conductance of 1.1 mA/v.

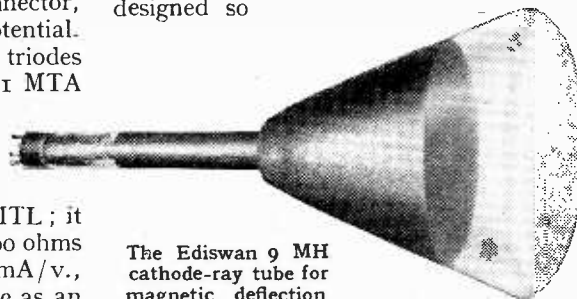
Gas-filled triodes for time-base use are now abundant. Mazda have the helium-filled T31 for use with high-voltage supplies, and the argon-filled T21 for the low voltages adopted when magnetic deflection is employed. Marconi and Osram have the GT1C argon-filled valve and Mullard the GT4H which is of the helium type. The Cossor model is the GDT4, and the gas is neon.

Television has been responsible for much interest and development in cathode-ray tubes, and if new types continue at their present rate there will soon be nearly as many models as there are valves!

Last year types for magnetic and types for electrostatic deflection were about equally divided among the television models. All the new ones are now made for magnetic deflection, and usually for magnetic focusing also. This is not necessarily for any technical superiority of the magnetic types, although some people do favour this type from the performance point of view, but primarily because magnetic deflection is cheaper than electrostatic. The saving comes not so much in the tube as in the associated circuits.

Baird, Ediswan, Ferranti, and Mullard all have tubes of this type now, but Ediswan and Mullard retain their older electrostatic models, and these also comprise the Cossor range. The tubes range from 9in. in diameter to 15in., the usual being 12in., and all require some 4,000-5,000 volts anode potential. Baird tubes range up to 22in. in diameter, and are available with focusing and deflecting coils. The E.M.I. and Marconiphone tubes are available in two sizes, 9in. and 12in., and are electrostatically focused but magnetically deflected.

Oscillograph tubes are made in considerable numbers. Mullard keep to the high-vacuum type, and have a large range including a model specially designed so



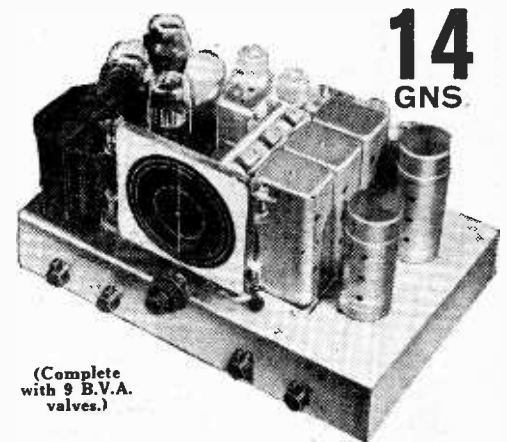
The Ediswan 9 MH cathode-ray tube for magnetic deflection and focusing.

that an unbalanced input can be used without distortion. Cossor have a large variety of both high-vacuum and gas-focused types, and in some of the latter split plates are employed to prevent origin distortion.



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# Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

## Superhet v. Straight Receiver

MR. P. K. TURNER'S letter is a magnificent example of the phrase, "Dragging red herrings across the path." I submit the argument is essentially on the fundamental principles of the two types and most certainly not a discussion on the abilities of the amateur constructor *versus* set manufacturer. I am accused of unjust comparisons between the two types, but that is where Mr. Turner is quite wrong; my comparisons were only made after careful practical investigation, and in this respect I have before me five reports from thoroughly competent engineers (not repairers) who have been comparing the amount of Morse interference received on superhet receivers with that received by a TRF receiver, both types being simultaneously tuned to the same station. Perhaps Mr. Turner will withdraw his accusation when I inform him that at least four times as much Morse is heard on the superhet as on a Philips TRF, and that wavemetering has shown the bulk of this to come in on the IF channel. These tests were conducted at various points along the South Coast from Beachy Head to Plymouth, the same receivers being used in every case.

If, as Mr. Turner says, a bandpass filter of wide frequency admittance is permissible at signal frequency, I am compelled to ask him to read my proposals on a modified superhet. again, for surely I stated that the first circuit could be quite flatly tuned. Also, when selectivity is really demanded, such as at IF, I provide such in no uncertain way by the use of quartz crystal filters. It would appear Mr. Turner has not investigated quartz crystals as filters, neither has he realised the application of the Campbell Reactance Theorem to same.

But perhaps the most glaring statement is that Mr. Turner has not experienced trouble from trimmer drifts. There are but two answers to this: (a) either Mr. Turner will tolerate drifts which the present writer will not, or (b) Mr. Turner claims compression trimmers to be stable components, an item I can very easily disprove.

Perhaps, therefore, Mr. Turner will deal with the points raised in my letters in a specific way and not just content himself with the bald statement that he does not agree with me. Let me assure him, from my own viewpoint, he need not be afraid of entering into mathematics, for I shall be only too glad to reciprocate.

Portsmouth. "NAUTICUS."

## Superhet Noise

I NOTED "Diallist's" remarks (*Wireless World*, July 16th) on the high noise-to-signal ratio obtained with the average small superhet receiver when receiving quite weak short-wave signals.

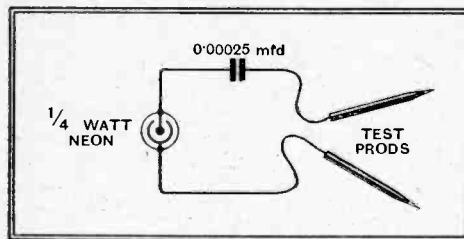
Regarding this generally agreed failing of the small present-day superhet, it occurs to me that, in view of the poor magnification and selectivity of tuned circuits at the very high frequencies, a degree of evenly distributed aerial reaction, applied by a separate reactor valve, would enable the superhet to compare more favourably with the straight reacting set at these frequencies. A gain of only ten times, while far too small to introduce ganging difficulties, would give, by

AVC action, a considerable reduction in set noises, and the reactor (not grid-current type) could be arranged to operate well away from the oscillation point at any setting, in which condition it would not be likely to introduce noises on its own account.

Have any of your readers found such a scheme a worth-while addition to the small superhet?  
HAROLD J. CULPECK.  
London, S.E.6.

## Simple Oscillation Tester

VARIOUS methods of testing for self-oscillation in the frequency changing stage of a superheterodyne have been described in *The Wireless World*, but all require a comparatively expensive milliammeter or voltmeter. A neon tube connected as in the accompanying diagram is



Neon tester for superheterodyne oscillators; arrangement suggested by Mr. Watson.

considerably cheaper; in use one prod is applied to chassis and the other to oscillator anode. If the valve is oscillating the neon tube will light.

A neon lamp similar to that used in Hunt's capacity bridge is very suitable; possibly a G.E.C. "Button Tuneon" would do, but I have not tried one.

Spalding, Lincs. A. W. WATSON.

## Transient Response

I HAVE noticed with interest that my article on "Transient Response" has produced several replies.

I would say that I am quite unrepentant, but prefer to "reserve my defence" until the initial wave of criticism has exhausted itself.

P. G. A. H. VOIGT.

Upper Norwood, S.E.19.

IN the *Wireless World* of July 30th Mr. Voigt issues an appeal—or is it a challenge?—to theoreticians to meet him on his own ground with his own weapons. I am rash enough to accept the challenge, but time will only allow a few rounds:

First, there is no question that even Mr. Voigt's smooth transient consists of frequencies extending from very low to over 1,200 c/s. There is nothing capricious about the Fourier analysis of such a pulse; if a sharply tuned resonator responds to the pulse, then the frequency of the resonator is present in the pulse. If this were not so Fourier analysis would be purely a mathematical recreation.

Now what happens when Mr. Voigt's transient is made to excite, say, a tuning fork of frequency 500 c/s. The fork will be impulsed and left ringing, and, moreover, if the fork were tuned instead to 600 c/s the excitation would be much the same.

So we say the transient contains a wide range of frequencies, and frequencies in the neighbourhood of 600 c/s are of much the same strength as frequencies around 500 c/s. It is true that by rounding off the transient the very high frequencies have been removed.

Now let me tackle Mr. Voigt's imagined loud speaker with a perfectly flat frequency characteristic but a poor transient response. Unfortunately, his suggested arrangement does not retain a flat frequency characteristic. Imagine two perfect loud speakers fed from a common supply; there will be an interference pattern round the speakers. Only at points equidistant from each speaker will the frequency characteristic appear to remain perfect; elsewhere, depending on the frequency, there will be an excess or deficiency of sound. Reflecting surfaces produce an effect similar to the second speaker except that now there is no position in which the frequency characteristic remains perfect, as the reflected sound must always arrive later than the direct sound. So it is with Mr. Voigt's echo room; however irregular it is, he will not be able to find a point on the wall at which the frequency characteristic appears perfect. In fact, if the room is perfectly irregular there will be a certain number of resonances proportional to the volume of the room between any given frequency limits. The rule can be given as

$$\frac{4\pi}{3c^3} (f_1^3 - f_2^3)$$

resonances between frequencies  $f_1$  and  $f_2$  per unit volume, where  $c$  is the velocity of sound. The number of resonances per cubic foot are approximately  $3(f_1^3 - f_2^3)$ , where  $f_1$  and  $f_2$  are expressed in kc/s. So for a room  $12 \times 12 \times 10$  ft. = 1,440 cu. ft., between 0 and 1,000 c/s there are 4,320 resonances; these are crowded nearer the higher frequencies as there are only about 4 below 100 c/s, 30 between 100 c/s and 200 c/s, and so on. These resonances need not appear in the overall characteristic of Mr. Voigt's echo room, and do not if the reverberation time is constant as was specified, but at any one chosen point some of the resonances will appear. The resonant frequencies will depend on the position of the chosen point, and can be modified by altering the shape of the room. The results to be expected from altering the shape are that some resonances may be enhanced at the expense of others, or the resonances may be made more marked but fewer by moving some of the resonances to coincide with each other. The total number of apparent resonances may thus be altered. The sharpness of the resonances is decreased by introducing damping on the walls or by any other means which reduces the reverberation time. The presence of these resonances destroys both the frequency characteristic and the transient response.

Is it possible to have a loud speaker with a perfectly flat frequency characteristic and yet a poor transient response? I believe it is. If the source of the sound is not at the same position for all frequencies, even if this only means that high frequencies come from the centre of the cone and the low frequencies from the cone as a whole unless the phases are correctly adjusted, the transient response will be imperfect. I believe that it has never been shown that under these conditions the frequency characteristic is necessarily imperfect in every direction.

I am not aware that any general proof of the rigid relation between frequency characteristic and phase characteristic (which together give the transient response)

Letters to the Editor—

for a point source has been published, though I have private information that a proof has been discovered recently. One is led to believe in it after making several fruitless attempts to escape from it, and one can see in simple cases that any change of relative phase with frequency is always accompanied by the same relative change of response. The proposition is, of course, limited to linear systems.  
Cambridge. W. B. LEWIS.

RECENTLY Mr. Voigt challenged the "mathematicians" in a most interesting article on transient response. Heaven knows I am no mathematician, but I am an engineer who employs mathematics as a useful tool, so I am going to take up his challenge.

But first let us clear up the point he is really aiming at. I think he will agree that I state his case fairly if I say that he wants to prove that, for reproducing transients, good frequency response is not so important as good damping. I, on the other hand, believe that *both* are essential.

He agrees that for the typical "Heaviside function" type of transient, shown in his Fig. 1, response from zero to infinite frequency is necessary. Then he claims (quite justly) that this transient cannot occur in air; and propounds instead, as a reasonable transient to cater for, that shown in his Fig. 4.

Then he drops his big brick. He states that he will be very surprised if his transient contains any frequencies other than its two "components" of 300 and 600 cycles. This would be true if his transient were repeated over and over again—but then, of course, it wouldn't be a transient at all! But the fact that it is *not* repeated completely alters things. This transient, just like any other, does contain *almost* all frequencies. I have analysed it roughly, and the curve shows the result.

As Mr. Voigt explained, there is no component of zero frequency, because the plus and minus areas of the transient are equal. Likewise, the amplitudes at high fre-

parative amplitudes.) Curiously enough, the maximum output is neither at 300 or 600 cycles, but at about 500. There is *no* output at 1,200 cycles and thereafter at every 600; and there are maxima at about 1,400, 2,000, 2,750, 3,250, and at these two latter frequencies plus multiples of 1,200 cycles, e.g., 3,950 and 4,450, and so on. These maxima are quite small, the value of each being approximately  $(600/f)^2$ , where  $f$  is the frequency considered. (*Negative* maxima, of course, only mean reversal of phase.)

As stated above, the high-frequency components of this pulse are small, owing to the absence of steep wavefronts. Mr. Voigt rightly says that an instantaneous rise or fall of pressure—i.e., a vertical wavefront—is impossible in practice. But we know that very high frequencies—up to 50,000 cycles or more—can certainly be transmitted as air waves; so that we must in practice be prepared for much "steeper" transients than his, and in these the components of really high frequency will be much more important.

If, for example, we used one cycle each of 3,000 and 6,000 cycles instead of his 300 and 600, the frequency scale of the curve would be ten times as high, and components up to at least 30,000 cycles would be quite important.

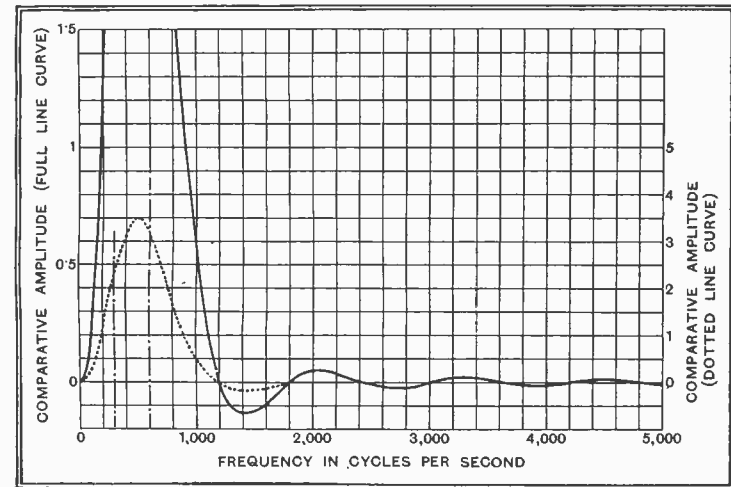
I have not analysed his second transient, because it is a laborious business in any case. The result would be different in detail but of the same general nature.

But one important point must not be overlooked. To get an exact reproduction of the transient waveform, our apparatus must have a frequency range from zero to infinity. But this is *not* necessary for sound reproduction. Our ear itself is limited in frequency response, and hence cannot ever hear such a transient in its true wave form. But if our apparatus has as good a response as the ear itself, it can supply the ear with all that it *could* hear, and so give perfect reproduction *as judged by ear*.

No two men's ears are exactly alike, but very careful experiments indicate that a response from about 30 to 15,000 cycles is sufficient even for transients of very steep wavefront; for those in ordinary music 11,000 or so seems quite adequate.

Mr. Voigt's second main point is a very neat arrangement to show that an arrangement with infinite frequency response but poor damping will still not reproduce transients; and he is perfectly correct in this. But he follows this result with the state-

Mr. P. K. Turner's analysis of the transient shown in Fig. 4 of Mr. Voigt's article.



quencies are small, since the transient has no very steep "wavefront." But practically any such transient has some energy at all frequencies from zero to infinity, except for a series of isolated "zero points."

In the curve the dotted line shows the amplitude at frequencies up to 1,800 cycles, while the full curve shows them to a much larger vertical scale up to 5,000. (The vertical scales are arbitrary, showing only com-

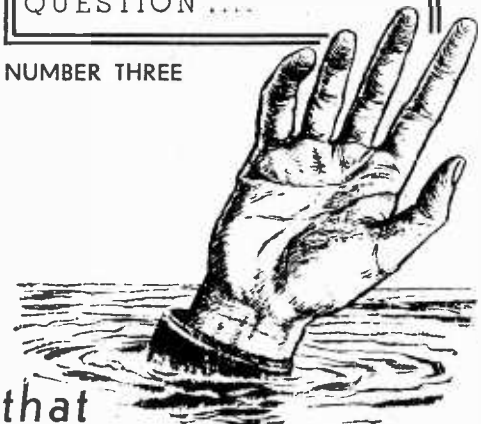
ment that only 1 in 1,000 of speakers as made have moving parts light enough not to cause some such effects in practice.

Here, again, he is unintentionally misleading. The actual weight or mass is quite unimportant by itself. It is the ratio of mass to damping resistance that is important.

The matter is more easily dealt with in the electric equivalents. Here a circuit

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## Letters to the Editor—

with capacity and/or inductance has a "time-constant" depending not on the C or L only, but also on the resistance. For inductance only the time constant is proportional to L/R; if we double L we can still make the current rise just as quickly by doubling R.

Similarly, if for L we substitute mass and for R the corresponding dissipative mechanical (and acoustic) resistance, the same law holds for getting into rapid motion.

It must be realised that this damping arises in three main ways: first, by doing useful work on the air; second, by useless losses in the speaker itself; and third, by the presence across the speaker of a low-impedance driving circuit. The second is a real waste, and is to be avoided as far as possible; but the first and third damp without wasting power.

My own case, summarised, is that it is essential to have a *wide* response curve for reasons already indicated, while a comparatively *flat* one, without sharp peaks or dips, is usually an indication of efficient damping. To produce a flat curve *without* sufficient damping would need the mechanical equivalent of a complicated multi-stage filter circuit.

P. K. TURNER.

Isleworth.

MR. VOIGT'S article on transients has apparently roused the interest which it deserves.

Mr. Davies seems to have got very near the mark with his "wavefront steepness" idea, but that steepness depends not only on frequency but also on amplitude.

Mr. Baggally points out that the curves quoted involve sudden changes in acceleration. This is obviously true, but I fail to see how that involves an infinite band of frequencies, bearing in mind that the acceleration is finite, as Mr. Baggally points out.

To get the waveform shown we have only to deflect a violin string at a rate too slow to produce an audible note, release it and let it carry out a complete cycle under its own tension and catch it again when it has returned and is momentarily at rest. We assume, of course, that our imaginary violin does not introduce any overtones. We have only to release two strings tuned to 300 c/s and 600 c/s, and we have our wave as shown in Fig. 4 of the article.

As the string goes to rest naturally at its extremes, I see no particular difficulty in holding it, since no change of velocity is involved, and we apparently do not get any spurious frequencies produced.

I quite agree that if the cycle began at any point other than that of extreme deflection and hence, rest, some peculiar things would happen, but Mr. Voigt selected his starting point carefully.

Birmingham. H. O. BRADSHAW.

## National Close-down

THE reason for the absence of protest against the silencing of the "Little National" is that the majority of the daytime listeners are women. The objectors are probably those like your correspondent of a fortnight ago and myself, who have had to change the switching and inductances of pre-tuned receivers so that their wives may have the morning talks and a musical background to their housework.

As for the sudden announcement of the change—well, *coup d'état* and *fait accompli*

are not English phrases. That such methods usually succeed is not creditable to those who adopt them.

Complete depreciation of the National programme without notice is a prospect which seems to face all those in the affected districts who are unable to erect efficient aeriels and cannot tolerate electrical interference in their music. Their numbers must be great, for these are the heaviest populated areas in the country, and therefore the places where it is often difficult or impossible to secure a high signal-to-noise ratio on any except local stations without the use of an aerial which the circumstances render quite impossible or highly expensive.

I would like to suggest that the B.B.C. refrains from going any farther with these changes for the present. A campaign might begin for the provision of proper anti-interference aeriels by the owners of flats, at the tenants' expense, of course. It might be linked up with the drive against the generators of this interference, and with the efforts of those who wish to tidy up the fantastic array of poles and wires in back gardens. When these efforts of the B.B.C., the Government, Messrs. Belling-Lee and the aesthetic reformers have produced some result, then it may be that Droitwich will be worthy of the PPQA and the finer efforts of the manufacturers of loud speakers. Until then, to deprive millions of listeners of good quality reception in order to foster an already overgrown spirit of parochialism, shows a lack of a sense of proportion somewhere.

Whatever arguments are brought forward, it still seems ridiculous that the vibrations of a violin played within two miles of my receiver should have to travel two hundred miles in order to reach me, losing most of its harmonics somewhere on the way.

London, N.19.

W. J. S.

IN the West Country we have felt the loss of the National medium transmitter acutely; here, contrary to your opinion, there has been no lack of protest, my business having received hundreds of complaints by telephone, letters and personal calls. In my experience this is the listener's usual reaction: he takes his complaint to the trade

source that supplied and services his apparatus; it is my belief that this happens throughout the country, but the trade is apathetic in the face of the Corporation's dictatorial attitude.

This business has, as usual, passed all complaints received to Broadcasting House, lodged a protest, and advocated to complainants the advisability of direct communication; we know of approximately 100 such letters and have seen many of the replies, which are perfect examples of political diplomacy in that they fill a sheet of paper without saying anything.

It is strange that in one case an individual had replies in triplicate posted in separate envelopes—economy? Each reply emphasises the fact that more letters have been received in favour of the change than against, but we have yet to meet the listener who favours the change.

Mr. Mead's two criticisms of Droitwich, i.e., atmospheric interference due to low field strength, and woolliness due to long-wave coil windings, are also ours.

The cleverness shown by the Corporation in their choice of transitional period has my admiration; similarly with programmes, things can be got away with in July and August that would create quite a different atmosphere in November. A. A. TURNEY.

The Signal Shop, Bridgwater.

I WOULD like to join Mr. S. H. Mead in lodging a protest against the close-down of the London National during daytime. As bad luck would have it, I had just built a really high-class R.F.-det. unit, working only on the medium waves, for feeding my high-fidelity paraphase-push-pull amplifier, about a fortnight before—and I am not going to alter it as results are extremely realistic.

While on this subject of realistic reproduction—why can't we have our organ music from the local studios? Surely there are sufficient good organists in London. All "quality enthusiasts" will be unanimous in their verdict on how much superior local studio quality is to that relayed from the provinces.

Cannot local organists visit the B.B.C. instead of playing on their own cinema organs? THEO. VAN DER WALT.

London, E.1.

## RANDOM RADIATIONS

By "DIALLIST"

## One Day More

THERE'S not much more of Olympia left, for on Saturday night the big doors close on what has undoubtedly been one of the most successful of all the Radio Exhibitions since the first in 1922. If you have not yet paid your visit seize this last opportunity, for it's a show that's well worth seeing in every way. The television section is attracting an enormous amount of interest, and I shall be surprised if many of those who hesitated a year ago about investing in televisions don't now make up their minds to take the plunge forthwith. One comment that I have heard from a good many people who hadn't seen television for twelve months or so is that the illumination of the screen is vastly better than it was. If you've witnessed television pretty frequently during the last year you perhaps don't realise what im-

provements have been made so readily as do those who come to it afresh after a longish interval. Television is certainly good enough for anyone nowadays, and it seems likely to develop fairly soon into the general hobby that it deserves to be. Naturally, it can't hope to claim any such numbers as "sound" broadcasting, for the cost of the apparatus is an almost insuperable barrier here. I believe, though, that the televisor will soon become a regular part of the equipment of well-to-do homes within the service area of the television transmissions.

■ ■ ■

## Some Servicing

A FRIEND of mine had not long ago a weird adventure with a servicing firm when his set went out of action. The firm called in to deal with it professed themselves able to deal with receivers of any make or

**Random Radiations—**

kind. Believing that their claims were genuine he sent his set to them, but, do what he could, he was unable to get it back again for several weeks. The fault had proved difficult to trace; they were waiting for spare parts, and so on and so on. On its return the set functioned in some kind of way, but was certainly not its old self. Eventually it went to another servicing firm who *did* know their job. Their report was illuminating. The apparatus had been partly dismantled, it appeared, and re-assembled by someone without the circuit diagram and more or less by the light of nature. Finding the going difficult, the assembler had just altered things to suit himself, and the set, as delivered by him, was quite different from what it had been in its original state. A large part of it had to be rewired by the second service firm, after which its performances were as good as ever.



**Car Aerials**

ONE sees a good many novelties in car aerials nowadays. The original types arranged under the running boards or beneath the roof are still by far the commonest, but others of new kinds are making their appearance. One that is becoming familiar is a single wire stretched between supports over the top of the roof. This gives good results, but some car owners don't like the look of it, and there is always the risk of forgetting that it's there if you are driving down a narrow country lane with low overhanging branches. Another kind that I haven't yet seen in this country is becoming more and more popular in the United States. This consists of a single telescopic metal rod mounted on an insulator fixed to the rear bumper. When it is not in use it folds up out of the way, and if you want to bring it into action it is a matter of seconds to extend it to its full height. Those who like doing little jobs in the workshop could improvise a very useful aerial of this type from one leg of a discarded camera stand of the metal telescopic kind.



**Push-pull Knobs**

WHAT I call the push-pull knob has been widely adopted nowadays by set manufacturers. The arrangements are delightfully simple. The end of the spindle is cut to a D-shape, and the knob itself has a D-shaped hole with a piece of spring across the flat part. In theory, at any rate, you have only to push the knob home on to the spindle to make it stick firmly in position, though it may be pulled off instantly when required. I suppose there's a good deal to be said for knobs of this kind. One of their virtues is that they don't "free-wheel," and another that they lighten the

tasks both of those who assemble sets in the factories and of those who may have to remove the chassis subsequently for servicing purposes. That's as may be, but I can't say that I am entirely in love with them. My objections are two-fold. The first is that if they do come off—and at least one knob has become detached in transit in about half the sets sent down to me for test when I come to unpack them—it is ten to one that the little piece of spring, which is the key to the situation, has come adrift and lost itself for good and all. I keep a reserve of old clock-springs of different widths to meet such emergencies, and it's easy enough to snap off a bit of suitable length with flat-nosed pliers. But in the average household clock-spring is unlikely to be available, and a knob that comes off may mean a set out of action until the services of a repair-man can be obtained. My second objection is that if the spring is firm enough to make the knob a really good fit for the spindle you have to pull so hard to remove the knob that you feel you must be subjecting delicate things, such as ganged condensers, switches and volume controls to undue endwise strains. Personally I much prefer the now unfortunately old-fashioned knob secured to its D-shaped spindle by a setscrew.

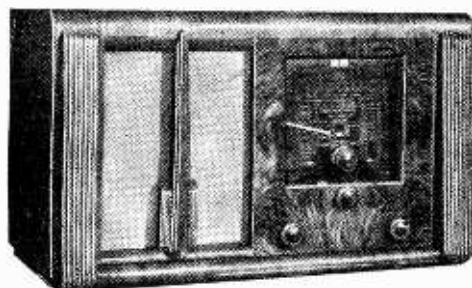


**Set Makers, Please Note**

EVERY year I try out in my own home a pretty big number of receiving sets, and I have, therefore, good opportunities of noting small shortcomings that may not be obvious to those who designed the sets. One particular grouse that I have has already been mentioned editorially in *The Wireless World*: there is no standard arrangement of knobs; therefore, unless each is marked you don't often know what its particular function is without referring to the book of the words. The main tuning control is usually in the middle just below the dial, but the volume control, the tone control, the wavechange switch and so on may be placed to the right of it, to the left of it or beneath it. And sometimes there are other knobs as well. Ideally, there should be some standardisation of the position of controls, but ideals are proverbially unattainable. If there can't be standardisation, knobs should be marked, and marked plainly.

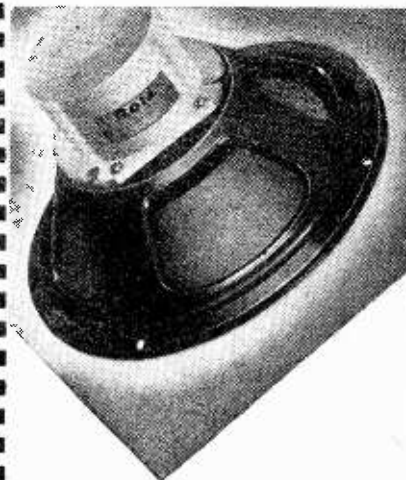
**Make Them Plain**

That brings me to another grumble. Wavechange switches are often the very dickens. Sometimes the letters L, M, S and G, standing, of course, for Long Waves, Medium Waves, Short Waves and Gramophone are merely moulded on the periphery of a hexagonal knob, and even in a normally well-lighted room you just can't read them unless you strike a match or use a flash lamp. Sometimes, again, the various positions of the wavechange switch are indicated just by coloured dots on the face of the knob. There are three big objections to this. The first is that the dots are not easy to see except in the strongest of lights; the second, that there is no standardised colour scheme—green may mean short waves in one receiver and gramophone in another; the third, that quite a few people are semi-colour blind and have difficulty in distinguishing, particularly by artificial light, between, say, a rather indefinite blue and a rather indefinite green. I am sure that I shall be voicing the feelings of most listeners when I say that there should be on the tuning dial a very clear indication of the position of the wavechange switch.



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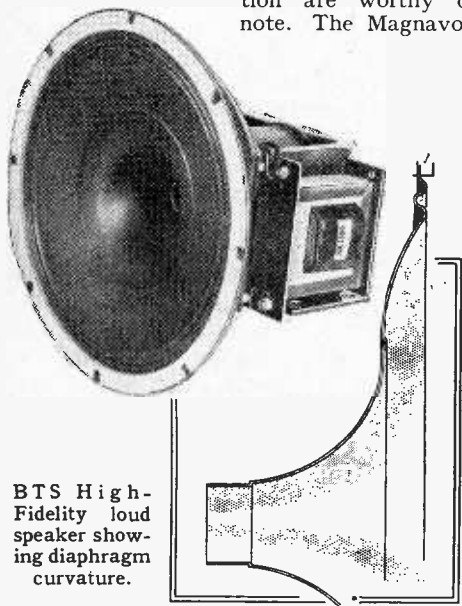
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# Loud Speakers and PA

## Improvements in Electro-acoustic Apparatus

AS far as the design of small moving-coil units for incorporation in receiving sets and extension loud speakers is concerned the year has been one of consolidation rather than of exploration into new fields of development. The frequency response of the majority of standard broadcast receivers is already comfortably accommodated by the single cone type of unit, and improvements which have taken place are mostly in the direction of making the fullest possible use of the aluminium-nickel-cobalt alloys which were introduced last year. These have proved of the greatest value for permanent magnet loud speakers for use in battery receivers, and the introduction of units such as the Rola F742-PM and F1050-PM have, by their increased efficiency, enabled designers of battery sets to effect useful economies in rating of their output stages. At the other end of the scale we find massive magnets such as those used in the Haynes Senior PM loud speaker and some of the Goodmans Auditorium models with flux densities which are quite equal to, if not in excess of, the average field strengths of energised types.

There has been no big drive to produce new high-fidelity loud speakers, but one or two individual contributions in this direction are worthy of note. The Magnavox



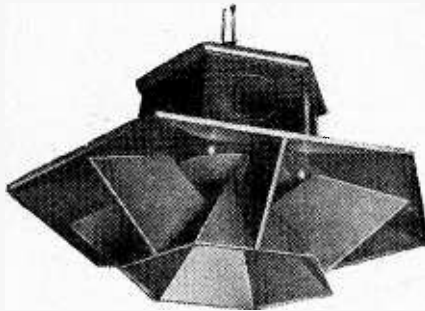
BTS High-Fidelity loud speaker showing diaphragm curvature.

Duode 33, for instance, has appeared with a modified diaphragm of the curve-sided type starting with a very steep angle near the speech coil and then returning rapidly to an almost flat plane for the remainder of its diameter. A very similar form of construction has been adopted in the BTS High-Fidelity loud speaker, and in this case the curvature of the diaphragm is convex near the centre and slightly concave towards the periphery. Another notable high-fidelity loud speaker is the W.B. "Planoflex," in which the box baffle plays an essential part. The curve of this reproducer appeared in our first show number.

It is in the application of loud speakers to PA work that we find, perhaps, the most activity. Here there has been a notable advance in the power handling capacity,

and horn type units such as the Film Industries' new LS8 will handle 35-40 watts speech power when used in association with a 70-inch exponential horn.

A new high level in power-handling capacity, at least as far as this country is concerned, is reached by the Tannoy high-power loud speaker which has been specially designed for naval purposes. A large domed aluminium diaphragm is used and a series of radiating holes collect the pressure wave uniformly from all parts of the diaphragm and recombine it at the throat of

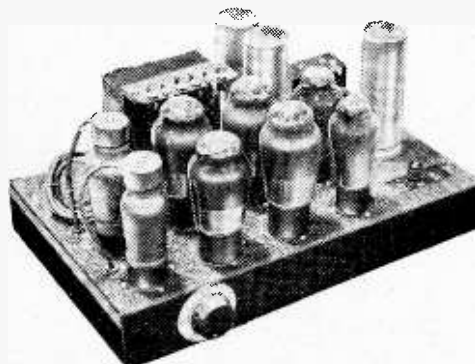


Goodmans Concentric Diffuser unit.

the horn without introducing appreciable phase differences. The horn, which has a flare of 2ft. diameter, is a massive aluminium casting designed to remain rigid under the considerable acoustic pressures associated with a 300-watt input and an electro-acoustic efficiency of the order of 50 per cent.

Before leaving PA loud speakers of special design, reference should be made to the new Goodmans Concentric Diffuser loud speaker. This is designed to radiate sound uniformly in a horizontal plane. Immediately below the unit the sound field is of low intensity, and advantage may be taken of this fact in the placing of the microphone to overcome feed-back troubles. There are six cells in the construction of the baffle, each of which can be regarded as a short tapered horn. The reproducer is a 12-inch permanent magnet unit with a 1½-inch voice coil and a field of between 14,000 and 15,000 lines.

Complete PA equipments fall naturally into two groups. On the one hand, we have apparatus specifically designed for a given purpose, such as the general order and telephone system for use on board ship and the railway terminus PA equipment shown on the Tannoy stand, and, on the other, com-



Shaftesbury high-gain amplifier chassis. Output 20 watts, gain 98 db.



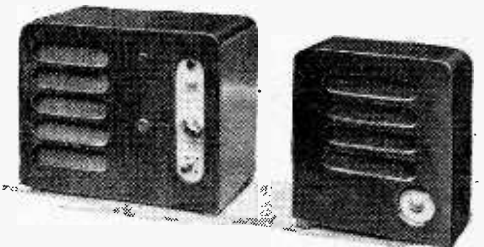
Tannoy high-powered projection loud speaker designed to handle 300 watts.

prehensive unit systems such as the Ardente amplifier and "500" series input units from which any desired specification can be fulfilled at a moment's notice.

Portable dance band amplifying equipment, of which the Shaftesbury "Paragon" is a good example, is still in demand and is catered for by all the leading manufacturers of PA apparatus.

In the design of amplifiers, which together with loud speakers are the foundation of the PA industry, there is a noticeable tendency to dispense with pre-amplifiers for microphones of the moving-coil and ribbon type and to produce single high-gain amplifiers complete with power output stage for this purpose. Gains of the order of 100 db. on outputs of 10 and 20 watts are now quite common. Tetrode output valves are also gaining ground and the Sound Sales 35-watt amplifier may be quoted as an example of their application. This unit makes use of two KT66 valves or their equivalent in Class AB push-pull with negative feed-back.

Finally, there is another new development which can rightly be regarded as falling within the category of PA. We refer to the



Master unit and sub-unit of Ardente "Selectacall" loud speaking intercommunication system.

loud speaking intercommunication systems for offices and works of which the Tannoy 2-watt and Ardente "Selectacall" systems are examples.

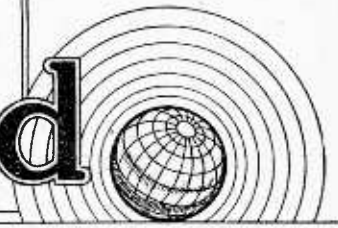
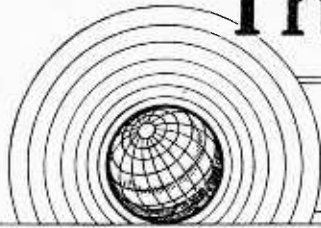
**Wireless Servicing Manual**, by W. T. Cocking. Third edition. Pp. 241+x. Published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 5s., post free 5s. 5d.

THE new edition of this popular book on receiver servicing includes much additional material, for a new chapter dealing with the aerial-earth system has been added. Not only are anti-interference types treated in this, but useful information is also given on resonant aerials for television reception.

The appendices have been added to also, and the tables of valve-base connections have been brought up to date by the inclusion of the latest types of valves.

# The Wireless World

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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

### The Olympia Theatre

#### An Admission of Incompetence

SO once again this year the radio theatre at Olympia has been run in competition with the Wireless Exhibition.

A few years ago there might have been some justification, or at least some plausible arguments could have been put forward for holding the theatre show, but for the Exhibition authorities to persist to-day to argue that the theatre is there to make people radiominded and to give them an idea of what broadcasting can provide for them, is a pathetic admission of failure to appreciate that the people for whom manufacturers now have to cater are already in possession of a wireless set and thoroughly familiar with what broadcasting can provide. So we must look elsewhere for some reason why the authorities should continue the theatre show at all, and we probably find it in the desire to get more newspaper publicity and increase the entrance receipts at the turnstiles.

Let us contrast the position of the radio theatre with television. Television provided every justification for making provision for the maximum number of people visiting Olympia to have the opportunity of looking in and being made television-minded. Only a handful of people in London to-day have seen television, and if only half the attention had been given to providing the best possible facilities for everyone to get acquainted with a television performance as was given to the organisation of the theatre shows, the Exhibition as a whole would have benefited enormously.

The absurdity of the situation was exposed when the organisers of the theatre performances made representations to the television demonstration section, complaining that the sound

from the television instruments interfered with their show.

We have persistently expressed the opinion that it ought not to be necessary to provide a bait such as the theatre in order to induce the public to visit Olympia.

If the Exhibition organisers must augment their receipts at the turnstiles to help pay for the Exhibition, then let them run a theatre show for profit in the West End at some other time, or indulge in any form of legitimate trading so long as the show remains a wireless show, as we believe the great majority of the exhibitors would wish.

## Television

### Measuring Public Response

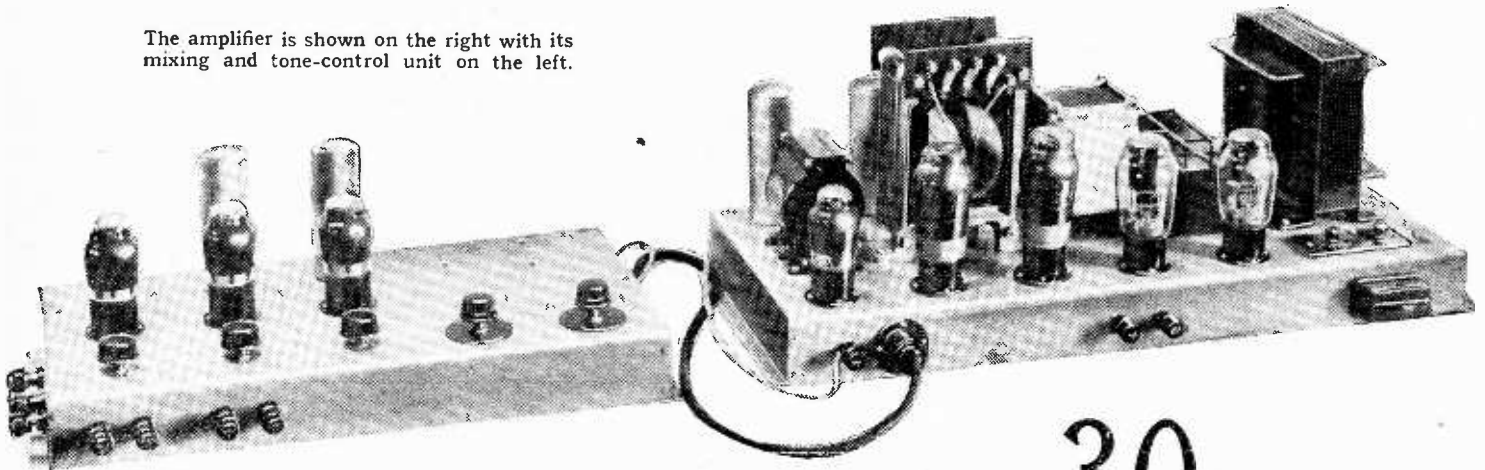
IN the published Report of the Television Committee in January, 1935, the following recommendation appeared: "We hope that it may be possible to negotiate an arrangement with the trade whereby periodical returns may be made of the total number of television sets sold in each town or district, since this would provide some measure of the growth of the demand."

Just what has happened about this recommendation we do not know, but we are sure that the advisability of it was at no time of greater importance than now when the public begins to show real interest.

In the case of sound broadcasting there has always been the published return of licences to indicate the growth of interest.

There should be no secret made of the success or otherwise of the television adventure, and before launching out on another station in Birmingham, or elsewhere, the degree of success of the London experiment should be made known.

The amplifier is shown on the right with its mixing and tone-control unit on the left.



# 30-watt HIGH-QUALITY PUBLIC

**A** LARGE output is essential for PA work and is most economically obtained from pentodes, while good mixing and tone control systems are very desirable. These are included in the amplifier described in this article and the adoption of negative feed-back results in a very high standard of quality of reproduction.

**I**T is customary for apparatus with an output greater than some 12-15 watts to be termed PA equipment, in spite of its applications being by no means confined to public address work. This is probably its greatest application, it is true, but there are many cases when a greater output than that provided by domestic apparatus is necessary. The operation of a number of loud speakers in different rooms, the application of volume expansion, and the modulation of a low-power transmitter all demand the use of an amplifier which is capable of providing an unusually large undistorted output.

The Wireless World 30-Watt PA Amplifier meets most of these requirements in addition to those of most occasions upon which public address apparatus is needed. A larger output is necessary only for large outdoor gatherings and very large halls.

### Tone Control

It is not sufficient in PA apparatus to provide a large output. Satisfactory operation is only obtained when it is possible to mix two input channels so that the comments of an announcer can be made with a background of music pro-

vided by gramophone records. In addition, it is often convenient to be able to change from one input source to another by means of a fade-over control.

By no means least important is the question of tone-control. The proper reproduction of records demands a rising bass characteristic, but this is undesirable on speech. At large volume, in fact, a falling response in the bass is often required if boominess is to be avoided. It is thus desirable to be able to vary the bass response in steps on either side of the normal flat characteristic.

In the treble a similar state of affairs

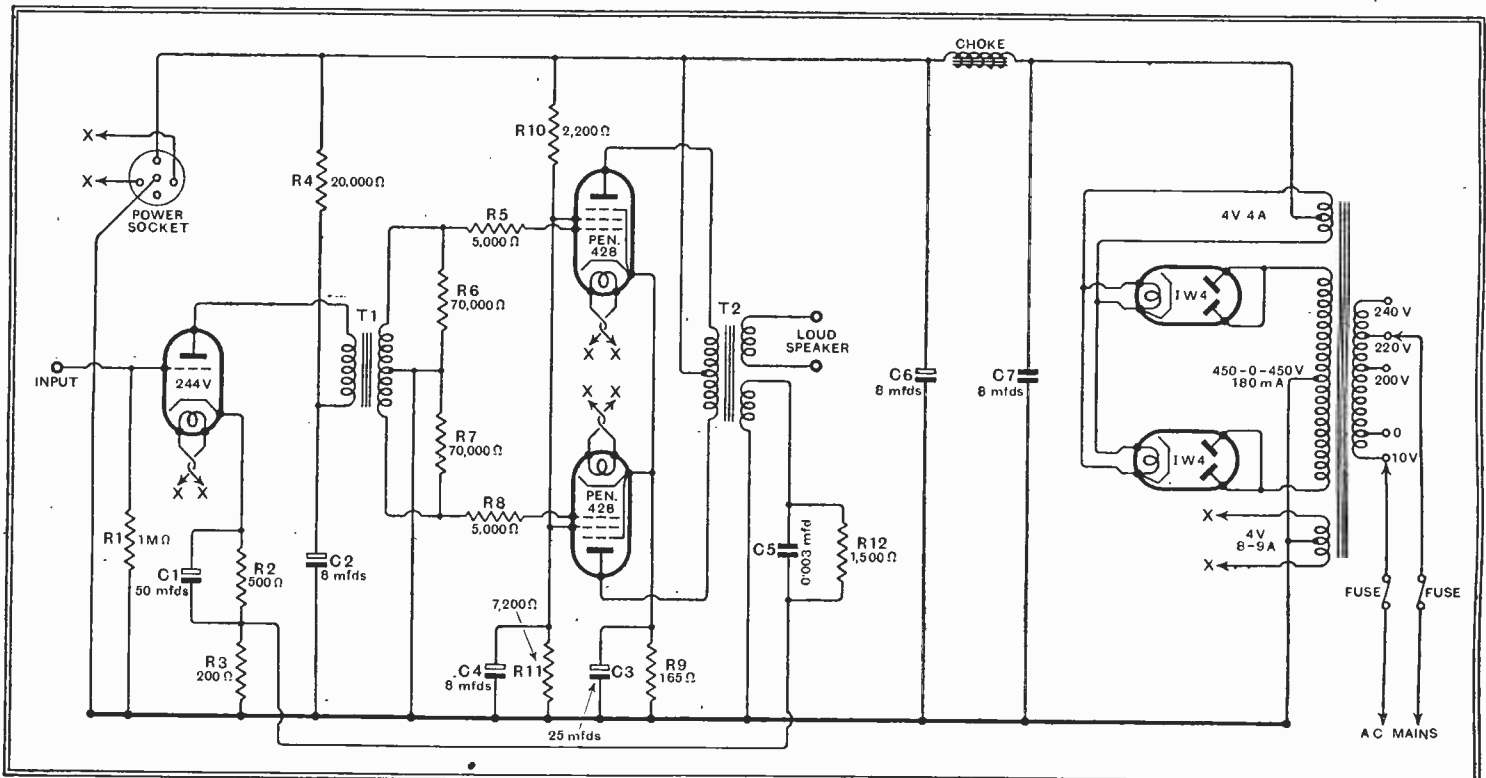


Fig. 1.—The complete circuit diagram of the amplifier is shown here. Negative feed-back is applied from the special winding on the output transformer in conjunction with R12 and R3.



exists. Some reduction of the upper frequency response is often necessary on gramophone in order to attenuate needle scratch, but a rising characteristic leads to increased intelligibility of speech. An independent treble tone-control is thus desirable.

The circuit diagram of the amplifier proper is shown in Fig. 1, and it will be seen that two pentodes are used in push-pull in the output stage. Although each valve alone is capable of an output of only 5 watts, the pair deliver no less

The anode supply is some 375 volts, and the screens are fed at 275 volts from the potentiometer comprising R10 and R11. The consumption of this potentiometer is fairly heavy, since it is necessary for the screen potential to be maintained substantially constant in spite of a fluctuating screen current.

In the grid circuit anti-parasitic resistances R5 and R8 of 5,000 ohms are included, and the two halves of the input transformer secondary are shunted by 70,000-ohm resistances in order to keep

output the input required is some 3.5 volts RMS.

Generously designed mains equipment is essential for good results, since it is important that good regulation of the HT supply is obtained owing to the fluctuating anode current. Two rectifier valves are used with a mains transformer rated at 450 v. 180 mA., and a single smoothing choke is adequate for hum-free operation.

Turning now to the mixer and tone-control unit, provision is made in this for the use of both microphone and pick-up, for it is highly desirable that two such input channels should be capable of being mixed to any desired degree. It is then possible, for instance, to superimpose speech on music and to adjust their

# PA Amplifier

## ADDRESS EQUIPMENT

By W. T. COCKING

than 28 watts to the loud speaker! This is due to the adoption of Class AB operating conditions. Grid current is not permitted, but some degree of over-biasing exists so that the conditions approach those of a quiescent push-pull stage. They are not very near them, however, for there is a large standing anode current, and the rise in current at full output does not exceed about 50 per cent. of the no-signal current. Class AB operating conditions are only permissible with push-pull, on account of the cancellation of even harmonics obtained with this circuit.

A properly designed Class AB stage introduces very little harmonic distortion, usually about 3 per cent., and the use of pentodes is advantageous in reducing to a minimum the output required from the penultimate stage and the power needed from the mains equipment. As normally applied, however, a pentode output stage has the disadvantage of leaving the loud speaker substantially undamped with the consequent accentuation of low-frequency resonances. This can be overcome by the proper application of negative feed-back, which can make a pentode output stage react on to the speaker just as if it were a triode.

### Negative Feed-Back

It is true that the amplification is reduced to the same order as that of a triode, but if the feed-back is introduced over two stages the voltage handling requirements of the penultimate valve are not increased. In addition, the frequency response is extended, and there is normally a welcome reduction in amplitude distortion.

It will be seen from Fig. 1 that the output valves are operated with a common bias resistance R9 of 165 ohms shunted by a 25-mfd. electrolytic condenser C3.



The amplifier unit with its cover in place.

down phase-shift at high frequencies. The penultimate valve is a triode of moderate AC resistance with the transformer included directly in the anode circuit and decoupling provided by the 20,000-ohm resistance R4 and the 8-mfd. condenser C2. Bias is provided by the voltage drop across the resistances R2 and R3 of 500 ohms and 200 ohms respectively.

The resistance R3 is the one across which feed-back voltage is developed, for with R12 it forms a potentiometer across a special winding on the output transformer. The feed-back voltage is  $2/17$  of the AC voltage across the transformer winding. The secondary winding proper is wound in several sections which can be connected in series or parallel to obtain different output impedances.

The condenser C5 shunting R12 is for the purpose of increasing the feed-back at high frequencies, and also for introducing a phase-shift which corrects the phase-change in the amplifier, and so ensures stable operation.

An output of 28 watts, measured in a resistance load connected to the transformer secondary, is obtained with a low degree of harmonic distortion. At larger outputs the waveform departs seriously from the desired sine wave. For 28 watts

relative volumes to the desired level. Although not essential, it is useful to have two input channels for gramophone so that two turntables can be used and a rapid changeover from one to the other obtained, thus securing continuity of programme. Mixing between such channels is unnecessary, however, and a simple fader suffices.

### The Mixing Circuit

The circuit of Fig. 2 shows the arrangement adopted. Two pairs of terminals enable two pick-ups to be connected and the fader R13 and R14 enables a fading change-over from one to the other to be secured as well as volume control. The input valve functions as an amplifier on these channels only. On microphone, there is an input volume control R15 which feeds the other input amplifier which functions only on this input channel.

Mixing is effected in the anode circuits of these valves, and it could be done merely by joining their anodes together. This arrangement is often used but has the disadvantage that each valve works into a load circuit resistance less than its own AC resistance, a condition which is liable to result in harmonic distortion unless the

**30-watt PA Amplifier—**

inputs are very small indeed. Resistances R18 and R19 are accordingly included in the anode circuits in order to maintain a load impedance on each valve of about twice its AC resistance and so obtain linear operating characteristics. This system of mixing has been previously described in *The Wireless World*<sup>1</sup> in an article dealing generally with mixing

their main function is to enable a wide range of tone control to be obtained. It is possible to include a control which reduces the bass and treble response without a loss of amplification, but it is not possible to include one which increases the response to any marked degree without losing gain to at least as great an extent as the rise at the ends of the characteristic. It is, therefore, necessary to include

ance R27 and the 50,000-ohm resistance R26; actually, 3/53rds of the output of the valve is utilised. When the bass-control switch is in position 4 a condenser C16 of 0.25 mfd. is included in series with R27 and the impedance of the lower limb of the voltage divider rises as the frequency gets lower, and so the proportion of the output which is applied to the following valve increases, giving a rising bass

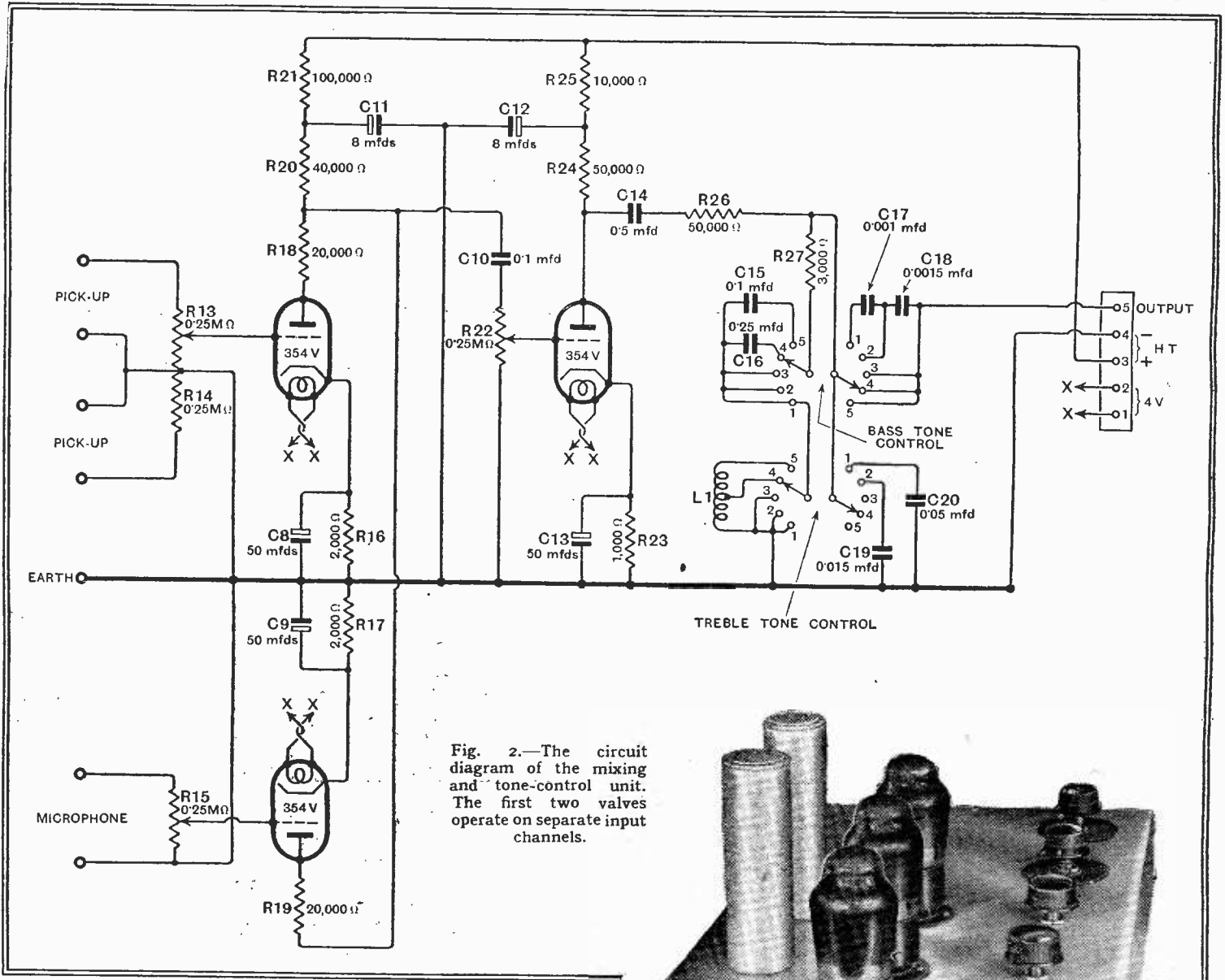
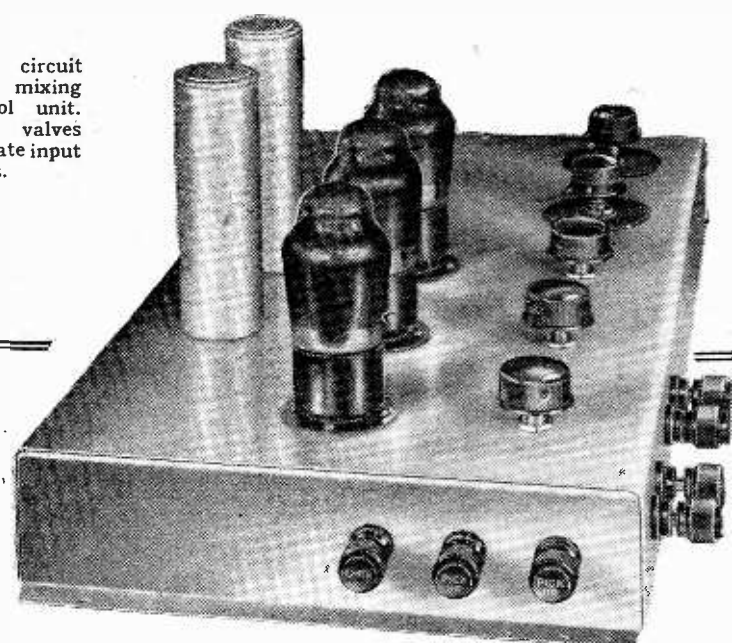


Fig. 2.—The circuit diagram of the mixing and tone-control unit. The first two valves operate on separate input channels.



All the variable controls on the mixing unit are arranged for easy access.

circuits, and full design details were given.

Between this two-valve mixer and the succeeding stage, resistance coupling is used. The coupling resistance R20 has a value of 40,000 ohms and decoupling is provided by the 100,000-ohm resistance R21 and the 8-mfd. condenser C11. A further volume control R22 is included in the grid circuit of the following valve, and it functions as a master gain control. The input controls R13, R14, and R15 enable the volume on these two channels to be independently controlled, but R22 controls all input channels simultaneously. It is, of course, not an essential fitting, but it is a useful refinement.

This valve and its associated circuits provide some degree of amplification, but

<sup>1</sup> *The Wireless World*, October 9th, 1936.

an extra stage of amplification to make up for the loss in the tone control circuit.

This gain is provided by the second stage, which gives good amplification between its grid and anode circuits. When the tone-control switches are set for a flat characteristic (positions 3), most of this gain is thrown away by the voltage-divider comprising the 3,000-ohm resist-

characteristic. In position 5 the action is the same, but a smaller capacity is included and the rise in response is greater.

The same action is secured, but this time at high frequencies and by the introduction of inductance L1 in series with R27, in positions 4 and 5 of the treble-control switch. The impedance of the circuit rises with frequency and the re-

**30-watt PA Amplifier—**

sponse also increases. When both bass and treble controls are set to give a rising characteristic the resistance, capacity and inductance are all in series and the impedance is a minimum over the middle range of frequencies. The response consequently rises at each end of the scale.

The treble response is reduced in positions 1 and 2 of the treble-control switch by the simple expedient of shunting the circuit by the condensers C19 or C20 respectively. The bass response can also be reduced by including small capacities in series with the output; in position 2 of the bass-control switch C18 is in action, while in position 1, C18 and C17 are in series.

(To be concluded).

**THE LIST OF PARTS USED.**

*Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.*

**AMPLIFIER UNIT.**

- 1 Mains transformer with connecting block. Primary: 200-250 volts, 50 m.A. Secondaries: 450-0-450 volts, 180 mA.; 4 volts, 4 amps. CT, 4 volts, 8-9 amps. CT  
Savage T18581
- 1 Output transformer, 1-4-9 and 16 ohms  
T2 Sound Sales 428/30F
- 1 Smoothing Choke, 25H., 180 m/A.  
Ch Vortexion CH25
- 1 Input transformer, push-pull, ratio 1:3.5  
T1 Ferranti AF5c

**Condensers:**

- 1 0.003 mfd., mica, C5 Dubilier 670
- 1 50 mfd., 12 volts, electrolytic C1 T.C.C. "FT"
- 1 25 mfd., 25 volts, electrolytic. C3 T.C.C. "FT"
- 1 8 mfd., 500 volts, electrolytic C6 T.C.C. 805
- 2 8 mfd., 440 volts, electrolytic C2 C4 T.C.C. 802
- 2 4 mfd., 650 volts, DC working C7 Dubilier Type LEG

**Resistances:**

- 1 200 ohms, 1/2 watt, R3 Dubilier F1/2
- 1 500 ohms, 1/2 watt, R2 Dubilier F1/2
- 1 1,500 ohms, 1/2 watt, R12 Dubilier F1/2
- 2 5,000 ohms, 1/2 watt, R5, R8 Dubilier F1/2
- 2 70,000 ohms, 1/2 watt, R6, R7 Dubilier F1/2
- 1 1 megohm, 1/2 watt, R1 Dubilier F1/2
- 1 20,000 ohms, 1 watt, R4 Dubilier F1
- 1 165 ohms, R9 Dubilier "Spirohm"
- 1 2,200 ohms, 20 watts, R10 Bulgin PR8A
- 1 7,200 ohms, 40 watts, R11 Bulgin PR36A

- 4 Valve holders, 5-pin, without terminals Clix Chassis Mounting Standard Type V1
- 2 Valve holders, 7-pin, without terminals Clix Chassis Mounting Standard Type V2
- 1 Twin safety fuse-holder with 5 amp. fuses Belling-Lee 1033
- 3 Terminals, ebonite shrouded, Input, LS+, LS- Belling-Lee "B"

- Chassis, 24x10x2in. Sound Sales
- Miscellaneous: Peto-Scott  
3 lengths systoflex, small quantity Nos. 16 and 18 tinned copper wire, etc. Screws: 30 1/4in. 6BA R/hd., 6 3/8in. 6BA R/hd., 26 3/4in. 4BA R/hd., all with nuts and washers.

- Valves:  
1 244V met., 2 Pen. 428, 2 IW4 Mullard

**MIXER UNIT**

- 1 Choke, 0.54H., tapped at 0.18H. L1 B.T.S. WW1
- 2 Switches, double-pole, 5-way, with knobs B.T.S. C125

**Condensers:**

- 1 0.001 mfd., tubular, 450 volts DC working C17 T.C.C. 300
- 1 0.0015 mfd., tubular, 450 volts DC working C18 T.C.C. 300
- 1 0.015 mfd., tubular, 450 volts DC working C19 T.C.C. 300
- 1 0.05 mfd., tubular, 350 volts DC working C20 T.C.C. 250
- 2 0.1 mfd., tubular, 350 volts DC working C10, C15 T.C.C. 250
- 1 0.25 mfd., tubular, 350 volts DC working C16 T.C.C. 250
- 1 0.5 mfd., tubular, 350 volts DC working C14 T.C.C. 250
- 2 8 mfd., 440 volts, electrolytic C11, C12 T.C.C. 802
- 3 50 mfd., 12 volts, electrolytic C8, C9, C13 T.C.C. FT

**Resistances:**

- 1 1,000 ohms, 1/2 watt, R23 Dubilier F1/2
- 2 2,000 ohms, 1/2 watt, R16, R17 Dubilier F1/2
- 1 3,000 ohms, 1/2 watt, R27 Dubilier F1/2
- 1 10,000 ohms, 1/2 watt, R25 Dubilier F1/2

- 2 20,000 ohms, 1/2 watt, R18, R19 Dubilier F1/2
- 1 40,000 ohms, 1/2 watt, R20 Dubilier F1/2
- 2 50,000 ohms, 1/2 watt, R24, R26 Dubilier F1/2
- 1 100,000 ohms, 1/2 watt, R21 Dubilier F1/2
- 2 Potentiometers, tapered, 0.25 megohm R15, R22 Dubilier "B"
- 1 Fader, 0.25+0.25 megohm, R13, R14 Dubilier "Fadover"
- 3 Valve holders, 5-pin, without terminals Clix Chassis Mounting Standard Type V1
- 1 Connector, 5-way Bryce 5C4
- 1 Cable, 5-way with twin 70/36 leads and 5-pin plug Goltone
- 7 Terminals, ebonite-shrouded, PU(4), Mike (2), E Belling-Lee "B"
- 1 Length screened sleeving Goltone
- Chassis, 19x9x2in. Sound Sales
- Miscellaneous: Peto-Scott  
4 lengths systoflex, small quantity No. 18 tinned copper wire, etc. Screws: 12 1/4in. 6BA R/hd., 2 1in. 6BA R/hd., 2 3/4in. 4BA R/hd., all with nuts and washers.
- Valves:  
3 354v. plain Mullard

## Mechanical Scanner for Television-Telephone Service

FOR the German Post Office's television-telephone service between Berlin and Leipzig, and now extended to Munich and Nürnberg, a mechanical scanning apparatus is employed. The two-way television service is shortly to be extended to Hamburg, Munich and Western German cities.

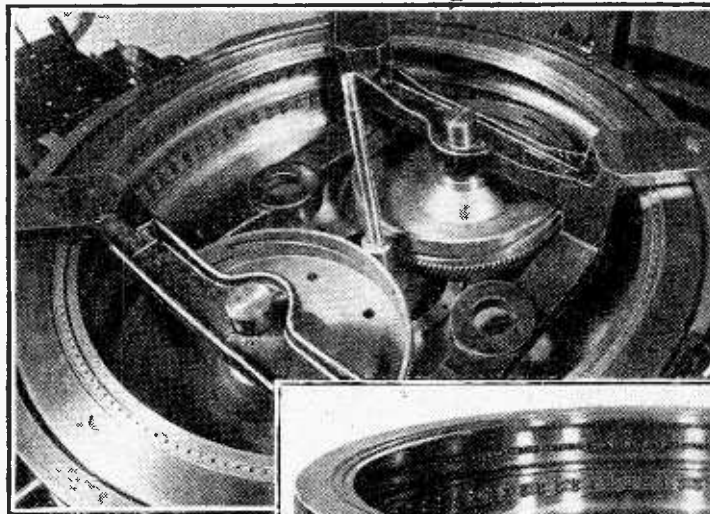
As the persons at each end of the line must be able to watch one another on the screen of a cathode-ray tube receiver, it is necessary to provide scanning means which

mechanical disc scanning system, which only illuminates the object during the brief moment the scanning ray passes over it.

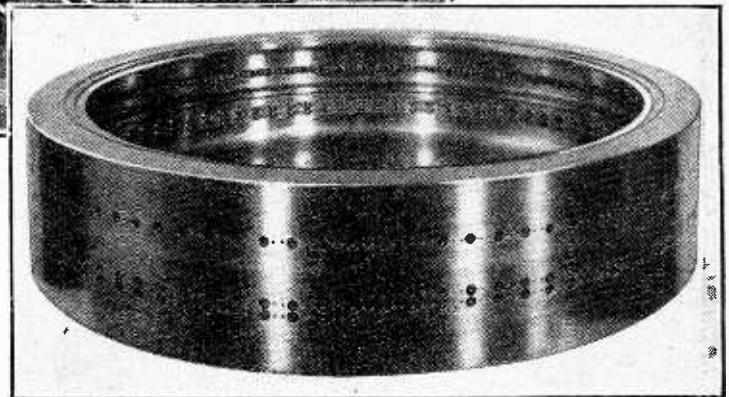
To enable the power of the illumination to be reduced it was thought best to introduce lenses into the holes. It was found, however, that simple lenses caused distortion, especially as the rotation of the disc tended to displace the lenses. Telefunken, who supplied the apparatus, therefore, produced a lens drum. Properly corrected microscope lenses were mounted on the interior circumference of a hollow cylinder.

In this way the energy of the rotating drum operates in the direction of the optical axis of the lens system and, therefore, does not interfere with them.

The light gain obtained by the use of the lens drum as compared to the ordinary Nipkow



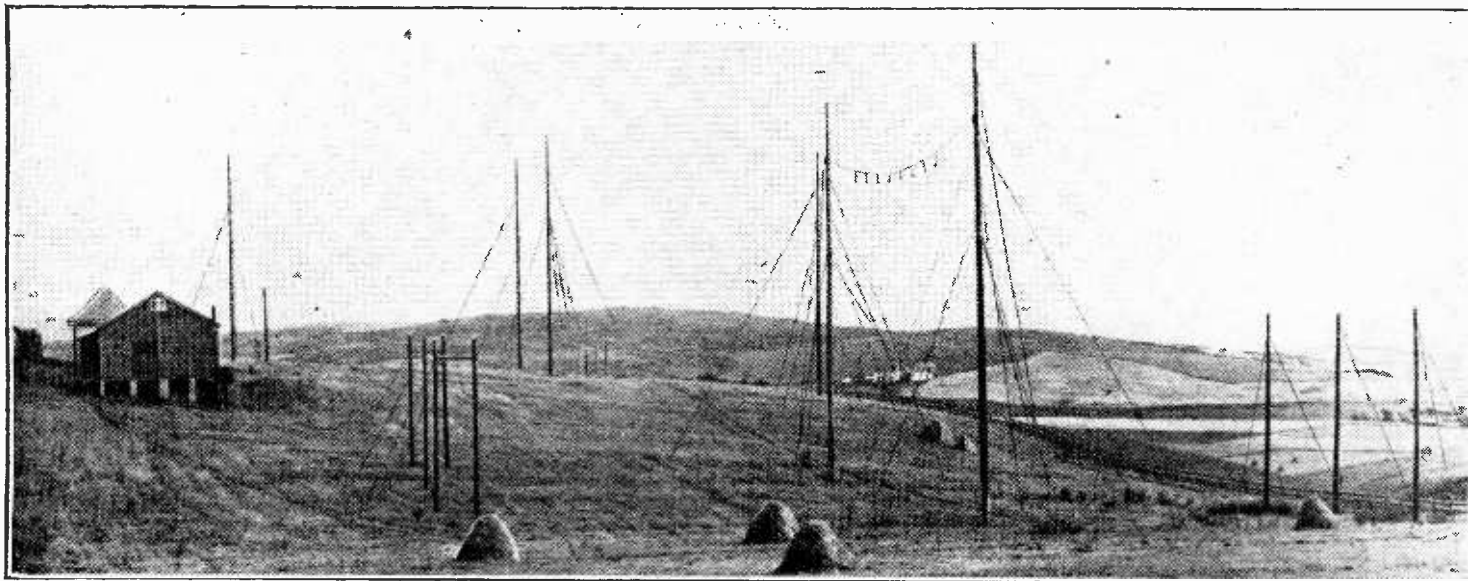
The Lens drum is seen above with the associated mechanism for driving.



will not dazzle. A permanent flood of light would obviously make it difficult to discern the image on the receiver. The Post Office, therefore, decided to make use of the

disc is about twenty to thirty times, in spite of the fact that the power of the arc lamp is only one-twentieth of that employed with the disc.

# Radio Link with Ireland



The receiving and transmitting aerials at Ballygomartin near Belfast.

## NINE ULTRA-SHORT-WAVE CHANNELS TO JOIN UP TELEPHONE SYSTEMS

**T**HE inauguration by Sir Walter J. Womersley, M.P., Assistant Postmaster General, of the Belfast-Stranraer 9-channel Ultra Short-Wave Radio Telephone Link, took place on August 31st.

Although the use of ultra-short waves for commercial telephony is by no means new—an experimental service having been operated by the Post Office as long ago as 1932—this is the first application in Great Britain, or in fact in the world,

of a system wherein as many as nine telephone channels are passed simultaneously over a single radio link.

This system is the outcome of many years of research by engineers of Standard Telephones and Cables, Ltd., into the technique of ultra-short-wave communication, coupled with long and arduous field trials. It is interesting to note, too, that these waves are by no means the limit of wavelength for communication purposes and that the researches of

Standard Radio engineers into Micro-Rays resulted in the design and installation as long ago as 1933 of the Lympne-St. Inglevert Micro-Ray Link used by the Air Ministry, which operates on a wavelength of 17.4 cms. over an optical distance of 21.7 miles (35 km.)

Foremost among the virtues of the ultra-short waves is the possibility of transmitting wide band-widths. The width of the band that can be transmitted increases as the wavelength is shortened, and it is for this reason mainly that high definition television

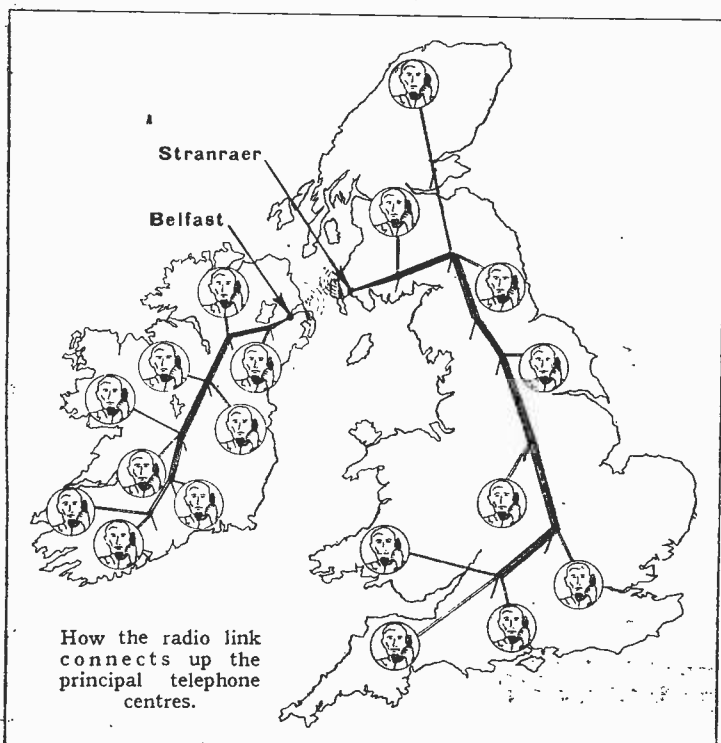
stations all operate in this region, as they require a total band-width of as much as 6 megacycles.

The equipment is designed for unattended operation and is capable of complete remote control from the nearest telephone exchange. In addition it is provided with spare equipment, part of which is brought automatically into operation on the occurrence of any abnormal condition. Both transmitting and receiving equipments derive their whole power supply from the public supply mains, the only battery used in the equipment being that for the operation of the relay system. A diesel electric power plant is arranged so that in the event of failure of the public electricity supply, it will automatically take over the load approximately one minute after such failure and thus avoid serious interruption of the service.

### PRINCIPLE OF OPERATION

#### The Transmitter

Let it be assumed that the input of Channel 1 is supplied with sinusoidal tone of frequency  $f_1$  kc/s per second. This input modulates a channel-frequency oscillator having a frequency in the range 150 to 300 kc/s per second, say 155 kc/s per second, resulting in a carrier frequency of 155 kc/s per second together with upper and lower sidebands of  $(155 + f_1)$  and  $(155 - f_1)$  kc/s per second. If Channel No. 2 be supplied with a tone input of frequency  $f_2$ , this will modulate an oscillator having a frequency of, say, 165 kc/s per second, resulting in a carrier frequency of 165 kc/s per second and upper and lower sidebands of  $(165 + f_2)$  and  $(165 - f_2)$  kc/s per second. Similarly,



**Radio Link with Ireland—**

Channel No. 3 may have a carrier frequency of 180 kc/s per second, and so on to the ninth channel of which the carrier frequency might be 280 kc/s per second.

The bands of frequencies derived from the 9 channels are now added together, producing in total a single frequency band extending from  $(155 - f_1)$  kc/s to  $(280 + f_9)$  kc/s per second. This total frequency band is now used to modulate the output of the Ultra Short-Wave Transmitter having a carrier frequency in the neighbourhood of 76,000 kc/s and to produce by this means a lower side-band extending from  $76,000 - (280 + f_9)$  kc/s to  $76,000 - (155 - f_1)$  kc/s, the carrier wave of 76,000 kc/s and an upper side band extending from  $76,000 + (155 - f_1)$  kc/s to  $76,000 + (280 + f_9)$  kc/s per second. This is the band of frequencies which is radiated by the aerial system.

The band of frequencies radiated by the transmitting system, as described above, is delivered by the distant receiving aerial system to a superheterodyne type of receiver. The second detector of this receiver produces from the above input the original side band extending from  $(155 - f_1)$  kc/s to  $(280 + f_9)$  kc/s. This band of frequencies is then applied to a bank of nine selecting circuits which operate as band pass filters. The currents of frequency  $(155 - f_1)$ , 155 and  $(155 + f_1)$  kc/s, will be passed by the first filter to a detector circuit which delivers the original frequency of  $f_1$  kc/s to the first channel. Similarly, the frequencies  $(165 - f_2)$ , 165 and  $(165 + f_2)$  kc/s will be passed by the second filter to a detecting circuit which delivers the original frequency  $f_2$  to the second channel. In this manner the whole of the band of frequencies delivered by the second detector of the superheterodyne receiver will be split up, detected and delivered to the appropriate channel.

The carrier frequency of the ultra short-wave transmitter is held constant within

very close limits by a crystal controlled master oscillator while the beating oscillator of the superheterodyne receiver is similarly crystal controlled. By this means a high degree of selectivity may be attained in the receiver without any necessity of frequent retuning.

The foregoing explanation covers the transmission of nine channels in one direction on a carrier wave of 76 megacycles approximately. For the reverse direction the circuits of the same nine channels are transmitted on a carrier wave of 83 megacycles approximately.

**Aerial Systems**

In order to minimise interference between the transmitting and receiving waves, the plane of polarisation of the waves emitted by the transmitting aerial is at right angles to that of the waves received by the receiving aerial. At one terminal, therefore, the transmitter is equipped with an aerial system designed for vertical polarisation, whereas the receiver is fitted with an aerial designed for horizontal polarisation. At the other terminal the receiving aerial is vertically, and the transmitting aerial horizontally, polarised.

**The Receiver**

The receiver is a superheterodyne in the output of the second detector of which the nine auxiliary carrier frequencies of the distant transmitter are present. Each auxiliary carrier, together with its side bands, is separated out by means of filters, amplified and rectified to reproduce the original speech frequencies corresponding to the channel in question. After amplification these speech frequencies are passed out to the line at the required level.

It is easy to mix together nine channels, but to separate them out again without noticeable crosstalk is a problem on its own. It is on the special design of the

channel selecting circuits, by means of which this end is achieved that the successful operation of the whole system primarily depends.

It is quite evident that a fault in any part of the equipment common to all channels would be a catastrophe; a fault in one channel is serious, but the failure for any appreciable time of nine channels is disastrous. The ultra short-wave transmitter unit, being common to all nine channels, is, therefore, provided in duplicate. The reserve unit is normally not under tension, but if a fault such as the failure of a valve occurs, the power supplies and the aerial are automatically switched from the service to the reserve unit and a fault signal is given to the distant remote control point. That portion of the receiving equipment which is common to all nine channels is similarly duplicated.

**DISTANT**

**RECEPTION NOTES**

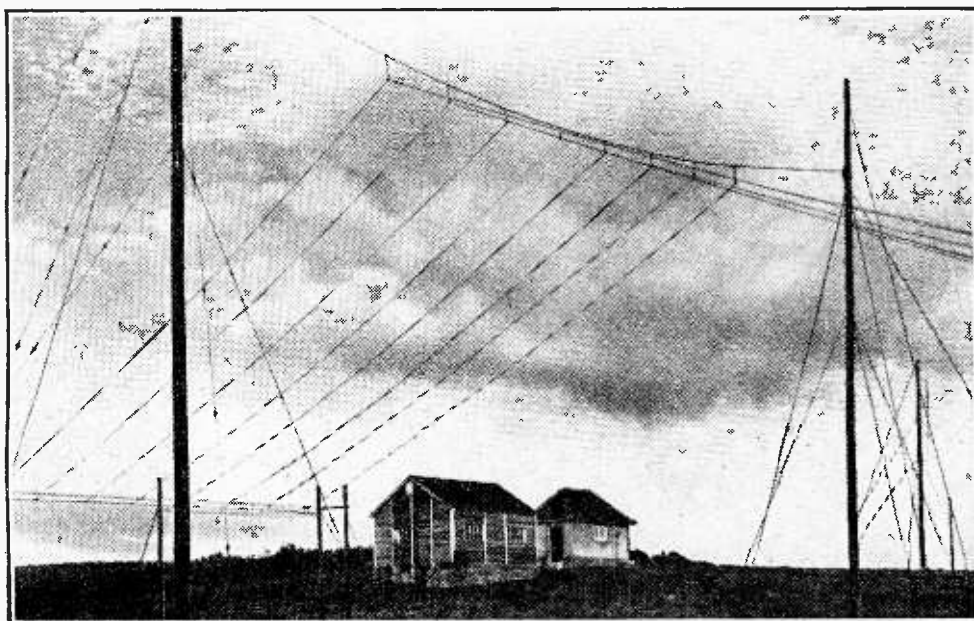
**W**HAT a mess the long-wave band is nowadays! You don't realise it if you use this band mainly for the reception of Droitwich or of Radio-Paris, or perhaps of some other station that is received with particularly good strength in your locality. But should you see a specially attractive programme advertised from Copenhagen and hope to get it better on 1,250 metres than on the 255.1-metre channel, which is cramped between Monte Ceneri on the one side and Nice Côte d'Azur on the other, you'll find that your best laid plans for making use of the long-wave relay are apt to go sadly agley.

Kalundborg is separated by a bare 8 kilocycles from Luxembourg and Moscow No. 1 of the lower-frequency long-wave stations, and by but 8 kilocycles again from Kiev on the higher-frequency side. In daylight, when the Russian stations don't come through very strongly, you may hear Kalundborg fairly well. After dark it is usually spoilt by heterodynes.

And the same thing applies to Warsaw, Lahti, and other long-wave stations. The Deutschlandsender is seldom receivable, no matter what the wireless set, with real entertainment value—unless you care to tune it in between 6 a.m. and 10 a.m., at which time most of us don't very much want broadcast entertainment!

Some time ago I suggested that it would be a good thing for broadcasting if the long-wave band were given up altogether. I am more strongly than ever of this opinion now. In the remoter parts of this country I have found by experience that Droitwich provides a pretty poor service. Nor have you to travel to places so very far away to discover this. In London there are large areas in which Droitwich is unreceivable at any time with any pleasure owing to the severe interference experienced from man-made sources when the set is switched over to the long waves.

The more powerful of the long-wave stations play havoc with the most carefully thought out plans for the medium waves by



The aerial systems at Portpatrick near Stranraer.

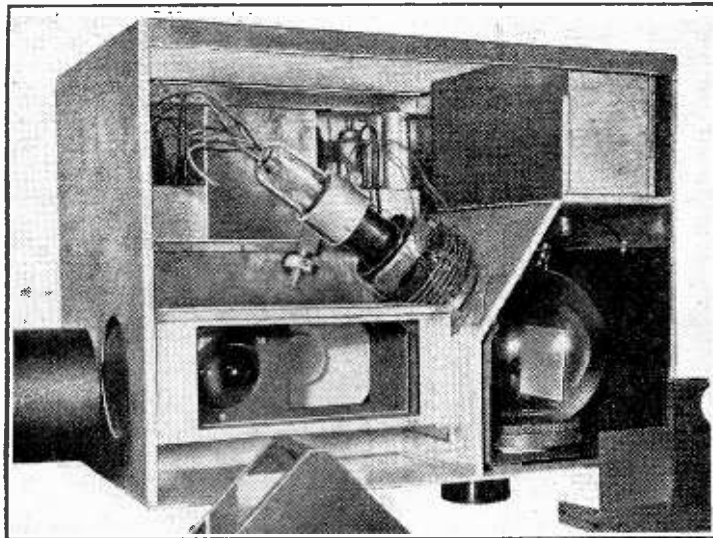
**Distant Reception Notes—**

giving rise to both the "Luxembourg Effect" and to strong harmonics on numerous wavelengths.

The present position is that every big country (and some little ones, too) wants a long-wave channel in the now out-of-date belief that long waves mean long ranges. They did at one time; they don't now that mutual interference, due to overcrowding, is so bad. When a few more of the promised (or should one say threatened?) long-wave high-powered stations have come into action, it seems likely that the whole band will have nothing to offer to the listener but a hotchpotch of whistles and splutters. At the very best, no station will be receivable unless the set is made so selective that the quality of reproduction is appallingly bad.

The long-wave band is overcrowded; it is going to be still more overcrowded and still more hopeless unless some of the important countries take the lead in giving it up as a bad job and abandoning it altogether. Some of them, having realised how useless it now is, would probably do so at once were it not that they fear "losing face" and letting some other fellow into a place that they no longer want themselves, but yet begrudge him.

Our own B.B.C. is, in my humble view, fighting a losing battle in its avowed endeavour to make Droitwich eventually the sole source of the National programmes. It is apparently closing its eyes to the fact that before very long the bigger Deutschlandsender will make its appearance—unless, indeed, the long delay in the opening of this station and the secrecy that prevails about it mean that the Geneva authorities, who can see as far as most people through a brick wall or a hopeless wavelength position, have decided that a giant long-wave station is not worth the candle, or, rather, the kilowatt.



Set manufacturers would rejoice and owners of "all-wave" sets would benefit vastly could Europe's chief broadcasting authorities be induced to sink their pride and admit that a long-wave channel has ceased to be one of the most desirable of things from their point of view. I know that, if they gave way, a host of smaller fry would rush to seize the channels vacated. But would they gain much, when all's said and done, and would the important countries lose much? I don't think so; but that's just my view.

D. EXER.

# Jerkless Film-Scanning

**T**HE use of a projector known in Germany by the name of "Mechau," in connection with an Iconoscope camera for film television, presents a number of advantages over the ordinary projector operating on the Maltese cross principle.

In the "Mechau" projector the film never jerks, but moves forward continuously. Projection is effected by means of rotating and oscillating mirrors which move in conformity with the film as shown diagrammatically in Fig. 1. It will be observed that

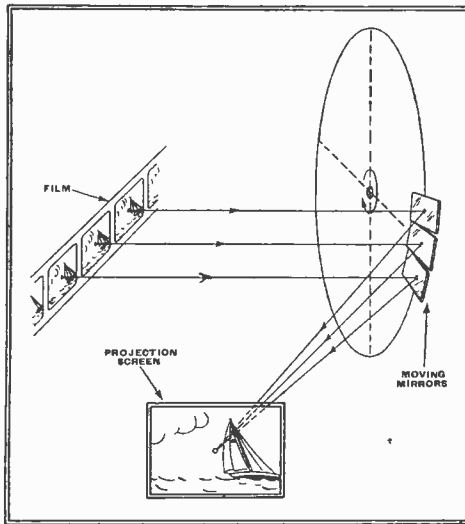


Fig. 1 Illustrating the principle of mirror movement.

during the forward motion of the film to the height of a single frame the mirror in the path of the projection ray alters its position in such a way as to make the corresponding picture appear stationary. The change from frame to frame takes place by the next frame

The Iconoscope camera used in conjunction with the "Mechau" projector seen below.

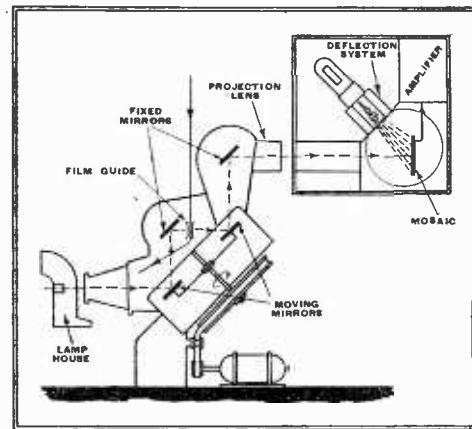
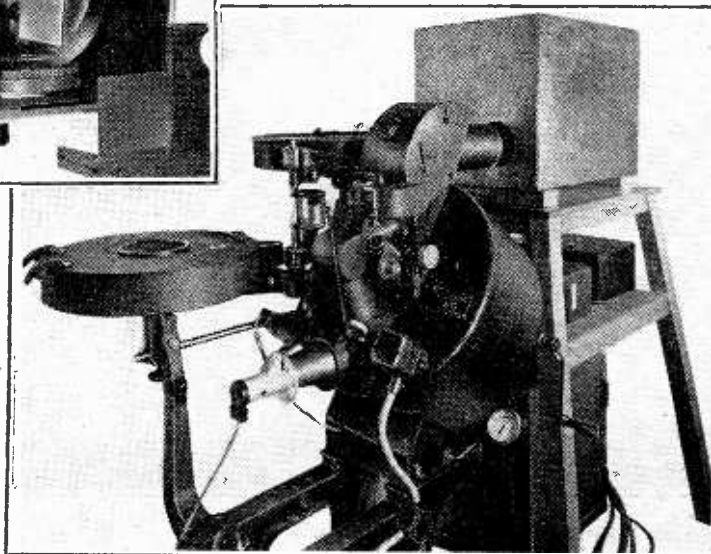


Fig. 2. Showing the position of the mirrors in the film projector.

always appearing in the following mirror at the moment the previous frame is about to disappear.

The mirrors are in a closed drum. The light beam from the source of light falls twice on the set of mirrors, passing through the moving film on its way. It leaves the machine through the projection lens at the top.

## Flicker Compensation

The storage effect of an Iconoscope camera effectively compensates for the very slight flicker which occurs when a change from frame to frame occurs. Thus the cathode ray which scans the mosaic in the Iconoscope camera encounters an image which is entirely free from frame-change effects, i.e., it has a continuous image to scan exactly similar to that obtained by direct television of real moving objects. This is the most important feature of the whole apparatus; the scanning process is entirely independent of the film motion. There is no necessity to synchronise as is necessary when employing an ordinary projector.

The fact that the same type of Iconoscope camera can be used either for film scanning and for outdoor scenes without any adaptation makes it a simple matter for the operator to switch from an outdoor scene to the film transmitter.

The use of the "Mechau" projector, together with the storage effect of the Iconoscope camera, makes for a considerable saving in the source of illumination. The continuous light on the photo-electric screen permits the use of an ordinary lamp instead of an arc in the film projector. The "Mechau" projector combination has also the advantage over the ordinary type that no time need be allowed for the forward feed of the film, which occupies 25 per cent. in the Maltese cross projectors.

A. G.

# Flexible Tone Control

## THEORY AND CONSTRUCTION OF A VERSATILE UNIT

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

**T**HE common or domestic tone control is a creature of very restricted habits. Externally it takes the form of a knob, which, when turned, is useful for (1) muffling any sizzles, whistles, or crackles; (2) reducing any brilliance of tone that might distract attention from conversation, knitting, etc.;

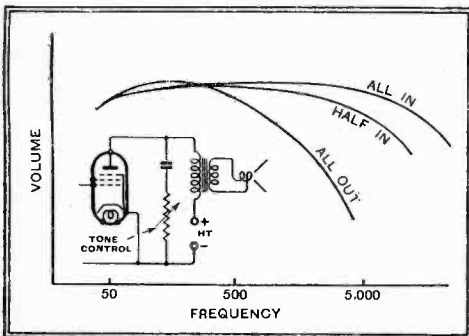


Fig. 1.—The influence on frequency characteristics of the commonest type of tone control (shown in the inset).

(3) giving the owner a chance to say to his friends, "Just listen to the bass!"

The circuit almost universally used is that of Fig. 1, which also illustrates the effect on the frequency characteristic—a progressive slicing down of the higher tones.

As already mentioned this type of control is limited to the action shown, and therefore cannot serve all of its various purposes ideally. For example, the only way to increase bass is indirectly, by suppressing the treble, which is rather like trying to supplement a scanty helping of meat by throwing away some of the potato. If gramophone records are reproduced by a system giving level amplification, the characteristic is something like A in Fig. 2, owing to the progressive reduction in the recorded amplitude below

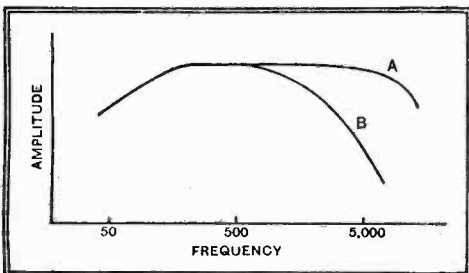


Fig. 2.—The curve A represents the frequency characteristic of gramophone recording, as reproduced by a perfectly flat system. If the tone control of Fig. 1 is the only type available, the result of trying to compensate for loss of bass is shown by B.

250 c/s. When the common tone control is brought to bear on this situation the result is shown by B—a rendering devoid of both brilliance and depth.

A problem wholly outside the capabilities of this same tone control is the boosting of top frequencies to compensate for loss in a selective tuning system, particularly if it is carried to extremes as in the "Stenode."

And there are other situations where a flexible control of tone is useful—to compensate for peculiarities of pick-up, loud speaker, or room acoustics; to enable speech to be reproduced at greater than original volume without loss of clarity; and to modify a disagreeable balance of tone in broadcast or record.

The system to be described has been designed with special reference to the "Inexpensive Amplifier,"\* but it can be adapted to almost any amplifier without much difficulty. Also, although certain particular values are specified for the components, it is hoped that the following explanation of the principles of the scheme

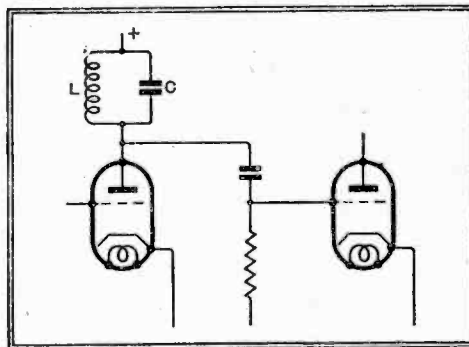


Fig. 3.—Elementary representation of the type of tone control described in this article.

will make it quite a simple matter to modify them to suit any special requirements.

The most obvious shortcoming of the simple tone control is its inability to lift any part of the characteristic above its original level. The loss in gramophone recording is 15 db. at 50 c/s., so it ought to be possible to command a compensating boost of at least this amount.

In trying to achieve this, two errors are common. The first is in attempting to get a sufficient boost by using a sharply resonant circuit. In Fig. 3, which represents part of the amplifier circuit, L and C comprise a tuned circuit which is designed to resonate at the frequency to be strengthened. Like any tuned circuit, if it is "sharp" any electrical impulse sets

\* The Wireless World, June 18th, 1937.

*THOUGH primarily designed for use with the "Inexpensive Amplifier" described in the June 18th issue, the unit discussed in this article is applicable to other amplifiers. It provides almost unlimited scope for adjustment of frequency characteristics.*

up forced oscillations, which die out more or less gradually. While this has its advantages in radio frequency tuning circuits, it is definitely undesirable in audio circuits. The character of transient sounds is altered by the "hang-over" and blunted "attack," which is a difficult enough problem in the loud speaker without introducing it into the amplifier too. Apart from this tone deformation, any extraneous noise—clicks, hiss, atmospheric—produces oscillations at the natural frequency of the control circuit. A mechanical parallel to this is the hiss, amounting in bad examples almost to a whistle of easily distinguishable pitch, caused by record surface irregularities shock-exciting the pick-up movement at its resonant frequency.

### Damping the Circuit

This unpleasant possibility can be excluded by designing the circuit so that at the sharpest setting it just fails to be oscillatory. If this is accomplished by a resistance in parallel with L and C, the maximum allowable value (neglecting resistance in series with either L or C)

$$R = \sqrt{\frac{L}{4C}} \text{ ohms, where L and C are in}$$

henries and farads, or more conveniently in microhenries and microfarads. In practice, owing to inevitable resistance in the L and C branches, the limit of parallel resistance is somewhat higher. And as a slight overstepping of the strict limit has no serious results, and helps in design, we shall go up to double the resistance—

$$R = \sqrt{\frac{L}{C}} \text{ If the resistance, R, is variable}$$

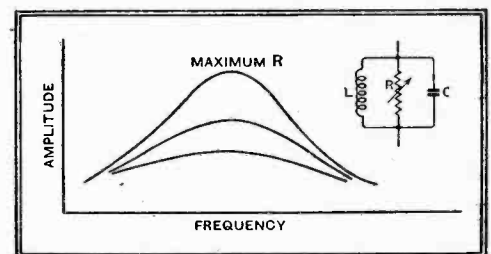


Fig. 4.—How the effects of the circuit of Fig. 3 may be varied. For reasons explained in the text, it is assumed that R does

not exceed  $\sqrt{\frac{L}{4C}}$

**Flexible Tone Control—**

up to this limit, it forms a convenient control of the boost. Although a very sharp peak is not possible with the restriction imposed, it is enough for most purposes. Examples from life will be given presently, but Fig. 4 indicates the general effect.

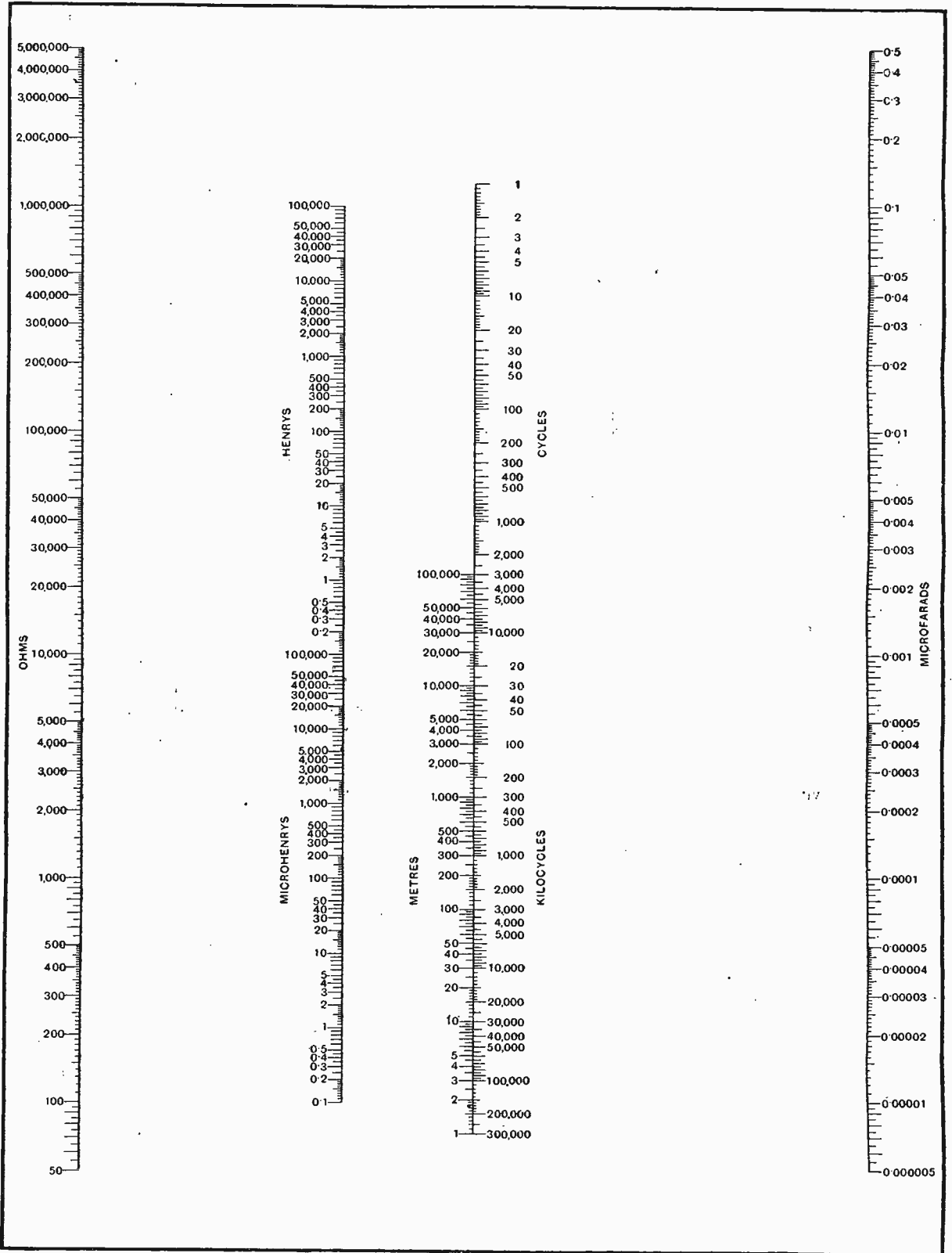
For some purposes a slope in one direction only is preferred, and is easily obtained by using R and either L or C only.

The tone control circuit has been shown as an intervalve coupling, and, although there are other arrangements, this is the simplest and most generally useful. When a considerable difference in amplification level is required between any two points on the frequency scale, at least as great a difference in the impedance of the coupling circuit as a whole is unavoidable. And that is where the second common error comes in. For minimum harmonic distortion the impedance of the coupling, with triodes at least, should be greater than the anode resistance of the valve itself. Any further increase in coupling impedance produces no useful increase in amplification, but probably a decrease instead. So it follows that for tone control purposes the impedance at the frequency of least amplification must be a small fraction of that of the valve. Under these conditions the signal-handling capacity of the valve is far smaller than one is accustomed by normal usage to expect. But according to the purpose of the tone control it is precisely at

important rule to observe in applying this type of circuit is to use it only at small signal levels. With ordinary amplifying valves this may be taken to mean that the output of the stage should preferably not be required to exceed about one volt.

In Fig. 3 a triode was shown, but the

impedance—a fact which greatly simplifies both design and construction. Actually the stage gain, on this assumption, is equal to the resistance, in thousands of ohms, multiplied by the mutual conductance, in milliamps per volt. So if at some frequency a valve



these frequencies that the signal is largest. So the danger of harmonic distortion is very great; and the most

pentode is obviously far better. All the amplification that is needed can be got with a coupling impedance that is much lower than the internal AC resistance of the valve, and in these circumstances the amplification can be taken as being directly proportional to the coupling

with a conductance of 2 milliamps per volt is required to have an amplification of 1, or zero db., i.e., to have no effect on the signal level at all, the coupling must be half a thousand, or 500 ohms. A coupling of 25,000 ohms gives a gain of 50, or 34 db.



**Flexible Tone Control—**

This gives the clue to the method of working out a control stage for specified requirements; and to illustrate it an example will now be given. Required: A stage to compensate for gramophone recording by giving a rise of 15 db. between 250 and 50 c/s., and no gain at the higher frequencies. Mutual conductance of valve under working conditions, 1.7 mA/V.

A gain of 15 db. is a voltage ratio of 5.6, so the coupling impedance at 50 c/s. should be  $\frac{5,600}{1.7}$ , or 3,300 ohms. At

250 c/s. and higher it should be  $\frac{1,000}{1.7}$ , or

600 ohms. As frequencies much below 50 c/s. are not likely to matter very much, one possible circuit would include both coil and condenser, to give a peak at about 40 c/s., which would have a fairly uniform slope beyond 50 c/s. The gain at 40 c/s. will have to be slightly greater—4,000 ohms would give enough and to spare. The exact values of L and C follow from two simultaneous equations—the one already given,  $R = \sqrt{\frac{L}{C}}$ , and the familiar one in terms of fre-

quency,  $f = \frac{1}{2\pi\sqrt{LC}}$ . This seems formidable, but actually takes approximately 2 seconds to work out by means of the invaluable chart, reproduced once more from earlier issues of *The Wireless World*. I must digress to say that this chart is not nearly so well known as it ought to be; and how anybody who has to calculate radio and audio circuits can find life bearable without it has long been a mystery to me. I got a photographer to dry-mount a copy on stiff board, with the Amps-Volts-Ohms-

Watts chart on the other side. A transparent rule with a line marked down the centre completes an outfit which is barely exceeded in utility by the slide rule.

Returning to our example, and putting the straight edge in line with 4,000 ohms and 40 c/s., the inductance of L is easily read off—about 16 henries. The capacity is off the scale, but as it is obviously equal to 10 times the capacity giving 4,000 ohms at 400 c/s., it is easily found to be 1 mfd.

At middle and high frequencies the gain is level at 1, and the coupling impedance therefore being level at 600 ohms, a resistance of that value, in series with the main circuit, is needed. The final result is shown in Fig. 5, and is seen to comply

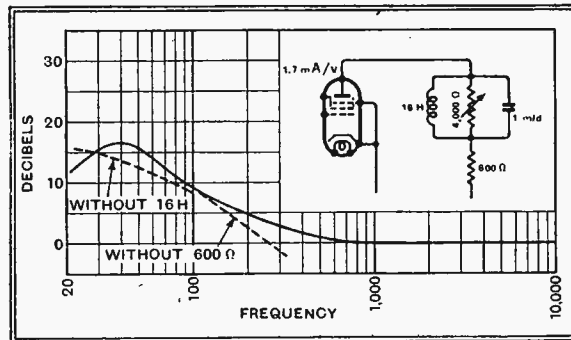


Fig. 5.—Actual example of bass lift circuit and its effect on frequency characteristics.

reasonably well with requirements. The bass boost can, of course, be controlled right up from ground level to the maximum shown. For ease in calculating for other requirements, it should be noted that the shape and size of this curve, plotted on logarithmic paper as here, is identical so long as  $R = \sqrt{\frac{L}{C}}$ ; all one has to do is to move the peak bodily over the paper

till it gives the desired characteristic, and then calculate the circuit values for one point—the apex.

If the general level is required to be higher the peak must be correspondingly higher, and the inductance greater. But even 16 henries is not very convenient. It is unlikely to be obtainable, in the first place; and, if it is, it is certain to be iron-core, which is not very desirable for this sort of work. An air-core coil of this inductance and reasonable resistance would be absurdly large, and any sort of coil is bound to pick up enough stray AC field to be troublesome at such a low signal level. If, in view of these drawbacks, the coil is omitted—and there seems little reason why it should not be—it is necessary to increase R; or the slope will fall off rather badly towards the top, as shown. Also the anode voltage of the valve will depend on R, though hardly enough to make much difference to a pentode. The anode current flows through R, however, and if the control element is not exceptionally smooth will make a nasty noise when adjusted.

**Increasing High-Note Response**

These objections to a coil hardly apply to a top-frequency booster, because the required inductance—generally less than a henry—is conveniently obtained without an iron core, and the sensitivity to hum frequencies is low. Also a rapid cut-off above the peak frequency is generally wanted.

Fig. 6 (c) shows how the characteristic curve of the circuit of Fig. 5 is controlled by adjusting series and parallel resistances. For coil omitted, see (a). At very low frequencies the level is controlled solely by the parallel resistance; at very high frequencies by the series resistance. The frequency where the slope occurs is determined by the capacity of the condenser (or inductance of the coil if a slope the

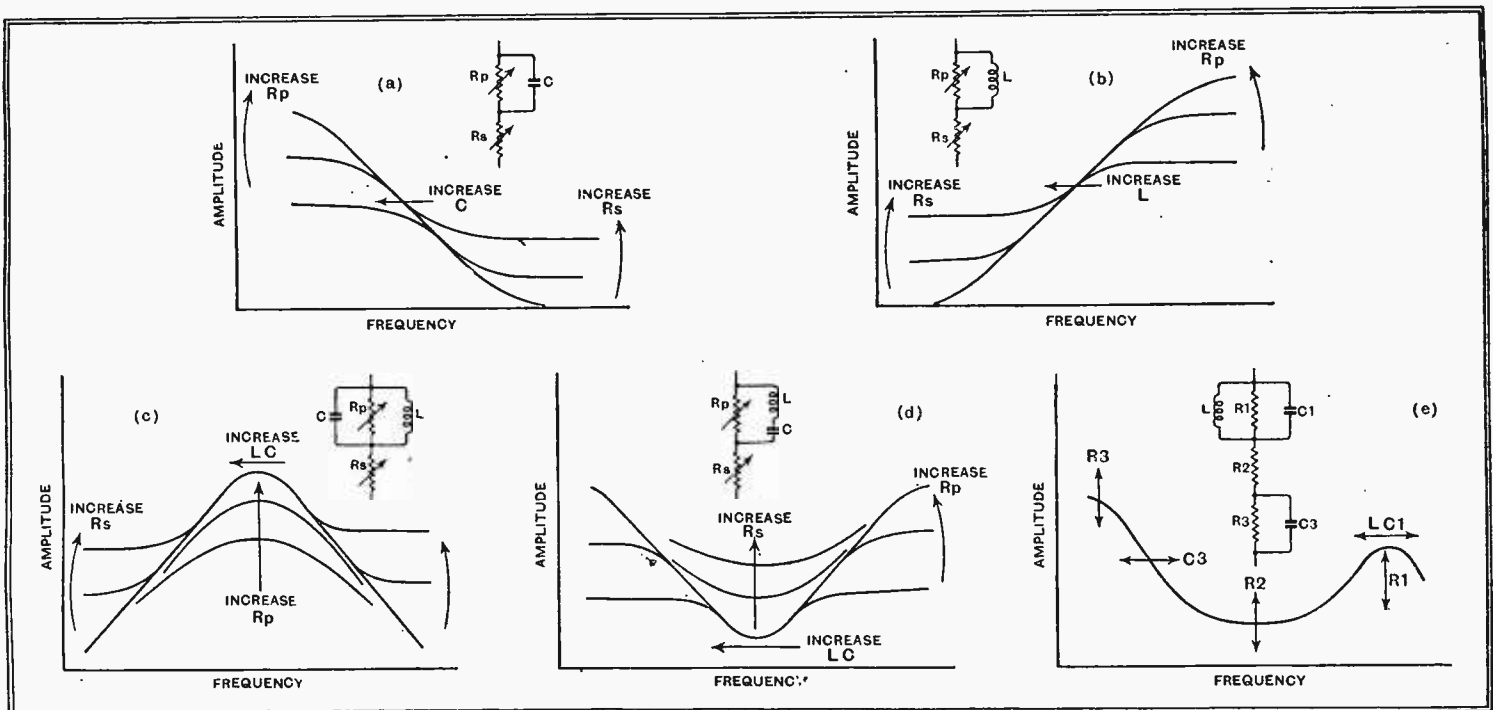


Fig. 6.—The four fundamental varieties of this type of tone control circuit are illustrated by (a)—(d), while (e) shows an example of what can be done with a combination circuit, such as that shown in detail in Fig. 7.

**Flexible Tone Control—**

other way is wanted). The middle of the slope is situated at the frequency which makes the reactance of the condenser

control between this stage and the first of the amplifier proper. But such volume control must not be relied upon if there is a possibility of a large signal being ap-

conjunction with the "Inexpensive Amplifier," it must be remembered that the T250/60 Partridge transformer specified is already being used up to and a shade beyond its rated load, without the extra stage, and a specially designed Partridge transformer, rated at 6 amps LT, should be substituted. Dubilier type "B" potentiometers have elements tapered suitably for the tone controls, and C<sub>1</sub> may conveniently be of the "squash" type for adjusting the peak frequency. For radio a whistle filter will probably be necessary, but no particulars are given here because the whole subject was very fully treated by P. K. Turner in "Rejecting Whistles" (Dec. 4th, 1936).

EDITORIAL NOTE.—With regard to the "Inexpensive Amplifier," mentioned in this article, it should be pointed out that the ratio of the output transformer may be calculated in the ordinary way; the optimum resistance is not critical, but may be estimated on a basis of about 10,000 ohms anode-to-anode load. The output transformer specified is recommended, as with other types there may be difficulty in obtaining a satisfactory amount of feed-back without instability; transformers may be obtained in any single ratio at the same price, but a tapped secondary costs slightly more.

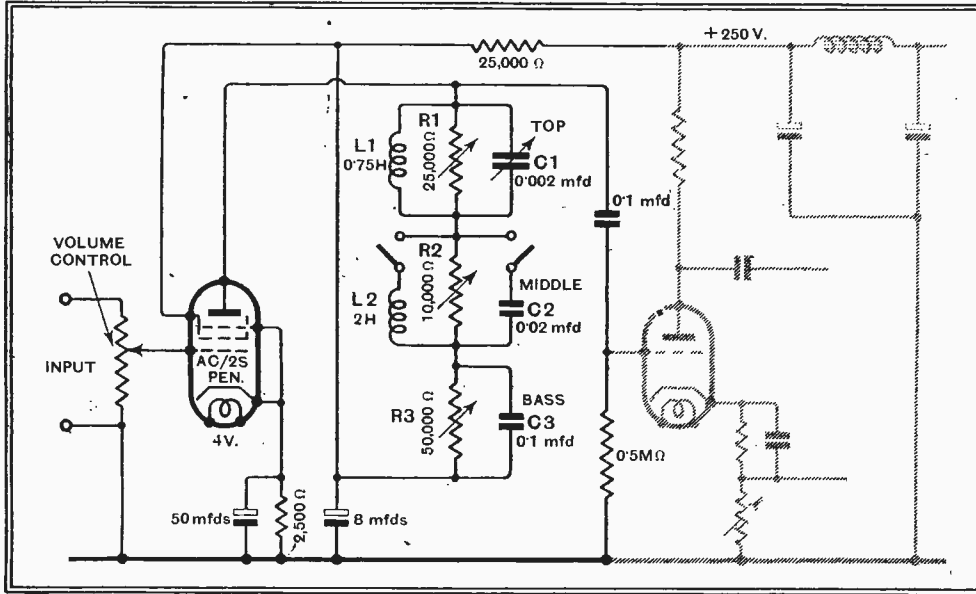


Fig. 7.—Circuit of the tone control stage designed as an example of the methods described. The lighter lines denote part of the circuit of the "Inexpensive Amplifier," showing how the control stage is connected.

equal to the geometric mean of the two resistances. Suppose these are 600 ohms and 4,000 ohms, as in the example already considered. The geometric mean of these is  $\sqrt{600 \times 4,000}$ , or 1,550; and 1 mfd. has this reactance at about 100 c/s. For confirmation see Fig. 5.

A combination of effects, such as a rise at both ends of the scale, or a rise

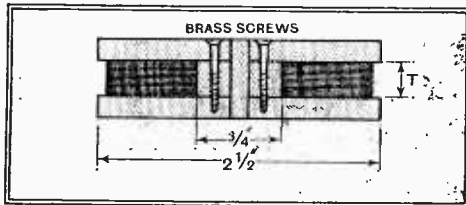


Fig. 8.—Section of tone control coil. The former can be built up of discs of wood or other material to dimensions shown, and wound nearly full of 40 gauge enamelled copper wire. For L<sub>1</sub> the dimension T is  $\frac{1}{8}$  in. and the number of turns 4,800. For L<sub>2</sub>, T is  $\frac{1}{8}$  in., and takes 8,000 turns. Half a pound of wire is more than enough.

at one and a fall at the other, can be obtained by connecting tone circuits in series (Fig. 6 (e)). That is what has been done with the circuit now to be specified in detail (Fig. 7). It is shown as connected to the "Inexpensive Amplifier," and the necessary decoupling circuit is included. A large decoupling condenser is needed, because the decoupling circuit itself tends to act as a bass-booster. When adapting it to some other amplifier this is a point that must be watched; the gain obtainable at very low frequencies is so great that motor-boating is likely to occur otherwise. Wiring must be arranged to reduce to a minimum the possibility of hum pick-up. Even when this has been done, as far as possible, the noise level may be noticeable when full bass boost is in use (it amounts to no less than 38 db.), and it may be thought desirable to introduce a moderate amount of volume

plied to the tone control stage, or it may cause harmonic distortion.

Fig. 9 shows some typical curves taken from this amplifier. The number of combinations is, of course, infinite. But it is important to note that a combination curve is not obtainable by adding the

decibels for the separate curves. A study of these curves, in conjunction with Fig. 6, will enable the controls to be used intelligently. The whole system is quite simple, compact, and inexpensive; and really does give endless scope for adjusting the frequency characteristic. Perhaps the most useful elaboration that could be suggested is a selection of several capacity values in place of the 0.02 mfd. condenser. The effect of this condenser depends largely on the setting of its parallel resistance, and as that may be dictated by other requirements—chiefly the "ground level" of gain—some independent variation of top cut may be worth including.

If the control stage is used in

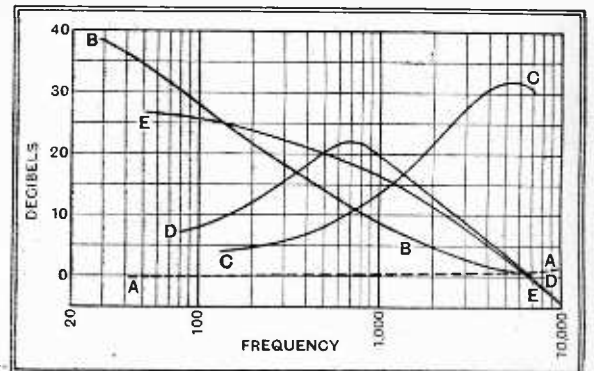


Fig. 9.—Examples of overall characteristic curves taken with the system specified in Fig. 7, up to and including the output transformer of the amplifier.

Comparison of A with the curve given for the "Inexpensive Amplifier" alone shows that the slight drop in the bass has been filled up even although no intentional bass boost is in circuit. This is due to the decoupling circuit acting as a booster.

	R <sub>1</sub>	L <sub>1</sub>	C <sub>1</sub>	R <sub>2</sub>	L <sub>2</sub>	C <sub>2</sub>	R <sub>3</sub>	C <sub>3</sub>
A	0	—	—	600	—	—	0	—
B	0	—	—	600	—	—	50,000	0.1
C	25,000	0.75	0.001	600	—	—	0	—
D	0	—	—	10,000	2	0.02	0	—
E	0	—	—	10,000	—	0.02	0	—

# BROADCAST BREVITIES

## Televising Football

THE camera operators with the B.B.C. mobile television unit have not yet been called upon to work really quickly, but they will have to "jump to it" next week when football is televised from the Arsenal ground at Highbury.

The powers-that-be are wise, probably, in deciding not to attempt televising a fully-fledged game, but there will be work enough in keeping the players in the small picture while they demonstrate tactics in front of the goal mouth.

## Return of an Old Favourite

The occasion is also interesting in that Mr. George F. Allison, the veteran football commentator—he gave his first broadcast in 1927—will be making his television debut.

Mr. Allison's voice is still well remembered, although his duties as secretary-manager of the Arsenal team have prevented him from broadcasting of late. He will introduce the players and interview them before the camera.

## Unkindest Cut of All

ALL modern broadcasting stations have, or should have, an alternative power supply. Novocastrians were forcibly reminded of this on August 24th, when a mains failure not only plunged their home into darkness from 9.0 to 10.0 p.m., but robbed them of broadcast entertainment from their own ancient transmitter just when they needed it most.

Everybody is asking whether the engineers can put some pep into the work on North-East Regional at Stagshaw.

## Adventures of Penmon

Penmon is the newest B.B.C. transmitter to depend upon a public power supply, and here, too, there has been trouble which could have been averted if power were independently generated.

Mr. L. Hotine, the B.B.C.'s Superintendent Engineer, still proudly recounts the way in which his staff rose to the occasion when a heavy storm blew down the power transmission lines last winter.

## The Cooling Oven

"The oven in which the tuning fork is kept," said Mr. Hotine, "is electrically heated. When the supply failed, the thermostatic device ceased to work and the temperature gradually fell. So we at once got in touch with our Equipment Department in London and arranged to have despatched to

Penmon during the night a small petrol-electric generating set, with an output of 200 volts at very low power in order to keep the tuning fork warm in its oven, although the transmitter was out of action. As a result, when the mains supply again became available we were able to carry on our transmission at the correct frequency. Otherwise we should have had to wait for two days to get the oven back to its correct temperature."

## Stations Should be Independent

Mr. Heath Robinson could have devised nothing better in the awkward circumstances. But the fact remains that transmitting stations should be self-

truth seekers to concentrate on the educational broadcasts if their attention is distracted by distorted speech or crackles. In fact, the guiding principle must be that listeners should forget the radio just as they forget the electric light or the hot-water radiators.

## No Boiled Shirts

Incidentally, the Committee offers some more golden hints to group leaders. Besides urging informality and the strict exclusion of the "boiled-shirt" atmosphere, it pleads with leaders not to give a second lecture on their own account when the B.B.C. talk is finished, and warns them not to prolong the subsequent discussion. In other words, don't suck the orange too



PARIS FOLLOWS LONDON. Impressed by the successful transmission of outdoor scenes by television in this country, the French Broadcasting Authorities are carrying out similar experiments. It will be noticed that an E.M.I. Emitron camera is being used.

supporting, more especially when, as in the Penmon case, they must otherwise rely on exposed overhead power cables.

## Campaign for Better Reception

A CAMPAIGN for better radio reception is about to be launched by the Central Committee for Group Listening.

The individual listener, accustomed to the idiosyncrasies of his own set at home, may acclimatise his ear to a jumble of sounds and translate them into a national lecture without difficulty. But when a group of people are concerned, reception must be flawless.

## Forget the Radio

The Committee intends to emphasise that it is impossible for the most earnest collection of

dry, because the pulp is indigestible.

## Intervals for Reflection

Another piece of advice will have to be taken with caution, like strychnine. It is that groups should assemble at least ten minutes before the talk begins in order to attune their minds to the subject in hand. The danger, of course, is that an energetic secretary may attune the set to the previous item—and is it not a notorious fact that talks are almost invariably preceded by dance bands or musical items in violent contrast?

## In the Shadow

But no doubt this fact has not been forgotten by the Committee's chairman, Principal J. H. Nicholson, M.A., who dwells in the shadow of Broadcasting House in Langham Street.

## "Listener Research" Boomerang.

THE B.B.C.'s Listener Research schemes have impressed most people as a serious effort to please the public.

America, however, places a different interpretation upon them—or, at least, the America represented by the "Atlanta Journal"—which proclaims that the British Broadcasting Corporation has "admitted defeat" by publicly confessing that it has no idea what listeners want.

Does America admit defeat when she holds a General Election?

## News from Aberdeen.

ABERDEEN will soon be in the broadcasting news again. It is understood that a site at Nigg, just outside the city, which B.B.C. engineers have been eyeing fondly for some months, has at last been acquired. Before next summer a 5kW. station should be radiating original programmes from the new studios as well as relaying Scottish Regional.

## "Period" Wireless Sets

DO we want Tudor wireless sets, or Queen Anne loud speaker cabinets? The question will be raised by Mr. Anthony Bertram in his series of talks on "Design" which are to be broadcast in the National programme every Monday from October 4th to December 20th.

Mr. Bertram is all for functionalism and all against the miniature baronial and the Tudoristic.

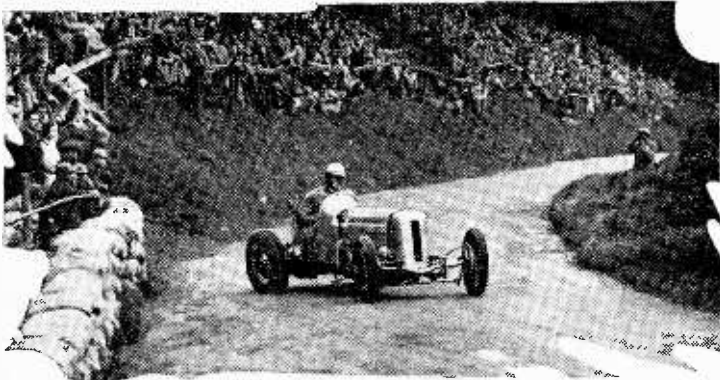
## Craze for Make-belief

Listeners with electric fires that flicker to resemble coal fires may switch off in disgust before they hear fresh condemnation of the craze for make-believe. For Mr. Bertram will spare no one who offends. He will point out, for example, that the man who lives in a false half-timbered mansion ought to fit his car with leaded panes and a thatched roof, and, to be consistent, should slip on a suit of natty tin armour.

## Looks and Acoustics

Mr. Bertram is not a destructive critic, however, for towards the end of the series he will give hints for the careful planning of homes, with ideas for the correct placing of radio sets and gramophones to achieve an ideal compromise, if such be necessary, between appearance and proper sound distribution.

ON lines similar to those adopted for his comic opera series, Gordon McConnell is to present songs from "The Belle of New York" for National listeners on Wednesday at 8.55 and again for Regional listeners on Friday, September 17th. Mr. McConnell says: "It is one of those quick-moving colourful shows that defy radio adaptation, for the humour is mainly visual, and only television could revive the real glories of this great success of the late 'nineties."



Autocar photo.  
AT THE HAIR-PIN BEND in the Shelsley Walsh Hill-climb. The 1,000-yard course has an average gradient of 1 in 10, the steepest being 1 in 6.25.

A compère will link together the book and the musical items for this broadcast, which will include such hit numbers as "La Belle Parisienne," "She is the Belle of New York," "The Purity Brigade," and "On the Beach at Narragansett." The compère will be Fred Duprez, the well-known comedian and raconteur, with Betty Huntley-Wright as Fifi Fricot, and Tessa Deane as Violet Gray, the Salvation Army girl who reforms the dissolute young man.

First produced in 1898 at the Shaftesbury Theatre, London, "The Belle of New York," which ran for 697 performances, introduced to London one of the most delightful of leading ladies—Edna May.

#### SPEED

THE annual hill-climb at Shelsley Walsh, known as the Midland Automobile Club Hill-climb, will provide exciting commentaries for National listeners on Saturday at 2.25.

F. J. Findon, the well-known commentator, stationed at the foot of the hill, will describe the start of the climb, while Alan Hess will have a microphone halfway up, at the hairpin bend. Listeners will hear the first commentator

# Listeners' Guide for

## Outstanding Broadcasts at Home

describing the entrant about to start and giving a description of the car he is driving. As he speaks the roar of engines being warmed up in the competitors' park will form a background of sound, increasing as the car nears the starting line, and growing to a roar as it speeds away at the fall of the flag. By a simple switchover,

authority on old-fashioned entertainment, and last broadcast in 1931. It gives a bird's-eye view of three centuries of fun.

A young man home from the Colonies is confused by the multiplicity of modern entertainments. "Now in great-grandfather's day," he says; but the programme, taking us back into the past, shows that entertainment in those far-off days was not quite so simple and innocent as one might suppose.

This programme, which gives a comprehensive survey of entertainment in 1937, at the end of the eighteenth century and at the beginning and end of the nineteenth century, will be heard by Regional listeners on Tuesday at 8.40 and Nationally on Thursday at 6.40. In the journey through three centuries of night life, listeners will meet Mozart, Grimaldi, Jenny Lind, Henry Irving, Madame Bonzo, the lady balloonist, and Marie Lloyd.

#### FAMOUS TRIALS

THE fourteenth broadcast in the Famous Trials series should prove an interesting and highly dramatic affair, for it deals with that of Lord Mohun. In January, 1693, Charles, fourth Baron Mohun, a famous roisterer in an age when duelling and general disorder were rife, was tried and acquitted by his fellow peers in Westminster Hall for his part in the murder of a certain Mr. Mountford.

The case reads like a romantic novel; this foolish young peer, having become involved with one of the bullies of the town, had concocted a scape-grace plan to abduct Mistress Bracegirdle, who was then at the height of her fame as an actress. Mountford, a fellow member of the Drury Lane Company, was murdered in the subsequent affray.

Having, as it has, the crisp interest of a law report and all the attributes of a melodrama from the stage of Drury Lane itself, this broadcast should prove one of the most interesting in this popular series of dramatic reconstructions.

#### 'OPPING 'OLIDAY'

EVERY year thousands of men, women and children from the metropolis, who would otherwise have little or no respite from the stifling atmosphere of the back streets, turn their only chance of a holiday into a lucrative business by going to the hop gardens of Kent to strip the bines. The original version of the programme with the above title was broadcast in 1934. Laurence Gilliam, who will produce the programme on Wednesday at 8 (Nat.), will include in it records of the scenes of excitement when the "'oppers' special" leaves London Bridge and sound pictures of the work in the hop gardens with, finally, one of the traditional sing-songs celebrating the end of the picking from a village inn in Kent.

#### RELAYS FROM ABROAD

Two broadcasts from the Fatherland will be relayed by the Regional station this week. On Sunday at 5 a programme of light music by the Deutschlandsender Light Orchestra will be heard.

For half an hour on Wednesday night, from 10.30, a programme of dance music will be heard from Berlin. Eugen



DR. JOHNSON'S statue in the Market Place at Lichfield. A short programme from the birth-place of the lexicographer will be heard by Regional listeners on Sunday at 9.5.

# the Week

## d Abroad

Wolff and his orchestra will have their programme transmitted to Britain from the Deutschlandsender station. Immediately after this, Germany will take, on the same line, a programme by Henry Hall and his dance orchestra.

Two further relays from abroad will be heard to-night (Friday) at 9.15 and on Sunday at 9.5. Regional listeners to-night will be treated to tzigane music direct from Hungary, whilst on Sunday a potpourri of Franz Lehár's works from Vienna comes into the National programme.



### FROM THE PROMS

THE outstanding items from this week's Promenade con-

certs are included in Saturday's, Tuesday's and Thursday's relays.

From Saturday's concert, during the relay from 8 (Reg.), will be heard Kodály's well-known suite "Háry János" which will be conducted by the composer. He will also be conducting Section C of the B.B.C. Orchestra in a programme of his own music from the National transmitter at 9.45 on Sunday.

On Tuesday the first half of the concert, which is devoted to works of Vaughan Williams, will be heard from 8 (Nat.). His Pianoforte Concerto in C will be played by Cyril Smith and "Hugh's Song of the Road" sung by Tudor Davies. The composer will himself conduct his Fourth Symphony in F minor.

### HIGHLIGHTS OF THE WEEK

#### FRIDAY, SEPTEMBER 10th.

Nat. 7.30, Five Hours Back. 8.35, Beethoven Prom.

Reg., 8, "The Little Mermaid" from Hans Andersen. 8.35, Northern Concert Party, including excerpts from the Little Theatre, Saltburn, and the New Pavilion, Redcar. 9.15, Tzigane music from Hungary.

#### Abroad.

Radio Paris, 9, Richard Strauss conducting his opera, "Ariadne auf Naxos," at the Théâtre des Champs-Élysées.

#### SATURDAY, SEPTEMBER 11th.

Nat., 2.25, Shelsley Walsh Hill-climb. 5.50, Finish of the King's Cup Air Race at Hatfield. 8, Palace of Varieties. 8.50, The Trial of Lord Mohun.

Reg., 8, Promenade concert. 9.35, Orchestre Raymonde.

#### Abroad.

All German stations, 8-10.20, The Reich Party Congress at Nürnberg, including the address by Herr Hitler.

#### SUNDAY, SEPTEMBER 12th.

Nat., 6.15, B.B.C. Military Band and Trefor Jones. 9.5, Potpourri of Franz Lehár's works from Vienna. 9.45, B.B.C. Orchestra (C) conducted by Zoltán Kodály.

Reg., 5, The Deutschlandsender Light Orchestra from Berlin. 6.15, Pianoforte recital: Solomon. 7.15, Evening at London's Bird Sanctuary: O.B. from St. James Park. 9.5, Programme from the birthplace of Dr. Johnson in Lichfield.

#### Abroad.

Milan, 9, Verdi's "Don Carlos."

#### MONDAY, SEPTEMBER 13th.

Nat., 8, Recital: John Brownlee (baritone). 8.35, "Wedding Day": a comedy with music.

Reg., 8, Henry Hall and his dance orchestra. 8.35, Wagner Prom.

#### Abroad.

Eiffel Tower, 9, Concert of contemporary Belgian and French music from the Belgian Pavilion, Paris Exhibition.

#### TUESDAY, SEPTEMBER 14th.

Nat., 7.30, The Song is Ended: a reminiscent programme of popular songs. 8, Vaughan Williams Prom. 10, Saw the Start: Lord Baden-Powell on the Boy Scouts.

Reg., 7, Medvedeff's Balalaika Orchestra. 8, Variety from the Theatre Royal, Stockport. 8.40, "The Pursuit of Pleasure": three centuries of fun.

#### Abroad.

Rome, 9, Verdi's "Don Carlos."

#### WEDNESDAY,

#### SEPTEMBER 15th.

Nat., 8, "opping 'oliday," 8.30, Recital, Titana Makushina (soprano). 8.55, "The Belle of New York." 10.20, The last fight of the *Revenge*.

Reg., 8.30, Conversation in a Train. 8.55, Brahms Prom. 9.40, Café Colette. 10.30, Dance music from Berlin.

#### Abroad.

Stuttgart, 9.15, Ten world-famous pianoforte pieces played in their original form by Ludwig Kusche.

#### THURSDAY, SEPTEMBER 16th.

Nat., 6.40, "The Pursuit of Pleasure." 8, Handel Prom.

Reg., 8, Radio Rodeo from the Union Cinema, Kingston. 9.5, Mantovani and his dance orchestra. 9.50, Handel Prom.

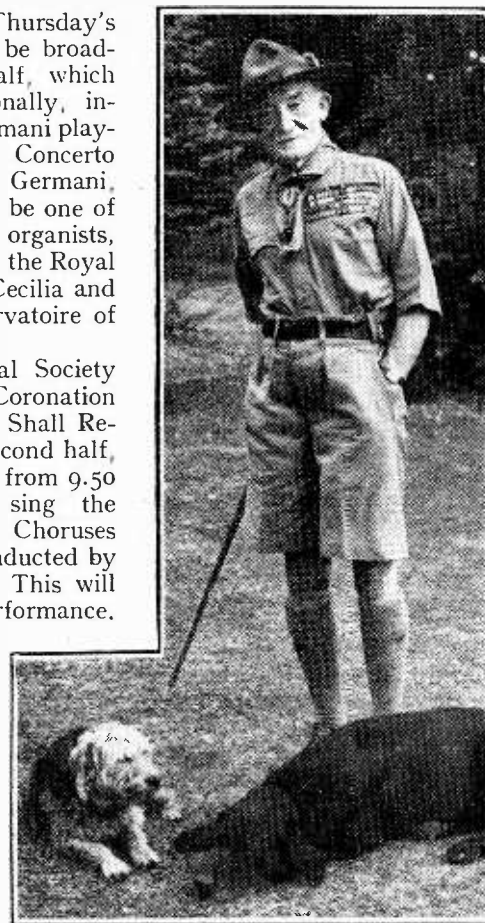
#### Abroad.

Toulouse PTT, 8.30, "A Midsummer Night's Dream," with music by Mendelssohn.

The whole of Thursday's Handel concert will be broadcast. The first half, which will be heard Nationally, includes Fernando Germani playing Handel's Organ Concerto No. 9 in B flat. Germani, who is considered to be one of the world's greatest organists, is Organ Professor at the Royal Academy of Santa Cecilia and at the Royal Conservatoire of Music in Rome.

The B.B.C. Choral Society will render the Coronation anthem "The King Shall Rejoice," and in the second half, which will be heard from 9.50 (Reg.) they will sing the second set of Five Choruses from the operas, conducted by Leslie Woodgate. This will be its first concert performance.

LORD BADEN-POWELL, who is here seen in his garden at Pax Hill, Bentley, Hampshire, will, on Tuesday at 10 (Nat.), be heard in the "I Saw the Start" series talking on the Boy Scout movement which he founded thirty years ago. He will also be heard on October 5th when he deals with the siege of Mafeking in the series "I Was There."



### OPERA

THE gala performance, at the Théâtre des Champs-Élysées by the Berlin National Opera, of Richard Strauss's opera, "Ariadne auf Naxos," is the opera event of to-night (Friday). This opera, which will be heard from Radio-Paris at 9, has had a curious history. First produced in Stuttgart in 1912, the Ariadne drama was incorporated with Molière's "Bourgeois gentilhomme." In the subsequent version the two are separated, and merely the ballet scenes of Molière introduced. The first English performance of "Ariadne" in the new and now universal version took place at Covent Garden in 1924.

Saturday brings another great German opera from the same stage. This time it is "The Valkyrie," under the baton of Furtwängler, which will be relayed by Paris PTT at 9.

Verdi's sombre tragedy, "Don Carlos," comes from Milan on Sunday and Rome on Tuesday, both at 9 o'clock. Various stations are relaying it, either whole or in part. This opera was written for the Paris

Exhibition of 1867, and was produced at Covent Garden in June of the same year. The story has its peculiar interest for England, for it is the historically true family tragedy of Philip II of Spain, husband of "Bloody Mary." Philip's first marriage, to the daughter of the Queen of Portugal, lasted but three years. Don Carlos, the unhappy hero of the opera, was the only son by this marriage. At the age of twenty-two he fell in love with his father's second wife, Elizabeth of Valois, was consequently imprisoned by his father, where he died in 1568.

Two tragic operas are offered to the listener's choice on Thursday evening. Lalo's "Le roi d'Ys" (Eiffel Tower, 8.30) is founded on an old Breton legend. Delibes' "Lakmé" (Strasbourg, 8.30) is the story of the unhappy love of a British officer and a Hindu maiden. It is Delibes' undoubted masterpiece, and gave John McCormack and Tetracini two of their greatest parts. Another choice for Thursday is Mendelssohn's "Midsummer Night's Dream," which, at 8.30, comes from Toulouse PTT, the 120-kW state-controlled station—not to be confounded with Radio-Toulouse.

THE AUDITOR.

# RANDOM RADIATIONS

## The New Wireless Bill

AT last the reason for the long delay in inaugurating anti-interference legislation in this country becomes plain. The Government is shortly to introduce a new wireless telegraphy bill which, besides replacing the main existing act and supplementary acts, will also contain clauses dealing with man-made interference with reception of the broadcast programmes. It's about time that we had a new wireless act. Present legislation is based upon a jumble of legislation, much of which is now really out of date. The new bill will clear up the general situation, and we all profoundly hope that it will give the Post Office ways and means of putting an end to the interference which has now become so serious a problem. One's only fear is that the anti-interference clauses may be too watery, establishing an unconscionably long time limit for the abatement of the nuisance. There seems no good reason for any long time limit; people have had plenty of warning that legislation was impending, and it's their look-out if they have installed recently electrical apparatus of a type which radiates unwanted impulses.

## What of Ignition Systems ?

It will be interesting to see how the bill tackles the problem of interference caused with short-wave and ultra-short-wave reception by the ignition systems of motor vehicles. Here, again, there would seem to

be a strong case for a firm hand and a short time limit. The motor industry has had plenty of time to take action, and on the whole it has responded pretty well to appeals. If you live anywhere near a main road you will know by experience that many modern cars, lorries and buses are pretty well innocuous so far as the short waves are concerned though there are others that aren't. Short-wave reception is becoming so enormously important nowadays that the assurance to the listener of peaceful reception on wavelengths between 10 and 100 metres is an urgent matter. The ultra-short wavelengths, too, must be cleared up if television and the high fidelity broadcasting of sound are to have their real chance.



## One Up to the Designers

ONE astonishing feature of this year's battery sets is the comparatively minute amount of high-tension current that they require to serve quite a number of valves and to give really excellent results. Not so very long ago we used to think we were doing pretty well if we could obtain decent quality of reproduction from a 3-valve set without exceeding a dozen milliamperes. Early battery superhets simply ate HT current. I can recall few of years gone by which could put up a respectable performance with less than 15 milliamps, and of many which made away with 20 or even more. Loads of this kind are all very well so long as you use either a dry HTB of really large capacity or an accumulator battery. But the public showed that so far as it was concerned there was only one kind of dry HTB—that composed of cells of flashlamp refill size. That being so, designers had to tackle the problem of producing the 10-milliamperere superhet. And, helped by valve makers, they've tackled it well and truly. I have tried out several 5- or 6-valve battery superhets this season whose consumption is under rather than over the 10-milliamper limit. And they are remarkably good performers, with plenty of volume for the average room and a degree of sensitivity which doesn't compare badly with that of most mains sets.

## Battery Economy

This doesn't mean to say that I agree that the "standard capacity" battery can be placed economically under a load of 10 milli-

amperes. Emphatically, I don't, for as a result of laboratory tests on many hundreds of such batteries, I am convinced that the economical load upon them is not much in excess of 5 milliamperes. But such batteries will deliver a nominal 10 milliamperes fairly well, provided that the listener does not notice or does not object to what I call "end of the evening" distortion. This is not greatly in evidence so long as the volume is

By "DIALLIST"

kept on the small side, in sets making use of automatic grid bias. But it can be pretty bad in those with a separate grid bias battery. Under load, the voltage of a small HTB called upon to deliver something like 10 milliamps may easily drop ten per cent. or more during an evening's listening. If the negative grid bias on the AF valves isn't reduced correspondingly (and it never is) you can get some pretty queer effects during the last hour or so. If you want to get the best from a battery set, even if its HT consumption is modest, always run it from a high-tension battery of adequate capacity. Not only your ear, but your pocket benefits.



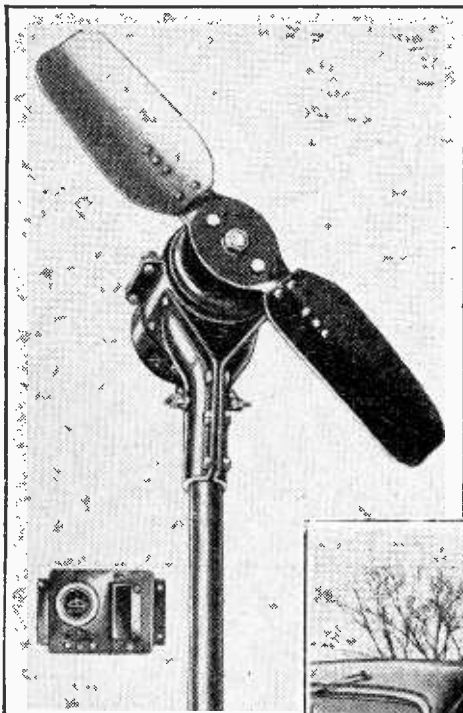
## All to Pieces

AFTER unpacking and connecting up a new set the other day I found it incapable of producing the slightest sound. So complete was the silence that it suggested a "dis" between the set and the loud speaker, and when I came to cast my eye over the innards of the set I found not one but both leads from the secondary of the output transformer had come unstuck. Having done a little work with the soldering iron I tried again. There were now signs that the AF department was working, but no station of any kind could be picked up. Further examination disclosed a lead adrift in the IF circuit. Once more the iron was heated up; once more I soldered. The third time is lucky, thought I, as I connected up once more. But I was wrong; there were still no stations to be heard. The last bit of trouble turned out to be a dud valve. And, of course, it was of the type that I neither had in my shelves nor could obtain of any local wireless shop.

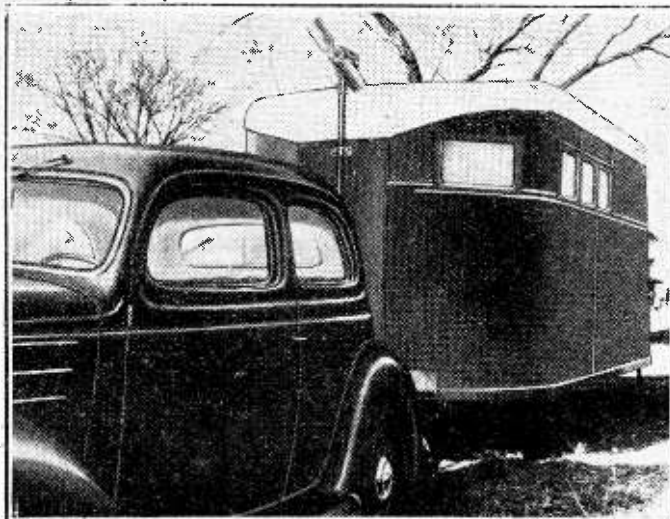
It's difficult to understand how that set ever got through its tests, for all those soldered joints were as dry as dry could be. Nor can I quite understand how the valve gave out in transit, for the set came down by road and the cardboard case that contained it showed no evidence of any violence.

## How Do They Pass ?

The other day I was talking to a man who does a pretty big business in wireless. In the course of our conversation he said, "It's utterly amazing to me how some of the sets that come into my hands leave the factory with a final test label duly attached and signed when they've got faults that any test ought to have disclosed." My reply was that if he'd ever been to the Mint and seen coins of the realm in the making and the testing, I was quite sure he would come away convinced that it was utterly impossible for one that wasn't absolutely perfect to slip through and get out into circulation. Yet any banker will tell you that defective coins aren't so very uncommon, and some of the defects are so obvious that they ought to be spotted a mile off. At the Mint every coin is weighed



**CARAVAN WIRELESS.** This 200-watt wind-driven generator has been produced in America with the object of rendering a caravan independent of the electrical equipment of the towing vehicle. It begins to charge at 20 m.p.h., the maximum rate of 25 amps. being attained at 45 m.p.h.



and measured for diameter and thickness several times during the various processes through which it goes. It is also scrutinised again and again by skilled eyes. In the testing rooms of reputable wireless firms every possible care is taken to check up every part of every set, and yet some queer things occasionally slip through unnoticed. One always hears about the duds, but perfect specimens get no publicity.

**Not Even Wired !**

One or two rather remarkable cases have come my way. The first was a set which looked as right as right could be at a cursory glance and was stated to be in perfect order on the test label. It proved to be completely dumb, and when the chassis was removed for examination it was found that in some extraordinary way some very important steps in the wiring beneath the chassis had been omitted. The next was a radiogram in which the automatic record-change apparatus hadn't been connected up. You'd have thought that either of these things would have been spotted instantly; but they just weren't. And then, valves. I've had one or two with the electrodes connected to the wrong pins, and it's most mysterious how they could have got past the testing panel in the factory. I suppose that, the human element being what it is, the really amazing thing is that so few sets and valves and other bits and pieces which aren't up to the mark manage to escape undetected from the works!

**G.P.O.—Made Static!**

WHAT a pity it was that the television demonstrations at Olympia suffered so much from interference. It was to be expected that in such a district at Olympia interference would be present, and the authorities took all reasonable precautions by covering each of the television viewing booths with wire netting which was earthed. They did not realise, however, that in the very show itself they would have to contend with the very worst possible type of interference in the form of diathermy apparatus used on the G.P.O. stand, where they were demonstrating interference sources and means of suppression!

Probably the only cure would have been to enclose the G.P.O. stand completely in a metal shield.

**Sound Interference**

Another form of interference which the television demonstrations had to endure came from the Radio Theatre performances, which at times became so noisy as to almost drown out the sound from the televisors. It is a pity that this, too, could not have been foreseen and provided against.

**Radio Servicing Simplified.** Sixth edition. Pp. 149. Published by the Automatic Coil Winder and Electrical Equipment Co., Ltd., Winder House, Douglas Street, London, S.W.1. Price 2s. 6d.

ABOUT one-half of this book is devoted to a description of Avo apparatus and how it may be employed to best advantage. Voltage, current, resistance and capacity measurements are dealt with, as well as valve testers, oscillators and output meters.

The second half of the book treats servicing problems and the use of meters in fault-finding is considered in some detail. The descriptions are in some cases rather

brief, but the range covered is wide and most ordinary problems are adequately treated.

**Les Récepteurs Radiophoniques.** Edited by the Bureau de Diffusion des Applications de l'Electricité et du Gaz of Sofina, Brussels, Belgium. Price Fr.14.

THIS publication deals with the characteristics of receivers. The different stages are each briefly described and the important points in design indicated, and the characteristics desirable in a complete receiver are then discussed. Valves and mains operation are included, and in conclusion tables are given showing in concise form ganging procedure, receiver measurements, etc.

**Television Programmes**

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Sound : 45 Mc/s. Vision : 41.5 Mc/s.

FRIDAY, SEPTEMBER 10th.

3, "James Simpson": a play by Nino Bartholomew. 3.20, British Movietonews. 3.30, "Risotto."

9, Merryll and Foster: two pianos. 9.10, Talk: "What is Good Design?" 9.20, Gaumont-British News. 9.30, "Behind the Beyond"—a problem play by Stephen Leacock. Cast includes Jane Carr.

SATURDAY, SEPTEMBER 11th.

3, "In Our Garden": C. H. Middleton talking from the garden in Alexandra Park. 3.15, Gaumont-British News. 3.25, Variety with Scott Sanders (comedian); The Whirlwinds (skaters); and the Geddes Brothers (clowns). 3.50, Cartoon film.

5.30-6.15, Conditions permitting, the Television O.B. van will televise the arrival of the first planes at Hatfield aerodrome at the finish of the King's Cup Air Race.

9, "Love and How to Cure It": play by Thornton Wilder. 9.30, British Movietonews. 9.40, Cabaret with Drury and Raymond (dancers) and Walsh and Barker (songs at the piano).

MONDAY, SEPTEMBER 13th.

3, The Danger of Tobacco: a monologue by Anton Chekhov. 3.10, Gaumont-British News. 3.20, Cabaret Cruise (No. 3) on board R.M.S. "Sunshine"—Fancy Dress Night. Passengers include Pamela Randall, Charles Heslop and Warner and Darrell.

9, The Danger of Tobacco. 9.10, British Movietonews. 9.20, Cabaret Cruise (No. 3).

TUESDAY, SEPTEMBER 14th.

3, A Variety Show. 3.20, British Movietonews. 3.30, "Behind the Beyond"—a problem play. 9, Speaking Personally: I—Sir Hugh Walpole. 9.10, Cartoon film. 9.20, Music Makers: Mildred Dilling (harp). 9.30, Gaumont-British News. 9.40, Cabaret.

WEDNESDAY, SEPTEMBER 15th.

3, Just for Fun!—a little show. 3.20, Gaumont-British News. 3.30, Seventy-seventh Edition of Picture Page.

9, Just for Fun! 9.20, British Movietonews. 9.30, Seventy-eighth Edition of Picture Page.

THURSDAY, SEPTEMBER 16th.

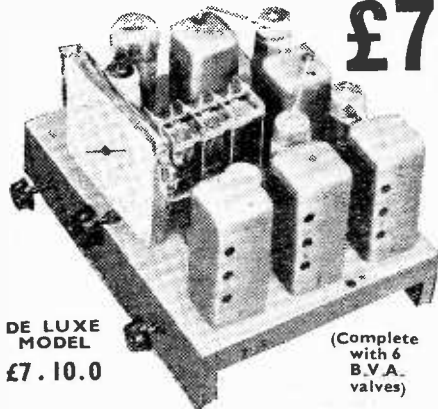
3, Scene from Shakespeare. 3.20, British Movietonews. 3.30, A little show.

9, Leslie Hutchinson. 9.10, Imagination in Wood—Carvings. 9.20, Gaumont-British News. 9.30, Variety.



**BATTERY ALL-WAVE SUPERHET**

**£7**



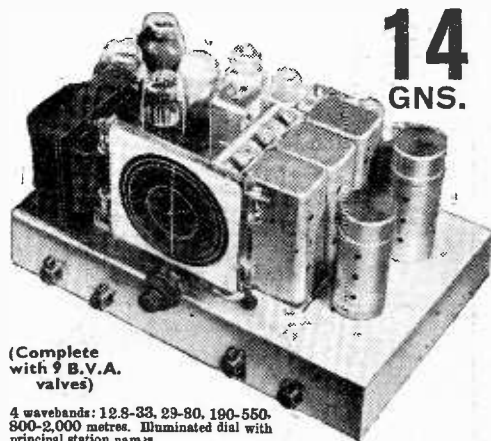
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(Complete with 6 B.V.A. valves)

The only receiver of its type now on the British market. Results on all 3 wavebands equal to mains receivers of equivalent type. Latest technical developments incorporated in circuit. Latest types valves, transformers, tuning coils, switches, etc. Specification in brief: radio frequency amplifier, first detector with separate triode oscillator; I.F. amplifier, double diode detector, L.F. amplifier, low consumption pentode output. D.A.V.C. volume control and tone control both operative on gramophone. Illuminated dial with station names. Wave-ranges: 19-50, 200-550, 900-2,000 metres.

**9 VALVE FOUR-WAVE SUPERHET DE LUXE**

**14 GNS.**



(Complete with 9 B.V.A. valves)

4 wavebands: 12.8-33, 29-80, 190-550, 800-2,000 metres. Illuminated dial with principal station names.

**Controls.**—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include: sensitivity control (varying bias on R/F stage). Q.A.V.C. with manual muting control for inter-station noise suppression. 5-position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram. **Circuit in Brief.**—Aerial input to pre-selector circuit, radio frequency amplifier, latest type triode-hexode, frequency changer, 2 band-pass I.F.T. coupled I.F. amplifiers, double diode detector, L.F. amplifier and special push-pull pentode output stage. Heavy cadmium plated steel chassis. Finest components and workmanship throughout. Harries' tetrodes in place of output pentodes if desired.

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# UNBIASED

## Hints to Islanders

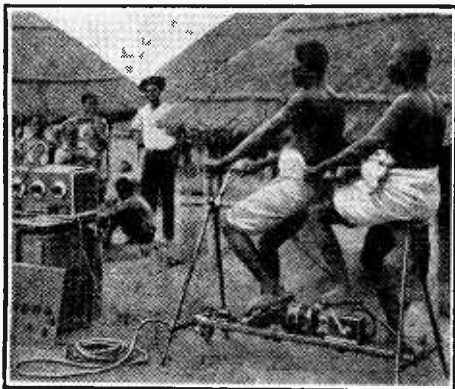
By FREE GRID

I AM very astonished to read in the pages of *The Wireless World* that the islanders of Tristan da Cunha employ such a comparatively unreliable arrangement as the wind-driven generator to charge their wireless accumulators when they have on their very doorstep a far better method.

It is true that in that part of the world there must be many days when the wind is blowing good and hearty, and the generator set a-spinning so merrily that there are bags of excess volts in hand, but what on earth is the good of that, for it is impossible to store them up for use on those occasions when a maddeningly monotonous calm sets in. Moreover, when these calm periods do come along they must be very exasperating, as you can bet your life that they occur on those days when some exceptionally spicy item is being broadcast, and the enraged islanders can do nothing about it.

Personally, I should have thought that even a bicycle-driven generator would have been preferable to a wind one, for surely there must be periods when the days drag rather heavily, and the islanders would be only too glad to ride round and round the island on bicycles fitted with carriers containing accumulators charged from a generator running from the back wheel in the manner of an ordinary cycle-lighting outfit.

The charging could even be done, of course, by towing a rotating generator round the island at the back of a rowing boat, using the principle upon which a ship's patent log operates. These



I have no picture from Tristan da Cunha, but this is how they do it in Africa.

methods are, however, not the ones I have in mind, for they both entail physical effort, a thing which must, I suppose, be as abhorrent to the islanders as it is to you and me. No, what I was thinking of was to use as driving force a natural phenomenon which is absolutely regular and steady all the year round, and with which Tristan da Cunha, like all other seaside places, is provided.

I cannot, I fear, claim any originality for my idea as I saw it used by a swimming-bath attendant many years ago. As many of you must be aware the swimming baths at many seaside resorts are so arranged that the water can be changed when desired without any cost to the local council. The dirty water is merely allowed to drain away into the sea when the tide is out, and the bath is automatically filled by the next tide.

In the case in question the bath attendant, in order to circumvent the exorbitantly high prices of the local accumulator charging station merely caused the cascade of water from the emptying bath to pass through a small water turbine while draining away, the turbine, being coupled to a generator.

It would surely be quite a simple matter for the islanders of Tristan da Cunha to dig a hole on the beach and invest in a simple water power station of this type. They would thus obtain a regular period of charging twice daily.

### "There Are More Things in Heaven and Earth . . ."

I MUST confess that I did not, until the other day, consider what became of those unfortunate mortals who allowed radio to take too secure a grip upon them. Most of us look upon it as a sideline, and thereby secure our salvation; but that it can enter into one's bones and so absorb the attention as to drive out all other thoughts is a matter which requires no great stretch of the imagination to believe. At any rate, I had occasion the other day to meet a few of these unfortunates and it touched me to the quick to see how devoted they were to their hobby, now, alas, become their life's occupation.

I had stopped my car in a quiet country lane and was listening to the News Bulletin when, with a great hullabaloo and shouting a crowd of people swept upon me, seized both me and the portable, and carried us up to the large country house from which they had emerged. They seemed delighted to see me, and all insisted upon shaking hands and saying how welcome I was. It was only on the arrival of another visitor that they, and I, discovered that they had mistaken me for another sufferer whom they had been expecting.

Presently a man in uniform appeared and leading me aside told me that this was a sort of home for incurable radio experimenters whose enthusiasm had led them to forsake their homes, their wives and their children. They lived in a world in

which the ordinary cares and anxieties of life were non-existent. Some of them had even forgotten their own names, but fortunately the language of wireless is rich in proper names and so they called each other by these.

My guide pointed to a small man with a very large bald head and explained that he was engaged upon trying to clear a space in the Heaviside and Appleton layers to let wireless radiations pass through, his idea being to communicate with the planet Mars. The mass of gear with which this individual was surrounded was a tribute to his skill, and he is firmly convinced that he will one day achieve his object.



I staggered towards my car.

I had a chat with him but his language was far too technical for me to grasp much of what he said.

In the next room was a team of experimenters who were working on the theory that there have been successive ages of civilisation, followed by periods when everything that has been learned by man is forgotten, corresponding to successive Ice Ages. We are, according to them, about half way through a period of civilisation just now. Their aim is to pick up some of the broadcasts of these former ages, and they showed me a monster receiver embodying five hundred valves which is being constructed for the purpose. I noticed that my guide tapped his forehead significantly, so with mumbled expressions of good luck, I passed on.

In another room was a queer assemblage of men who were seeking means to prove that the solar system is an atom with the sun as the nucleus and the planets as electrons. Suppose every other star, with its complement of planets, to be another atom; is it inconceivable that all these atoms may form the chalk or cheese of a vastly bigger world system? Likewise, is it inconceivable that the atoms of *our* chalk or cheese may be solar systems with their planets, each with men crawling thereon? Everything, they assured me, with tears in their eyes, was large or small by comparison with something else.

I pointed out that if this were so the solar system would be bobbing about all over the place. They insisted that this was so, but owing to the gigantic scale of it, in comparison with the atoms which we study, it appears to our senses to move slowly. My benumbed brain, however, would contain no more and I regretfully beckoned to the guide, who supported me until I reached my car. However, I promised to return some day.



# Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

## Radiolympia 1937

AS an old regular reader, I feel bound to protest at your Editorial in the *Wireless World* praising the Exhibition, especially in regard to television. When, may I ask, will the organisers and the B.B.C. cater for the poor buyer who has to work and report home to the wife and just sneaks an hour off to see and choose the latest set?

My brother, who has not seen any television yet, and I arrived at 6 o'clock one day and spent two hours gazing at all the television sets—poor things, all standing lifeless with not a picture to be seen. By 8 o'clock we had visited every stand and were fagged out. We learnt that none of the machines we had seen (dozens of 'em!) were in use. We had to get a ticket before we saw the "pictures," and were told to wait till 9 o'clock before we could see television. We went home!

V. R. CORNELL.

South Norwood, S.E.25.

## Television at the Show

I WRITE to draw your attention to the unsatisfactory arrangements adopted in connection with television viewing at Olympia. While sympathising with the desire of the R.M.A. to prevent the form of stampede which occurred at the 1936 Exhibition, I feel that caution has in this case been carried to excess and has produced the following very bad results both from the point of view of the general public, the scientific public and of those manufacturers interested in the sales of television receivers.

I have a television receiver at home and am, therefore, not particularly interested in seeing television, as such, at the Exhibition, but, on the other hand, I am extremely interested in comparing the different makes of receiver in order to decide upon their relative merits. This is normally quite impossible and I only achieved it by having a wordy discussion with one or more commissionaires in front of each booth and with the assistance of certain friends whom I happened to meet in the television enclosure.

A commissionaire told me that I could get an engineer's pass at the R.M.A. office, but this was not forthcoming, and I was informed that I must stand in a queue and obtain a ticket which would entitle me to watch an unspecified receiver for 15 minutes.

Now this is not good enough either for me personally or for those members of the public who wish to buy receivers and who have a very natural desire to make a full comparison before discussing business.

I would, therefore, strongly recommend that the system adopted in Germany, which has been found to be satisfactory on more than one occasion, should in future be adopted in this country. This arrangement consists of a large hall in which the centre space is reserved for the public and in which a portion, perhaps 15ft. deep, is railed off all round. At a distance of 5 or 6ft. outside the rails, the various receivers are placed without any partitions, except perhaps a rail, between them and with a label overhead giving the name of the company concerned. Behind the row of receivers is a series of small booths in which receivers may be demonstrated to those

customers who are technically interested or who may evidence a desire to make a purchase.

Such a scheme is ideal in that everyone can make a full and thorough comparison of all the receivers and may then view in comfort the receiver of his choice. No excuses can be levelled against this scheme on the score that it would bring about undue congestion, since the available space in the centre can easily be made of ample proportions.

In conclusion, I would point out that I am writing this letter as a private individual and that it is not in any sense written on behalf of the company with whom I am associated. It would, I think, be of interest, however, to hear through the medium of your paper what is the opinion of other private individuals and of those companies who exhibited television receiving equipment.

O. S. PUCKLE.

Edgware.

## Synchronising Signals in Television

A CERTAIN amount of interest has recently been aroused in one aspect of the transmissions from Alexandra Palace, and it is because of the importance of the issues raised that I am venturing to bring the matter to the notice of your readers.

Difficulties have been encountered in receiving broadcasts by means of mechanical apparatus, as distinct from a cathode-ray receiver, these being due apparently to an irregularity in the timing of the transmitted synchronising impulses which a cathode-ray receiver might perhaps be expected to follow, but which a rotating mirror drum or similar device, by virtue of its inertia, would be bound to ignore.

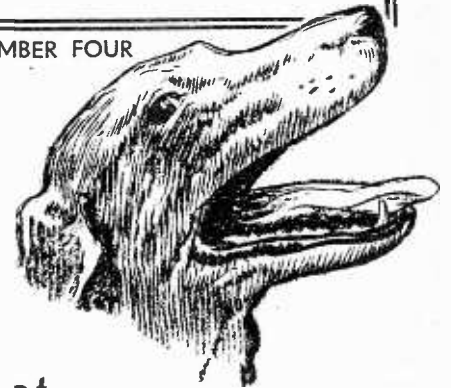
This irregularity may be quite easily observed on a cathode-ray receiver having steadily running scanning oscillators by cutting off the synchronising control and keeping the picture as still as possible by manual operation. It will be found that the picture is subject to irregular movement from side to side, a phenomenon which indicates that the timing of the line-scanning operation at the transmitter is in fluctuating phase-relationship to the scanning oscillations at the receiver. As the latter can be compared with, and if necessary controlled by, a stable sine-wave generator, it can readily be shown that the unsteadiness originates at the transmitting end.

Restoration of the synchronising control in sufficient measure will substantially remove these fluctuations, a fact which indicates that, although the line-scanning process at the transmitter is irregular, the synchronising impulses are correctly timed in relation to it, and when these impulses control the scanning oscillator of the receiver, synchronism is satisfactorily effected.

The importance of this defect in relation to mechanical receivers is self-evident, but the matter does not end there. If it is necessary to design scanning oscillators and synchronising circuits so as to be capable of keeping in step with irregularly timed syn-

Quaint IDEAS  
YOU ACCEPT WITHOUT  
QUESTION....

NUMBER FOUR



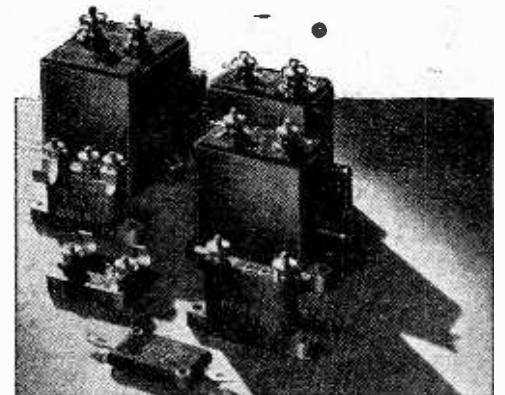
that  
**A BARKING DOG**  
doesn't bite.....

To prove your point would mean running certain risks—and it wouldn't be worth it.

When buying condensers, to hold the mistaken idea that all makes are alike, means taking risks too. It's far more simple and certainly safer to insist on condensers that the whole industry unreservedly accepts as being beyond reproach—T.C.C. Condensers. Dependable because they are specialist built, because years of intimate experience in the design and manufacture of condensers stands behind every type. Don't experiment with condensers; be guided by this—

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Letters to the Editor—

chronising impulses, a serious limitation is placed upon progress in the direction of what I submit is the ideal, namely, the use of scanning oscillators at the receiver which are so nearly constant in their frequency as to require only the minimum control to keep them in phase with the scanning operation at the transmitter. This desideratum has a direct bearing upon the question of maintaining synchronism in the presence of interference, since if it is necessary to increase control to take into account irregularly timed synchronising signals, the scanning oscillators will necessarily be more susceptible to interfering impulses.

It would seem probable that the whole trouble arises from the fact that the scanning and synchronising apparatus at the transmitter is governed as to frequency by the alternating current mains, the wave form of which is almost bound to be subject to small phase fluctuations. It would not appear impossible to derive a scanning frequency which was tied to that of the supply for long-period variations but was independent of it for those of short period; if, however, it came to a choice, I should favour a completely independent standard of frequency rather than the perpetuation of the present fault in the transmission.

P. W. WILLANS.

31, High Holborn, W.C.1.

[Since we received the above letter, publication has been given to the fact that the B.B.C. are adopting a synchronising system on the lines suggested here by Mr. Willans.—ED.]

Transient Response.

MR. P. G. A. H. VOIGT desires the demonstration that his special transient, which one could not conceive being naturally produced, contains all frequencies from zero to infinity. This is unnecessary, since any sharp corner, such as the start of an isolated half-sine-wave, means an infinite acceleration of amplitude, and this implies the same infinite frequency spectrum as the more familiar step, except that the distribution of energy is different. The step, Fig. 1, is the most violent transient possible, with equal velocity contributions from all frequencies.

The mathematical criteria for exactly reproducing an irregular wave are simply stated,\* and the engineering problem is to see how far these must be complied with in sound reproduction. The special limitations are the operation of the ear, with its frequency limits and time-constant, and the integrative effect of reverberation in enclosures.

First, the total attenuation of the system, that is the ratio of the output amplitude to the input amplitude (or driving force), must be independent of frequency from zero to infinity. We might have anticipated this from experiment, but there

have been some theoretical interaction between this criterion and the phase criterion. This demand is indicated by the line A1 in Fig. 2.

We know from practice, however, that the overall response of any system is not independent of frequency, but experiment agrees with theory in that if the attenuation is not represented by A1, which is desirable, but in fact is represented by A2, then it is a simple matter, if the curve is reasonably smooth, to add a further attenuation response, A3, in the system so that the total response becomes A4, which is independent of frequency. The actual value of the total attenuation is of no importance, since we can amplify as much as we like. This equalisation is very familiar, and is performed dozens of times in every trunk telephone circuit as well as extensively elsewhere.

The second result is that the phase retardation, B1, must be linear with frequency, that is, the number of radians phase retardation of the output amplitude at any particular frequency as compared with the input driving force of the same frequency must, when plotted against frequency, indicate a straight inclined line for zero to infinite frequency. The slope of this line is the time-delay for the frequencies to get through the system. If they all get through after the same time-delay, i.e., with the same velocity, the condition is fulfilled. In practice they never do, and the inclined line becomes a curve. That is to say, we desire a straight line relation indicated by B1, but we generally get B2.

On a telephone line, for example, the high frequencies get left behind because of resistance in the line, and the low frequencies get left behind because of the loading coils and transformers in repeaters; in fact, there is a frequency of maximum velocity of transmission and medium frequencies get reproduced first. If the high-frequency delay is sufficiently great the result is a tinny ring, due to high-frequency components of sounds arriving after the medium components have finished. In the case of telephony, the delay at the lowest frequencies is dis-

cies, as indicated by the linearity of the total phase retardation curve B4.

The third requirement for the perfect reproduction of a non-repeated change is that the phase intercept, I, which is the phase retardation at frequency = zero, must be a multiple of  $\pi$ , and if it is not we can never hope to reproduce the required change.

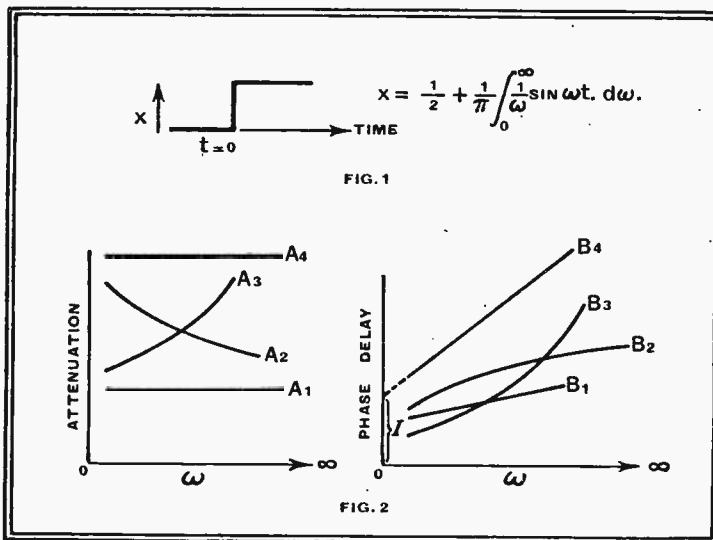
Any more or less general phase retardation of the component waves, as measured by I, alters the wave-form being reproduced, even if the attenuation and the phase delay are independent of frequency. The effect on the acceleration of a transient is that the component frequencies cannot all assist in such acceleration at the precise instant required and the transient must be distorted.

We might say that perfect reproduction of an acoustic wave-form involves the repetition of the wave-form of a sample of the original sound at the ear of the distant listener, and that all three criteria apply. This is vastly too strict, first, because the aural delay in perceiving a sound means that we never perceive an infinite rate of change in an acoustic wave. Even the crack of a pistol with its sharp wave-front is not markedly different from other sharp sounds; in fact, such rapid acoustic changes all sound alike, for the simple reason that any greater acceleration than the ear can accommodate cannot be perceived as such. If the impulse is very short the result is merely an apparent decrease in intensity with no change in character of the sound.

In practice, many impulsive sounds have set up some resonance, and this results in energy being sufficiently concentrated in some part of the frequency spectrum that a pitch can be recognised. It appears that about ten cycles of a frequency are required before the ear can perceive the frequency with certainty, otherwise it is merely a click of no definite connotation. It therefore follows that the phase intercept relation, which requires identity of phase at some arbitrary instant, is inapplicable to acoustic wave-forms, since they do not possess such high rates of change, because of their mode of generation, and even if they did the ear would never perceive such changes. The time-constant of the ear varies somewhat with frequency, but appears to be about 0.15 sec., which is a comparatively slow amplitude response when other mechanisms are considered.

The most generally accepted theory of audition, and one which appeals to the engineer, implies the resonant analysis before perception of the frequencies which are simultaneously applied to the ear. On this account it would appear that it is unnecessary to reproduce frequencies outside the upper and lower limits of audition, since such components could not be perceived in original sounds, and therefore not in the reproduction. This is naturally in accordance with experimental evidence, but it might be pointed out that this restriction of frequency band of response may have some link with the time-delay of amplitude perception, as obtains in mechanical systems of greater simplicity, and that research along these lines might produce important contributions to the theory of hearing, at least as far as the mechanism is concerned.

For practical purposes the theoretical criteria indicate that the response (or attenuation) must be independent of frequency over the frequency range of audition. We desire to know, in addition, whether relative phase retardations make any difference, it having been indicated that the phase intercept can be disregarded.



regarded since the ear does not perceive the effect.

It is common practice in telephone and programme lines to introduce further phase retardation using special types of filter sections but with reversed curvature, say B3, so that the overall delay, though increased, becomes constant for all frequen-

\* For proof, see "Electric Circuits and Wave Filters" by Dr. A. T. Starr, p. 336.

Letters to the Editor—

Since the ear requires a minimum number of cycles before it can recognise any definite frequencies at all, it appears that the small phase retardations which occur in microphones, amplifiers and reproducers are quite inadequate to produce effects associated with phase delay; the radio link, of course, introduces no phase retardations as far as this discussion is concerned.

Van der Pol made some experiments in which the phases of component frequencies of speech and music could be arbitrarily altered, but with negative results. It can naturally be fairly argued that no one has yet made a system of sound reproduction which sufficiently complies with the main criterion, i.e., response independent of frequency, to verify experimentally that there are effects which can be associated with differential phase retardation effects alone.

The remaining acoustic consideration is reverberation. Sounds picked up with a microphone for artistic purposes contain definite proportions of directly radiated and reverberant sound, the intensity ratio varying between about 2 for speech, other than talks and announcements when there is practically no reverberant component, and about 0.5 for large-scale music. The ear, however, is much more acute in perceiving the directly radiated sound than the reverberant component, the latter softening and blurring the effect of the former to an artistic degree to which we have been educated.

On reproduction, the same thing happens except that we can assume that the listener does not change his location with respect to the reproducer for different items, and therefore the contribution of blurring due to his surroundings is substantially constant. The beam effect with open-diaphragm loud speakers without deflectors causes a harshness directly due to this effect, the acoustic surroundings in most domestic premises being normally left to chance.

In the reverberant component, phase means nothing, since the average intensity is an integration of the emitted wave-form over a period of time, comparable with one second. Exactly to what extent the reverberant component blurs the direct component does not appear to have been settled, but while the direct component remains comparable with the reverberant component in intensity, any possible effect due to phase retardations would not be swamped.

So far, all claims for demonstrating aural effects due to relative phase retardations, other than the gross effects due to the properties of long lines, can be met with alternative explanations. For example, the well-known effect in coupling transformers which reduces the so-called attack in reproduction is due to the large number of cycles which are essential for a substantial change in the excursion of magnetisation. Amplitude distortion can account for effects hitherto associated erroneously with phase.

Summarising, we can say that phase retardation, which is apparently theoretically important, does not, in fact, enter into normal acoustic reproduction, and all effects obtained must be related to departures from the simplest attenuation criterion. Absorption of energy during a rise of amplitude and release during decay is simply associated with a normal resonance which is at once evident in the steady-state response of the system. There is no separate transient response. Mr. Voigt is right.

London, W.11. L. E. C. HUGHES.

The Radio Industry

COPIES of three interesting new publications have been received from the Westinghouse Brake and Signal Co., Ltd., 82, York Road, King's Cross, London, N.1. The first is the 1938 edition of that valuable and well-known little text-book, "The All-Metal Way," which deals with the applications to radio and television of Westinghouse metal rectifiers and Westectors. "Westinghouse Rectifiers for Telecommunication" is a publication that is addressed more especially to professional designers and technicians. It deals with the application of metal rectifiers to radio communication power supplies in both transmitters and receivers as well as with land-line communications. The third handbook is entitled "At the Correct Rate"; it contains information on battery charging. Readers interested in the subjects covered by these publications may obtain copies by applying to the address given.

The Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent, has just issued a new season's catalogue of rotary converters, etc.

Pifco, Ltd., the well-known manufacturers of meters, etc., has moved to Pifco House, 58, City Road, London, E.C.1.

Ardente Acoustic Laboratories, 11 and 12, Pollen Street, Maddox Street, London, W.1, have issued a well-prepared catalogue of sound-amplifying equipment, microphones, etc.

F. W. Lechner and Co., Ltd., agents for Kabi apparatus, has moved to 5, Fairfax Road, London, N.W.6.

The new season's Dubilier "Broadcast" catalogue describes types of condensers and resistances suitable for both amateurs and service engineers.

Dynatron Radio, Ltd., are co-operating with the Marshall Piano Co., of 18, Orchard Street, Oxford Street, London, W.1, and a complete range of Dynatron apparatus is available for demonstration in the showrooms of the latter firm.

Holiday and Hemmerdinger, public address and service engineers, have moved to 74-78, Hardman Street, Deansgate, Manchester, 3.

An attractively written book entitled "Wire," by Frank Boyce, author of "Tuning in Without Tears" and "Straight Black Lines," has been issued by the Scott Insulated Wire Co., Ltd., Queensland Works, Holloway, London, N.7. A limited number of copies are available for distribution to radio engineers and executives.

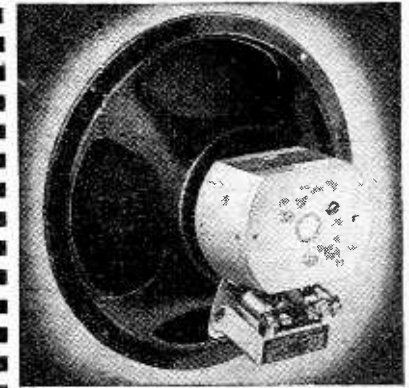
M.R. Supplies, of 11, New Oxford Street, London, W.C.1, will provide readers with a free album in which the firm's advertisements may be pasted.

The new Avo catalogue contains, in addition to full information about the latest types of Avometer, Avominor and other testing instruments, details of Douglas and Macadie coil-winding machines, etc. Copies are available from the Automatic Coil Winder and Electrical Equipment Company, Winder House, Douglas Street, London, S.W.1.

The Marconi exhibit at the Engineering and Marine Exhibition, which opens at Olympia on September 16th, will comprise two transmitters, an interesting all-wave receiver, and the latest design of auto-alarm apparatus, in addition to other equipment.

Another wireless firm to be represented at the Shipping Exhibition is Gambrell Radio Communications, Ltd., who is showing direction-finding apparatus, the G.R.C. auto-alarm Type 25 and two radio-telegraphic installations, in addition to lifeboat equipment, etc.

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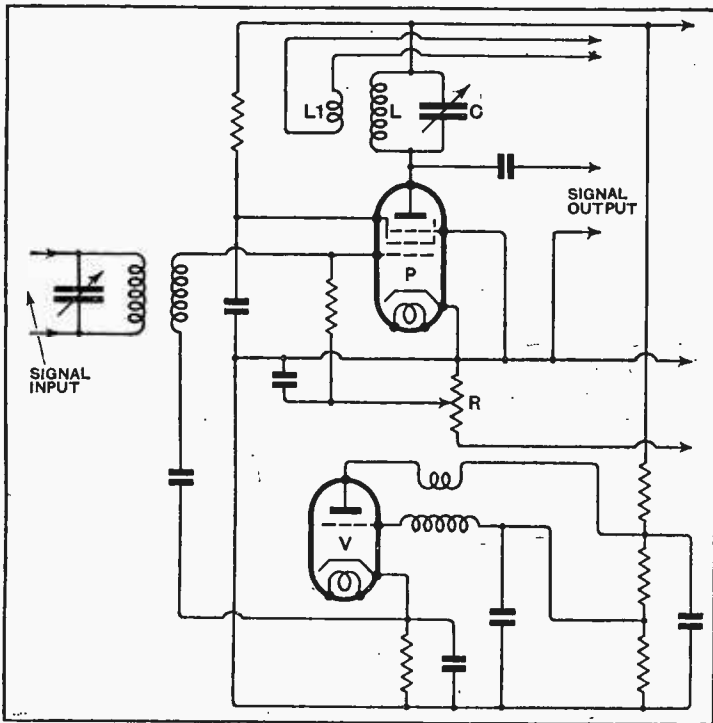
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# Recent Inventions

**Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.**

## CUTTING OUT INTERFERENCE

To reduce the effect of inductive "pick-up," particularly from the ignition system of a motor car or aeroplane, the signals are only allowed access to the input circuits of the receiver for a comparatively



Circuit for suppression of ignition noise in motor car or aeroplane radio apparatus.

small fraction, say, one per cent., of the duration of a given cycle. During the remainder of the time, they are allowed to build up in a very lightly damped circuit, so that the continuity of the signals is preserved.

As shown in the figure, the input pentode P is normally biased to the "cut-off" point by a resistance R in its cathode circuit. An auxiliary valve V generates a "peaky" wave, which is applied to the control grid of the pentode, so as to allow only sharp pulses of energy from the signal input circuit to pass through into the anode circuit L, C. Here they build up under the influence of reaction introduced by a coil L1 from a later stage on the receiver. To stabilise the building-up pro-

cess, a quenching frequency is applied from the oscillator V to the circuit L, C. The signal input is damped in order to prevent any undue persistence of the interference impulses on their way to the pentode P.

The Plessey Co., Ltd., C. E. G. Bailey and G. Baillie. Application date November 19th, 1935. No. 465282.

## TELEVISION SYSTEMS

IN scanning a picture the smaller the aperture used the better will be the detail produced. But a small aperture necessarily cuts

trast, whilst the other is coarse-grained but with accentuated light-and-shade values. The two sets of signals are superposed to give a clear-cut picture at a low level of valve "noise."

P. T. Farnsworth. Application date January 13th, 1936. No. 465631.

## AIRCRAFT WIRELESS

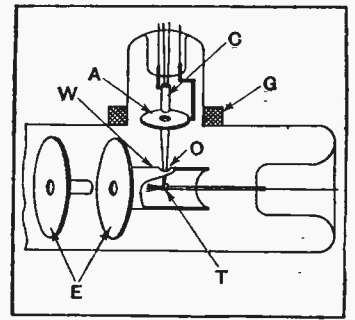
A DOUBLE - HETERODYNE set, suitable for receiving navigation and "blind-landing" signals on an aeroplane, is arranged so that the course-indicating signals, say, on 9 metres, are picked up by one aerial which feeds the input stages of the set. Other signals, such as those sent out on 7.9 metres by beacons marking the boundaries of the aerodrome, are picked up by a second aerial, which is coupled directly to the second intermediate - frequency stage of the same set, which is, of course, tuned to the beacon frequency. These "marker" signals are passed to the final detector stage, which is a pentode and acts as a super-regenerator.

A third aerial may be coupled to another of the intermediate frequency stages, in order to receive wireless telephony signals. The course - indicating signals are passed through a visual indicator, whilst the beacon and speech signals are filtered through to headphones.

R. P. G. Denman. Application date November 14th, 1935. No. 465792.

## CATHODE-RAY TUBES

WITH an ordinary indirectly-heated cathode, it is difficult to make the area of emission sufficiently small and precise to give a clear-cut point of light on the fluorescent screen. Also it is found that the emissivity of the cathode varies from point to point



Construction of CR tube to give a clear-cut point of light on fluorescent screen.

of bombardment. As shown in the figure, electrons from a heated cathode C are concentrated into a stream by a coil G and are then accelerated through an aperture A so that they pass through an opening O in the Wehnelt cylinder W and impact upon a target T, which may consist of caesium or rubidium or of highly emissive oxides. The resulting stream of secondary electrons passes through control electrodes E on to the fluorescent screen of the tube in the ordinary way.

Ferranti, Ltd., and J. C. Wilson. Application date October 3rd, 1935. No. 465266.

## IMPROVING SELECTIVITY

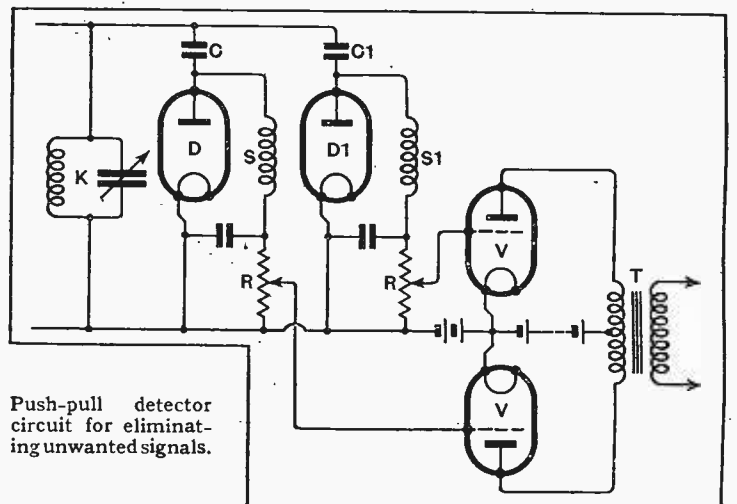
A MATHEMATICAL analysis is given to show that if two overlapping signals are fed in parallel to two detectors having different time-constants, the modulation of the weaker signal is, in effect, wiped out by that of the stronger signal, so that the latter is reproduced alone.

As shown, the input circuit K feeds the signals to two detectors D, D1 arranged in parallel. Both detectors are shunted by chokes S, S1, and the condenser C and resistance R are chosen to have a different time-constant from the condenser C1 and resistance R of diode D1. The outputs from the two detectors are fed to a push-

down the amount of light that can pass through, and this in turn reduces the "contrast" value of the picture. Although the falling-off in sensitivity can to some extent be compensated by further amplification, a limit is set in this direction by the rise in valve "noise" which soon tends to mask the signals.

On the other hand, the use of a larger aperture, although favourable to "contrast" values, necessarily produces a picture which is coarse in grain, because each picture "point" is of the same dimensions as the scanning aperture.

As a compromise, the picture is scanned simultaneously through two apertures of different size. One gives high detail and low con-



Push-pull detector circuit for eliminating unwanted signals.

over its surface, and also from time to time from the same point. All this gives rise to undesirable fluctuations in the strength of the electron stream.

To avoid these difficulties the stream is produced by a method

pull amplifier V, and the undesired signal is balanced out across the transformer T.

N. V. Philips' Gloeilampenfabrieken. Convention date (Germany) October 26th, 1935. No. 465333.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

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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

# Misuse of the Decibel

## *Ambiguous Amplifier Ratings*

**T**HE decibel notation, a most convenient shorthand in all calculations based on power relationships, is in danger of losing its effectiveness through misapplication. Already the layman is firmly convinced that it is a "unit" of noise, and now we find it being stretched in another direction to serve without qualification as a figure of merit for PA amplifiers.

The arguments against applying a decibel scale to an amplifier with a voltage input and a power output are ably presented by two contributors to our Correspondence columns this week. Only where the input and output resistances are identical, as in the 600-ohm lines of the telephone engineer, is it permissible to express an amplifier gain in db. without qualification; for then it is purely a power relationship and one, moreover, which reflects the actual conditions of working.

Enquiries have revealed a lamentable lack of uniformity in the methods adopted by the various PA concerns for calculating the "db. gain" figure quoted in their catalogues. In some cases the ratio of input volts to the volts developed in the output valve anode circuit is taken, so that it is necessary to turn up valve data in order to calculate the input required to give the maximum power output of which the amplifier is capable. Where the trouble has been taken to keep the "db. gain" on a power basis there has been apparently no attempt to establish a recognised input resistance. Generally an arbitrary figure is chosen which bears no relation to the output impedance of the micro-

phone used, but which gives a reasonable gain figure.

Presumably with the object of linking up with the amplifier gain figures and to facilitate calculations of overall gain the sensitivity rating of microphones is also now being expressed in db. Here confusion is worse confounded, for we find one firm calculating the power output of the microphone for average speech at a distance of 3 feet and referring it to a zero level of 6 milliwatts. Others take the zero level as one volt output for a sound pressure of one dyne per sq. cm. There is this to be said for the latter method of rating microphones, that it acknowledges the existence of voltage amplification between the microphone and the power output stage and also the fact that the microphone should be judged by the volts and not by the watts which it produces.

### *Essential Information*

Clearly, if the decibel is to be pressed into service for labelling PA amplifiers, manufacturers must get together and agree to use some uniform method of calculation. In the meantime, we suppose that the harassed PA installation engineer will continue to make a shrewd guess from experience of the degree of amplification that will be required for His Worship the Mayor when speaking at a distance of, he hopes, three feet from the microphone; and as far as we ourselves are concerned we shall continue when reviewing amplifiers to give a simple statement of the volts input required to give the maximum undistorted power output available.

# Auditorium Acoustics

**U**NDER the stimulus of broadcasting much research has been undertaken in recent years into the interior acoustics of buildings. In this series of articles the author summarises our present knowledge of the principles underlying the design of modern theatres, lecture halls, etc.

By D. B. FOSTER, M.Sc., Ph.D.

**T**HE study of auditorium acoustics probably dates back to pre-historic times and we know that the Greeks gave considerable thought to the subject in connection with their dramatic performances. It is, however, comparatively recently that auditorium acoustics has been studied on an accurate quantitative basis and the father of the science in this stage is W. C. Sabine who carried out his classical experiments at the end of the 19th century.

The necessary requirements of good acoustics in an auditorium are:

- (1) Even distribution of sound and freedom from acoustical defects due to shape.
- (2) Adequate loudness of the sound for all listeners.
- (3) Maximum intelligibility for speech purposes.
- (4) Optimum reverberation time for musical and other artistic purposes.
- (5) Minimum interference from noise.

Although it will be dealt with fully in later articles of this series it might be as well to state now that reverberation expresses the persistence of a sound in an enclosure after the source of sound has been stopped and the standardised measure is "reverberation time" which is the time taken for a sound to decay to one-millionth of its original intensity after the source has stopped.

The above five requirements are controlled by the physical characteristics of the auditorium which may be summarised as: (a) shape, (b) size, (c) nature of boundary surfaces, and (d) insulation of boundary surfaces to exclude extraneous noise.

The current article will be devoted entirely to consideration of the effect of shape on the acoustics of an auditorium, and succeeding articles will deal with the other factors and with the optimum conditions for different types of sound production and listening.

The shape of an auditorium should be designed from two aspects, first to avoid certain acoustical defects due to shape such as echo, and second to ensure adequate and even distribution of sound to all the listeners. Both these aspects depend upon the ability of a boundary surface to reflect an incident sound ray in a similar manner to which a mirror reflects a light ray.

The acoustical defects due to shape may be summarised as: (a) echo and flutter echo, (b) sound focusing and interference, and (3) resonance.

Echo is produced when the sound following a reflected path arrives at the listener more than  $1/17$ th second after the sound taking the direct path. Since sound travels at a speed of about 1100 feet per second, this delay corresponds to

an increased travel of about 65 feet and it will thus be seen that echo can exist in quite a small auditorium. For example, a ceiling which is as low as  $32\frac{1}{2}$  feet, can give rise to the defect. Since, however,

the delayed sound will usually be much weaker, due to dispersion and absorption, than the direct sound it is often required that the reflecting surface shall be concave to focus the sound to audible intensity before the echo becomes objectionable.

This unfortunate combination of a remote and concave surface is ex-

emplified in the domed ceiling shown in Fig. 1. With the speaker at A and the listener at C the scale is such that the focused reflection taking the path ABC takes at least  $1/17$ th second or 65 feet longer than the direct path AC. In addition to the pure echo effect there is the discomforting inability to decide whether the sound is proceeding from the speaker or the ceiling.

Another and possibly more common form of echo, is that produced by a concave rear wall to the listeners in the front seats and even to the speaker himself.

## Avoiding Echo

In general, therefore, the possibility of echo should be minimised by keeping the ceiling height down to the minimum and by the avoidance of large concave surfaces.

Although a delayed reflection of 65 feet is required to produce distinct echo, smaller amounts of delayed reflection can produce changes of quality due to out-of-phase effects, and so all delayed reflections should be minimised. In certain auditoriums it may be impracticable to avoid a concave surface which might give rise to echo and in these cases the echo may be eliminated by breaking up the large concave surface with small convex panels as indicated in Fig. 2. The effect of the dispersion caused by these panels is shown in the dotted lines, while the focusing echo which would otherwise be produced is represented by the solid lines. This construction will produce adequate dispersion if the chord of the panel is about 5 feet with a radial depth of about 1 foot.

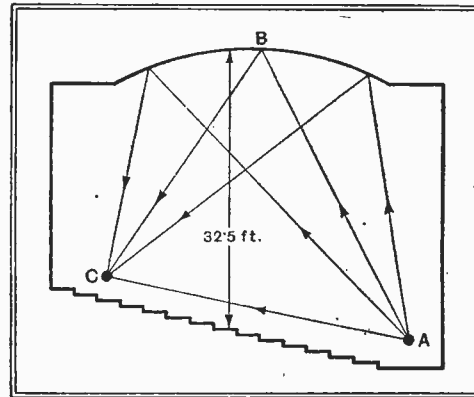
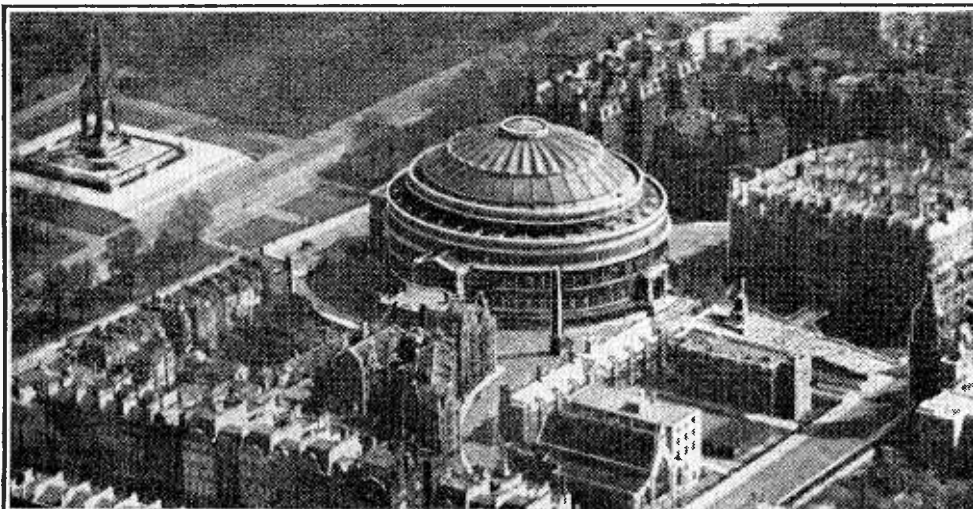


Fig. 1.—Illustrating the production of echo by a domed ceiling.



Elliptical in plan, and with a domed roof, the Albert Hall is a building of the type likely to produce echoes.

## PART I.—GENERAL REQUIREMENTS AND CONSIDERATION OF SHAPE

Flutter echo occurs when a surface which can give rise to echo is opposed by a second surface which can also give rise to echo. This common acoustical defect is often due to large parallel side walls. This defect can be demonstrated by a clap of the hands which will be followed by a series of successively weaker reports giving a machine-gun-like effect. The remedy for this defect is obvious and requires that large unbroken surfaces such as side walls be inclined at an angle to each other so that the sound may disperse.

The second acoustical defect due to shape, namely sound focusing, causes uneven distribution of sound, giving excessive loudness in certain areas which are the focal points of concave surfaces, and

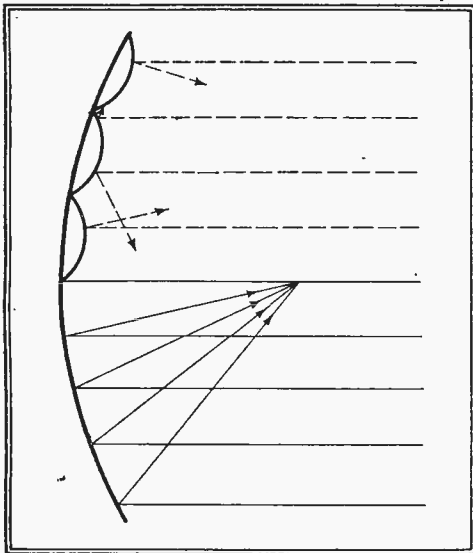


Fig. 2.—Echoes resulting from focusing can be dispersed by using a convex panelling.

giving inadequate loudness in other areas which are robbed of their share of reflected sound. An elliptical plan such as that employed at the Albert Hall is liable to give this defect as shown in Fig. 3, where sound from the speaker at A is concentrated excessively at B. This defect is liable to be most troublesome in large auditoriums where the ratio of reflected to direct sound is high and the reflected sound is the controlling factor in the loudness.

The third acoustical defect due to shape, resonance, which should not be confused with reverberation, occurs when the frequency of the sound coincides with the natural frequency of an air space in or adjacent to the auditorium. The effect is to give an enhanced loudness at that particular frequency. The main volume of air inside the auditorium is unlikely to give rise to resonance since its natural frequency would be very low, but small cavities such as boxes, alcoves and passages are likely sources. These resonance effects can be minimised by making the

cavities shallow and free from internal parallel surfaces. The ancient Greeks made use of resonance in their open air theatres where the average loudness was on the low side by placing on the stage earthenware vessels tuned to the fundamental voice frequencies.

Although not a function of shape, a common source of auditorium resonance is wall and panel vibration and this can be reduced by making the panels small, stiff and heavy. The average double brick wall construction will not, under normal circumstances, give rise to appreciable resonance. Under certain circumstances a small amount of wood panel resonance may be desirable since musicians tend to show a preference for playing under these conditions.

Having examined the three main defects due to shape we can consider how the shape should be controlled to give the positive effect of good distribution or equal loudness to all listeners. Since under open air conditions loudness falls off with distance away from the sound source it follows that under auditorium conditions the more distant listeners should receive a larger part of the reflected sound to make

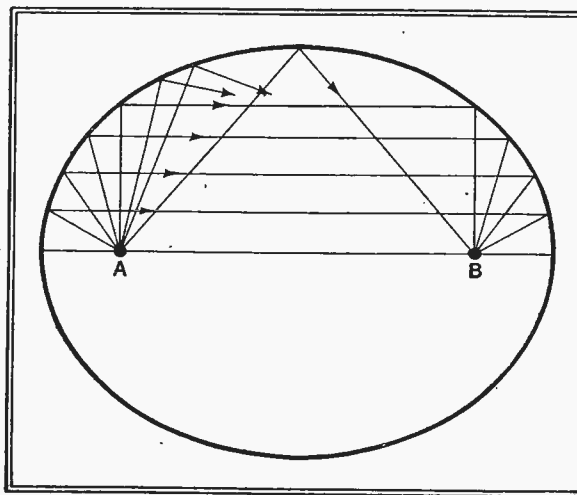


Fig. 3.—Reflections in a building of elliptical plan result in concentration of sound from the source A at a point B.

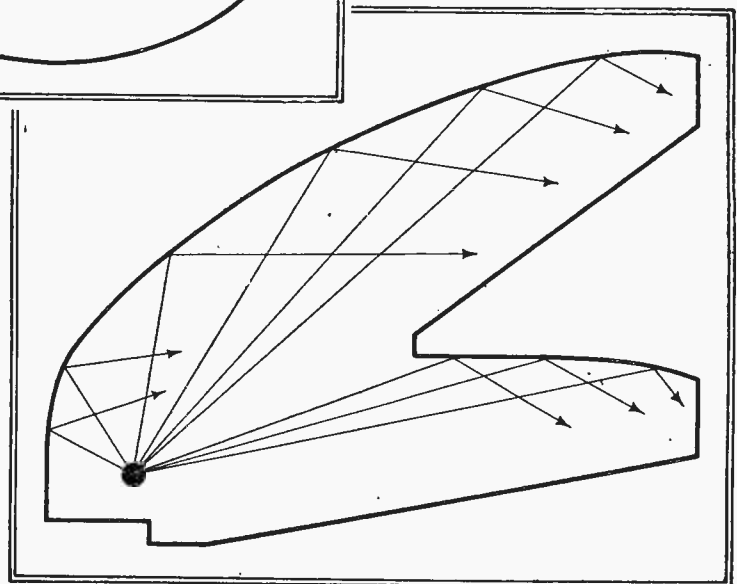
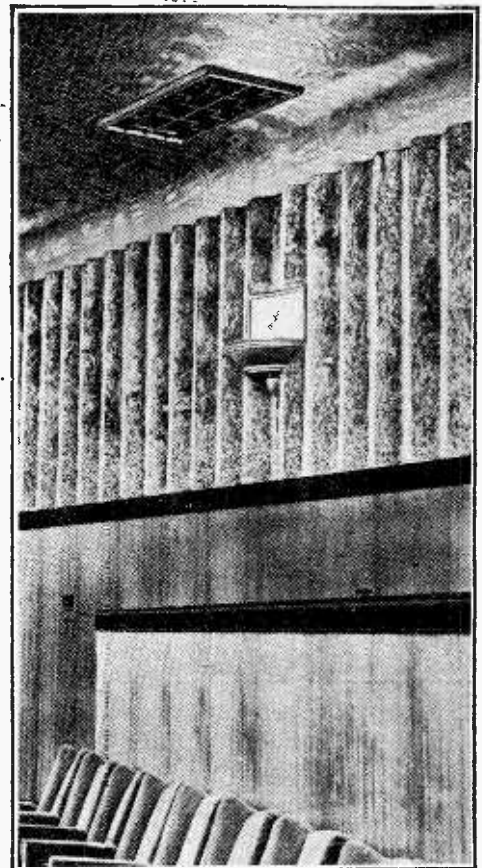


Fig. 4.—Section of theatre designed to reinforce sound over and under balcony by reflections from a curved ceiling.

Wall surface of the "Cameo" News Theatre, Victoria Street, London, S.W.1, showing curved panelling to break up reflections.



the loudness comparable with that in the front rows. The cross section in Fig. 4 illustrates the useful employment of reflected sound to augment the loudness of the more remote listeners.

The curvature of both the main and under balcony ceiling is arranged to reflect the sound to the rearmost seats, and this construction gives a larger opening than normal to the under-balcony area which is often relatively starved of sound. The reflecting surfaces behind the speaker are also arranged so that the sound is thrown to the distant parts of the auditorium. These back of speaker surfaces should never focus near the

**Auditorium Acoustics—**

speaker as he would then be overcome by the sound of his own voice and would probably reduce it and speak with inadequate loudness.



The ceiling of the Cambridge Theatre, Gt. Earl Street, London, W.C.2, is designed in accordance with the principle illustrated in Fig. 4.

In the corresponding plan view the side walls should be plain and smooth to give the maximum reflection to the rear. The walls should be divergent from the speaker to give natural distribution from the speaker and also to avoid flutter echo. The rear wall, although essentially straight, could be broken up by convex panels to minimise echo at the front seats.

In order to study the probable effect of shape in an auditorium before it has been constructed, use may be made of small-scale models having light rays radiating from the speaking position and mirrors

located on the various ceiling and wall surfaces. This enables detailed estimations to be made as to how the sound would be reflected through its first and subsequent reflections in the auditorium.

(The next article will be devoted to the effect of size and the nature of the boundary surfaces upon auditorium acoustics).

## On The Short Waves

### NOTES FROM A LISTENER'S LOG

FOR the benefit of both new readers and enquirers, may I state that I use a commercial superheterodyne receiver with two short-wave ranges, 19 to 8 Mc/s and 8 to 3.5 Mc/s. This particular receiver, of Australian origin, was chosen because it is equipped with an additional tuned RF stage on the highest frequency band. For listening above 19 Mc/s, i.e., below the 16-metre band in effect, an ultra-short wave converter is used, comprising a RF valve with a triode-hexode frequency changer, covering 65 to 18 Mc/s in one range.<sup>1</sup> When this converter is in use the main receiver is switched and tuned to 3.75 Mc/s and used as the IF amplifier.

An average-sized inverted "L" aerial is used for all bands, but a vertical dipole is used for reception of Alexandra Palace. The receiving location is on the west side of Clapham Common. For transmission on 28 Mc/s stacked horizontal arrays are employed.

The following information from the *Zurich Bulletin*, Nos. 36 and 37, and from *Nature*, August 21st, 1937, regarding recent sunspot activity will probably be of interest. The mean daily sunspot numbers for each of the six months October, 1936, to March, 1937, show, to quote from *Nature*, "how considerable has been the sun's activity of late." The numbers are,

<sup>1</sup> It is hoped to replace this receiver shortly with one of the new 1937 all-wave models which includes the 5-12-metre band.

respectively, 89, 115, 123, 133, 128 and 84. The highest value reached in the preceding 11-year cycle was 108 for December, 1929, but in the earlier cycle, with a maximum in 1917, the value 155 was reached in August of that year. The mean number for 1936 was 80.4; for 1935, 36.1; for 1934, 8.7; and for 1933, 5.7.

It will be seen that although the peak value for the previous cycle has been surpassed the peak value of 155 spots for 1917 still remains to be beaten. (What were ultra-short wave conditions like in 1917?)

It is interesting to note that there were, amongst others, two very severe magnetic disturbances between April 25th and 29th of this year, which correlate with meridian passages of large spots, and, perhaps more strikingly, there was also established on these dates a "close similarity in the variation of cosmic ray intensity and the horizontal magnetic force during the magnetic storm," according to a letter in *Nature* (No. 3538, Vol. 140, page 316, August 21st, 1937) from Victor F. Hess and A. Demmelmair, of the University of Graz, Austria.

The letter also states that a decrease in magnetic activity is accompanied by a decrease in cosmic ray intensity.

Incidentally, it is perhaps not without significance apropos the suggestion recently made in this column regarding the fall in F layer ionisation during magnetic storms, to note that between April 23rd and 28th

the percentage change of magnetic horizontal intensity fell from +0.4 to -0.8, such a change representing a very severe storm; the curve returned to normality on May 1st.

Bound Brook, W3XAL, is now using his European beam on 17.78 Mc/s until nearly midnight, except on Sundays, when an omnidirectional aerial is used between 5 p.m. and midnight.

A change is made to the S. American array daily at about 11.50 p.m.

It is understood that W2XE may extend shortly his 21.52 Mc/s transmissions to Europe until quite late in the afternoon.

ETHACOMBER.

### BOOK REVIEW

**A Guide to Amateur Radio.** Fifth edition, 1937. 160 pp. and over 150 illustrations. Issued by the Incorporated Society of Great Britain, 53, Victoria Street, London, S.W.1. Price 6d.

THIS handbook, prepared especially for amateurs interested in short- and ultra-short-wave experiments, grows in size and in scope with each succeeding issue. Two extra chapters have been added to the new fifth edition, these very appropriately being devoted to television and ultra-high frequency work respectively.

All the chapters have been revised and new material and illustrations added, so that it presents the very latest practice and technique.

Every aspect of amateur radio is covered in a manner that is instructive both to the beginner and to the experienced experimenter.

H. B. D.



**DIRECTIONAL OR NON-DIRECTIONAL.** This versatile microphone, produced by the American Western Electric Company, may be converted from a highly directional instrument, relatively insensitive to extraneous noises, into one having a good all-round pick-up. The conversion is made by removing the disc "baffle" cover.



# Built-in Noise Suppressors

OF the various methods of reducing electrical interference, those forming an integral part of the receiver itself have until recently been the least promising. However, work on such devices is now proceeding steadily, and our New York correspondent was very favourably impressed by the operation of the system he describes in this article.

## SIMPLIFIED AMERICAN CIRCUITS FOR REDUCING INTERFERENCE

THE need for noise suppression has long been apparent, and has thus been uppermost in the minds of many experimenters. However, it was not until 1936 that Lamb evolved a circuit (described in both *The Wireless World* and *The Wireless Engineer*) which seemed to hold interesting possibilities. Unfortunately, the Lamb "silencer" could be applied successfully only to certain superheterodynes; further, it complicated their design, construction and operation, and, unless carefully engineered, frequently caused instability.

However, Lamb's idea of "punching holes of silence in a signal where noise once dwelt" was so attractive that several American engineers searched for a simpler method of achieving this result. John H. Potts, of the magazine "Radio News," and J. E. Dickert, of the General Electric organisation, independently hit upon a scheme which seems to possess all of the advantages of the Lamb silencer plus the following:

1. Automatic adjustment of silencing bias for all values of carrier, including rapidly fading signals.
2. May be adjusted for maximum noise suppression at the expense of quality, or for negligible distortion with decreased suppression. This latter adjustment seemed quite attractive to the writer when tested in the reception of local broadcasting during heavy atmospherics caused by nearby thunderstorms.
3. Perfectly stable and may be applied to any receiver—TRF or superheterodyne—employing a diode detector. It is probable that it can be applied with success to the infinite-impedance detector as well.
4. No additional stages of IF nor any long shielded grid or plate leads are required, while the extra parts needed are few in number, amounting to one resistor, one condenser, and one diode.

When this simplified noise silencer is applied to a receiver fed from a well-designed and carefully installed noise-reducing aerial system, with the un-screened part of the aerial located well in the "clear," most of the noise picked up will be of the type characterised by a high ratio of peak to RMS amplitude, plus a comparatively long time interval between pulses. Interference of this type, which

is frequently caused by the ignition systems of internal combustion engines, is not psychologically objectionable until its peak voltage exceeds that of the signal modulation. Fortunately, noise pulses of this type possess the discriminating characteristic necessary for suppression by a "limiter."

The new limiter to be described depends for its operation on the fact that the internal resistance of a diode is nearly infinite so long as its anode is negative with respect to its cathode, but the instant that its anode becomes even slightly positive its resistance decreases to perhaps a few hundred ohms (depending on the voltage by which it is positive). Its application to a circuit is shown in Figure 1(a), where D1 is a conventional diode with its load R1 by-passed by C1. R2 and C2 constitute the usual AVC filter network. Across

R1 is connected the "noise diode" D2, connected with its anode to the cathode of D1 (and earth) and its cathode to the negative (or high signal potential) side of the load resistance R1.

Now let us consider the working of the noise diode. With zero signal across D1 the cathode of D2 will be at the same potential as its anode, and its internal resistance will be high, so that the shunting of R1 will be negligible. If a signal, such as a burst of noise, should appear suddenly across D1 point A (and thus the cathode of D2) will be several volts negative to earth, and the anode of D2 will therefore be positive by this same voltage,

reducing its internal resistance to a small value, and so shunting R1 to such an extent that perhaps only 1/1,000th of the noise will appear across the output of D1. Unfortunately, with this simple circuit any

By

W. N. WEEDEN

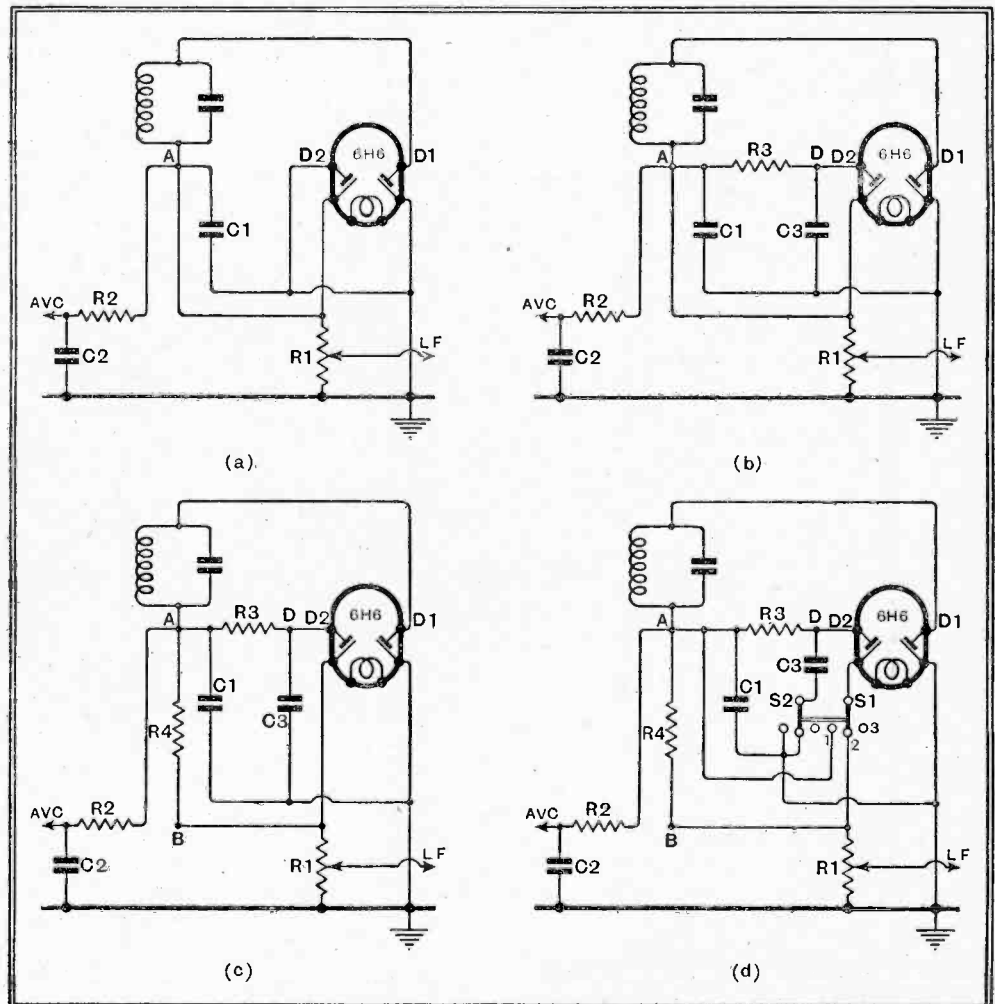


Fig. 1.—Noise-reducing circuits discussed in the text; the 6H6 is a dual diode with separate cathodes. Average values of components are: C1, 50 to 100 m.-mfd.; C3, 1 mfd.; R1, 50,000 ohms; R3, 1 megohm. In diagram (d) the switch positions are: 1, maximum suppression; 2, medium suppression; 3, no suppression.

**Built-in Noise Suppressors—**

desired signal across  $D_1$  would have the same effect as the burst of interference, reducing the output to almost zero.

Figure 1 (b) illustrates a practical circuit which makes it possible to introduce a signal across  $D_1$  without making operative the silencer. The only additional parts involved are  $R_3$ ,  $C_3$ , which constitute a network designed to maintain the anode of  $D_2$  at the same voltage as its cathode for normal signals, while permitting the cathode to become negative by the difference in voltage between the rectified carrier and a pulse of noise, thus effectively silencing the output of  $D_1$  for short impulses of greater amplitude than that of the received carrier. This effect is possible because, thanks to the time-constant of  $R_3$ - $C_3$ , which is between  $\frac{1}{10}$ th and 1 second, any change in the voltage across  $C_3$  is prevented during a noise pulse of a duration of the order of 0.001 second (the average length of such noise impulses). The condenser  $C_3$  acts as a reservoir to maintain constant the voltage of the anode of  $D_2$ , while it is of sufficient capacity to add negligible impedance to the internal resistance of the diode when conducting.

As an example of its operation, let us consider that a signal of 10 volts peak is impressed on  $D_1$ , causing both the anode and cathode of  $D_2$  to float 10 volts below (negative) earth. Now if a noise impulse of 40 volts peak appears across  $D_1$ , superimposed on the signal, the cathode of  $D_2$  will follow the voltage developed across  $R_1$ , becoming minus 40 volts. As the charge on  $C_3$  is varied but little point D remains approximately 10 volts below earth potential, so that it is actually 30 volts positive with respect to point A, the differential between the signal and noise amplitudes.

Assuming that the 10-volt rectified carrier is modulated 100 per cent. the voltage at point A

will follow the modulation envelope, fluctuating between minus 20 volts and zero. Therefore,  $D_2$  will conduct during the portion of each cycle at which point A is more negative than point D, clipping the noise and positive modulation peaks down to the unmodulated carrier level. For many types of communication work, particularly for voice modulation, this deletion of the positive peaks does not detract from the intelligibility of the rectified signal, nor is the resulting quality displeasing even after long periods of listening.

For use in broadcast reception, where this distortion is not acceptable,  $R_1$  may be split into two equal resistors,  $R_1$  and  $R_4$  (see Fig. 1(c)), with the cathode of  $D_2$  returned to point B, the junction between them. In this circuit a rectified 10-volt signal, 100 per cent. modulated, varying between zero and minus 20 volts will appear at point B divided by two, making the total variation from minus ten volts to zero. Thus the cathode of  $D_2$  is never more negative than the anode, merely approaching that value. This system is capable of "squenching" noise peaks of higher than carrier value, but still does not distort the demodulated signal. It may be of interest to point out that this system also functions as a practical "squench" for inter-carrier noises.

**Avoiding Distortion**

A few precautions on the installation and use of this system may not be amiss.  $C_3$  should be kept as small as possible, as the attenuation of the higher audio fre-

quencies will distort the characteristic of the noise pulse, reducing the steepness of its wave front and decreasing the difference between it and the signal. For this reason the fidelity of both signal and noise diodes should be maintained as well as possible, whether or not such fidelity is warranted by the side-band cutting and AF restrictions. To aid this condition the sum of  $R_1$  and  $R_4$  should not exceed 100,000 ohms, although this requires that a fairly high value of signal be rectified for good fidelity. Also, leads to the resistors, noise diode and the AF amplifier should be as short as possible to eliminate the necessity for shielding.

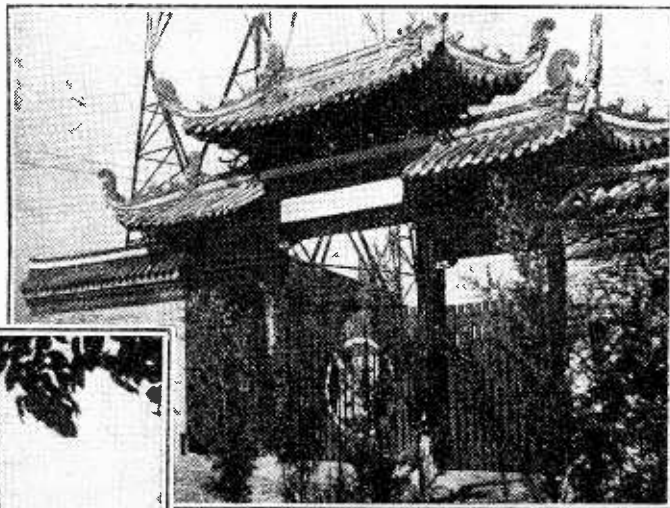
**Practical Details**

In obtaining the proper time constant for the noise diode bias reservoir at D,  $R_3$  should be a rather high value of resistance (up to about 1 megohm) in order not to shunt the diode load too severely.  $C_3$  should be a large value in order to minimize the AC impedance from the noise diode to earth.  $C_3$  must be non-inductive, so that its impedance at high frequencies will be negligible, and it is advisable to shunt this with a mica condenser of lower capacity. Diode biasing of the first AF valve is recommended where possible since coupling condenser and grid resistance further reduces the modulation capability of the signal diode. For the same reason the AVC network should be designed so as to present as high an impedance as possible to AF currents.

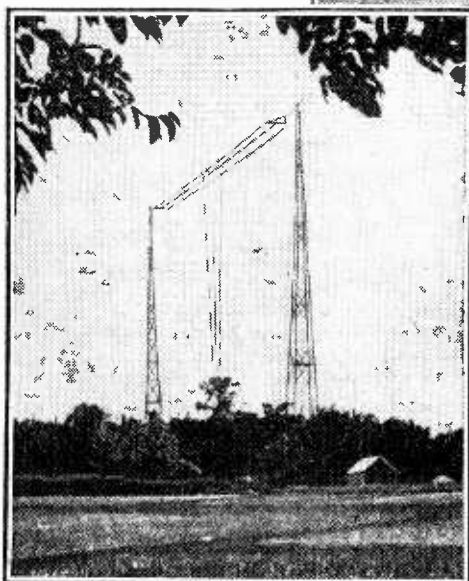
The circuit of Fig. 1(d) is the same as that of Fig. 1(c) with the exception that a double-pole, triple-throw (three position) switch is introduced to permit the user to select the degree of silencing desired, and to eliminate the silencer and its loading of the signal diode when not required.

These circuits cause no loss to sensitivity or selectivity, and prevent noise pulses at fast interruption rates from reducing sensitivity through AVC action. Since the additional size of this silencer is negligible it has proved of great value for aviation receivers, and also for use with ultra-high-frequency mobile police equipment where ignition interference from passing cars is practically eliminated. This circuit will take care of the rapid fading frequently encountered above ten megacycles.

Noise suppressors have a secondary field of usefulness that is often overlooked; for example, one of the American G.E.C. receivers, which has an audio output of 35 watts, is fitted with this type of limiter to prevent disquieting bursts of sound when the receiver is adjusted to reproduce at ordinary room level.



The wood carved portico with its peculiar Chinese roof at the entrance to the station grounds.

**New Chinese Station at Chengtu**

THIS 10 kW. station, which was recently erected by the Telefunken Co., and works on a wavelength of 536 metres, has been established by the Chinese government to serve the province of Szechwan. This part of China, which is situated on the borders of Tibet, is one of the most backward areas of the country, there being only 400 telephones in the whole of Chengtu, the capital, a city with

a population of nearly a million. The studios are in the city, with the transmitter situated three miles away. Although the installation is completely modern in every respect, an effort has been made to retain the traditional Chinese architecture in the station buildings, as is clearly shown by our photograph of the entrance gates. The two steel masts are over 120 feet high.

# Current

## EVENTS OF THE WEEK IN BRIEF REVIEW

# Topics

### Real DX

SHORT - WAVE enthusiasts who wish to test the capabilities of their sets will have an excellent opportunity of doing so during the first two and last two week-ends of October. During these periods the amateur transmitters of Australia and New Zealand are holding a special long-distance contest, and many reports are expected from this country.

### South African Tatsfield

A SPECIAL short-wave receiving station designed on the lines of the B.B.C. station at Tatsfield is to be erected by the South African broadcasting authorities. Its main purpose will be to enable South African listeners to hear, on their ordinary sets, relays from Europe and America.

### German Programmes in Spanish

THE special programmes which certain SW transmitters in Germany are broadcasting in Spanish for the benefit of South America are said to be proving exceedingly popular. Inhabitants of South American countries who are visiting Germany are invited to the microphone to give their impressions of the country.

### Radio Boom in Norway

COMMERCIAL wireless communication is rapidly gaining popularity in Norway. Compared with last year there is an increase of 34 per cent. in the number of messages handled by the Bergen transmitter, which is one of the most important of Norwegian stations. The great majority of these messages were sent and received on short waves. The number of wireless telephone calls is also up by more than 50 per cent.

### Dearer Listening in France?

GRAVE fears are being entertained by French listeners that there will be an early increase in the cost of radio licences. It is pointed out that the taxes imposed by the Government have already necessitated increases in the cost of many of the amenities of life, and it is thought that the Government can scarcely overlook so tempting a source of revenue as broadcasting. Many experts estimate that the cost of a licence will rise by at least 50 per cent. before many weeks have passed.

### Gaiety at the North Pole

SPECIAL programmes are being sent out from the station at Rudolf Island for the benefit of the Russian scientists who are at the North Pole. These programmes include musical items, news, bulletins and also the reading of newspaper articles and stories.

Several amateurs in New York and Chicago are reported to have established communication on 20 metres with the North Polar station.

### Indian Interference

IT is reported that special legislation to deal with electrical interference with broadcast reception is being contemplated by the Indian Government.

### Some Interesting Statistics

ACCORDING to the United States Department of Commerce, there are 30,000,000 receivers in use in America. Great Britain comes second with 10,000,000, while Germany is reported to have 8,200,000. There is then a tremendous gap in the figures, the next country being France with 2,626,000 sets in use. All other countries are well below the million mark.

### American Valve Invasion

SWEDISH wireless sets are noticeably cheaper this year and yet they have a greater number of valves. This is said to be due to the fact that a large number of Swedish set-makers have adopted American valves for their sets. The result is that a set which cost round about £14 last year can be had to-day in improved form for £2 cheaper. Although American valves predominate, they have not as yet completely conquered the Swedish market.

### Polish Developments

IT is reported that the number of wireless listeners in Poland is going up by leaps and bounds as it has been announced that a gold watch will be presented to the buyer of the 700,000th licence. During the past year there has been an increase of 123,079 in the number of licences issued.

A further incentive to listeners is being provided by the building of a 50 kW. station near Luck.

OUTRIGGERS from the ship's side are used by members of the crew of the Red Star liner *Westernland* to support the aerial for their broadcast receiver. The ideal place for an aerial is, of course, occupied by that for the ship's transmitter

When this station is completed it will give broadcasts in the Ukrainian as well as the Polish language.

### Bohemian Television

THE latest country to have made up its mind to establish a television service is Czechoslovakia. The authorities at Prague have decided upon the erection of a first-class transmitter, and, pending its erection, programmes are to be given by a small experimental station.

### Paris Conferences

THE International Congress of Radio and Electricity will be held in Paris from September 28th to October 1st. On October 2nd and 3rd the Committee appointed to report on electrical interference will hold special sittings.

### DF for Australia

NAVIGATORS are said to dislike the West Coast of Australia as being one of the worst beaconed coast-lines, length for length, anywhere in the world. This state of affairs will be mitigated before long and it is planned to place at least two, and probably three, radio beacon stations along this coast. These stations will form part of the scheme for building eight DF stations along the Australian coast.

### Television for the Deaf

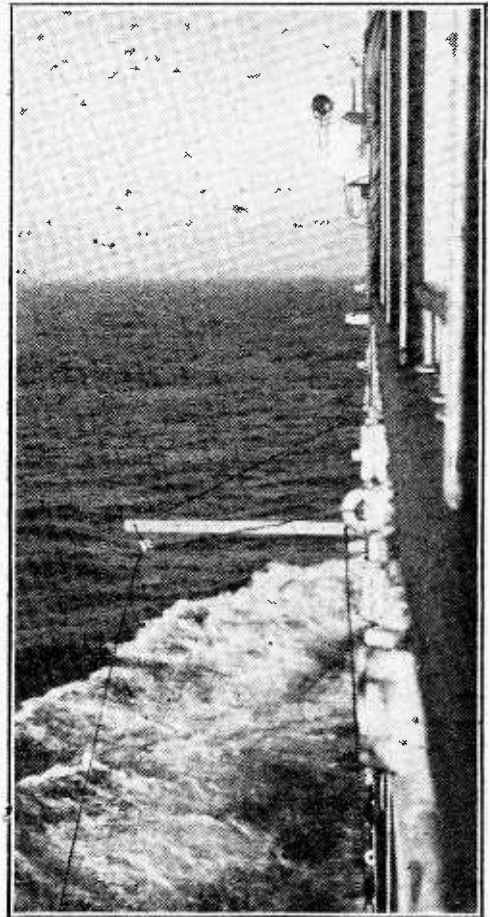
SUCH great success attended the recent efforts of the G.E.C., in their television experiments at the Tower House Home for the Deaf and Dumb at Belvedere, that the receiver

has been presented to the Home. Many of the inmates are, of course, only partially deaf, and have been able to enjoy the ordinary wireless programmes by means of headphones and special amplifiers. There is, however, a large class of men who, while not completely deaf, are sufficiently so to prevent them obtaining any pleasure from wireless. The addition of sight has, however, provided a means of interpreting the sound part of the programmes.

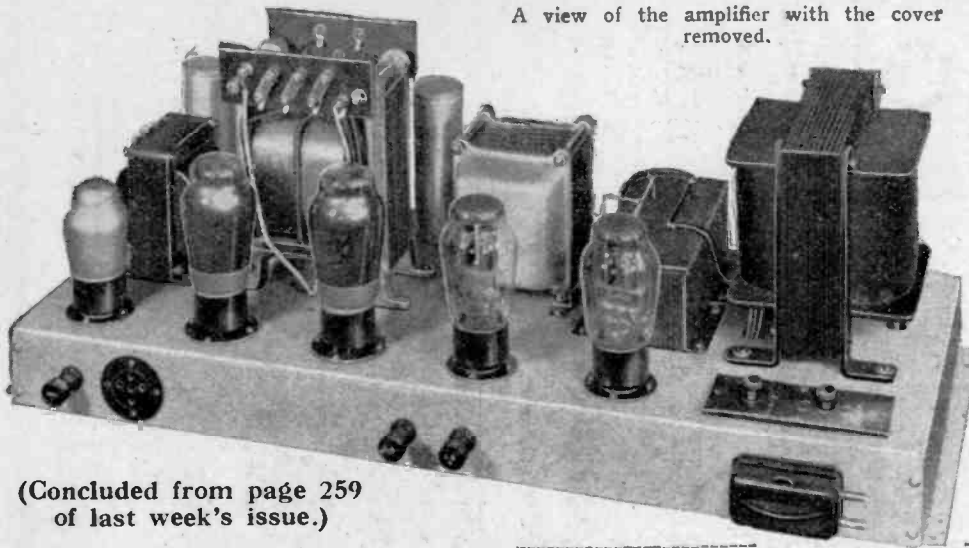
### Danish Amateurs Celebrate

A LARGE number of members of the E.D.R., the Danish Amateurs' Association, assembled recently in Copenhagen together with several colleagues from other countries to celebrate the tenth anniversary of the founding of the association. A corporate visit was paid to the exhibition at the Forum Hall, the Kastrup Airport, and the Copenhagen Broadcasting Station.

In the evening a dinner, at which over a hundred members were present, was held. A spirited address was delivered by Professor P. O. Pedersen. In the course of his speech the professor recalled the early days of wireless, during which he was closely associated with Poulsen, of arc-transmitter fame, and concluded by saying that in these times the joy and glamour of those early days was only to be found among amateurs.



A view of the amplifier with the cover removed.



(Concluded from page 259 of last week's issue.)

By W. T. COCKING

**I**N the actual work of constructing the apparatus everything is quite straightforward and is clearly shown in the wiring diagram. Care must naturally be taken to remove the paint from the chassis at all connections to it, not forgetting the cans of the electrolytic condensers. It is also important to make sure that the leads to the feed-back winding on the output transformer are not reversed, otherwise positive feed-back will be obtained with disastrous results to the performance.

The great advantage of negative feed-

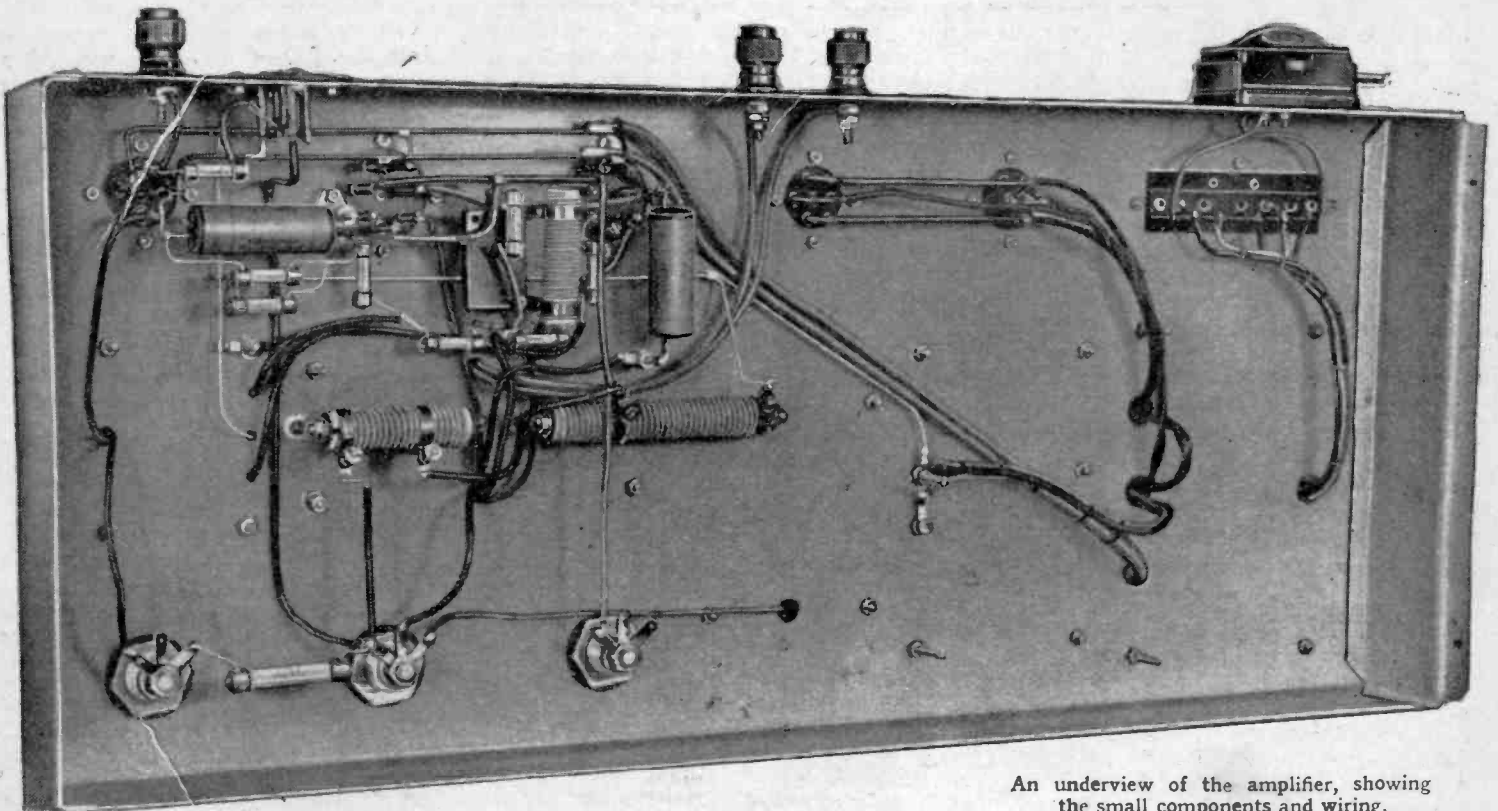
*THE theoretical considerations underlying the design of this amplifier were dealt with in last week's issue of "The Wireless World," and in this article the construction and operation are treated. Overall frequency response curves are also given.*

response is  $-1.4$  db. and at 20,000 c/s it is  $-0.8$  db., while the maximum response at 3,000 c/s is  $\pm 0.1$  db. The maximum variation is thus  $\pm 0.75$  db.

The results without feed-back are shown by the dotted curve, and are very much inferior. At 20 c/s the response is  $-6.95$  db. and at 10,000 c/s it is  $-3.6$  db., while it is up to  $\pm 0.2$  db. at 2,500 c/s. At 20,000 c/s the output was too small to

shown, but are evident to the ear when the amplifier is in operation. The harmonic distortion is noticeably lessened and the transient response considerably improved.

The effects of the tone-control circuit are shown by the curves of Fig. 4, which are overall curves measured from one pair of pick-up terminals to the output transformer secondary. With the tone-controls in positions 3 the curve is flat within



An underview of the amplifier, showing the small components and wiring.

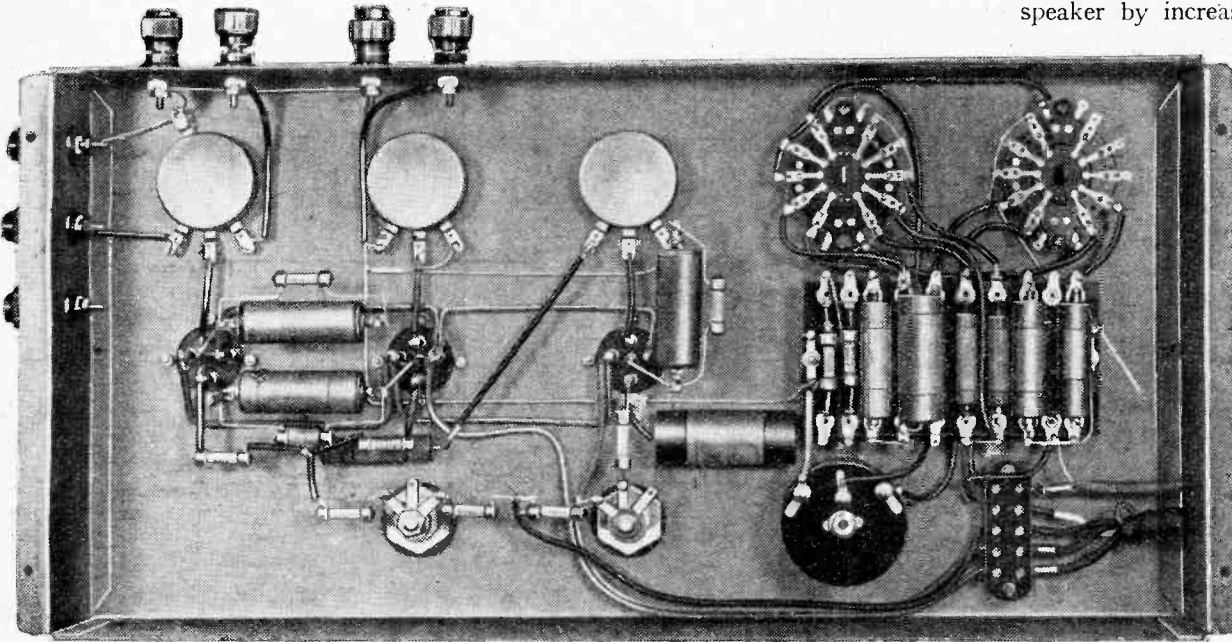
back is well brought out by the curves of Fig. 3. The solid-line curve shows the results when the tone-control switches are both in position 3 and the normal negative feed-back is applied. At 20 c/s the

measure with the output meter employed, but inspection of the curve shows that it is probably about  $-16.0$  db. The effects of feed-back in improving the performance in other respects are less readily

$\pm 0.75$  db. from 20 c/s to 20,000 c/s—an extraordinarily good response. In the other switch positions the response rises or falls in roughly equal steps, and the gain at mid-band is largely unaffected. In

# PA Amplifier

and they can be used to correct for some deficiencies in the response of microphones or pick-ups. They must not be used to correct for poor loud speaker response, however, or the undistorted power output will be restricted. If an attempt is made to correct for a poor bass response in a speaker by increasing the amplifier bass response, for instance, it will mean that the output stage must handle an abnormally great input voltage at low frequencies, and it will overload at lower volume than usual. This does not arise when the defect which requires correction comes before the output stage, as is



The underside of the mixing and tone-control unit. The tone-control components are grouped on a board near the switches.

this region the precise characteristics are not shown, for they depend on the combination of the two controls; no fewer than 25 curves would be needed to show the exact results, since the two switches enable 25 different characteristics to be secured! The change in gain at middle frequencies is small, however, being less than 2 db., and the result

recording deficiencies at low frequencies, while a level response at high frequencies is usually best. In cases where needle scratch is prominent, however, a drooping treble characteristic may prove more satisfactory. On microphone a flat bass

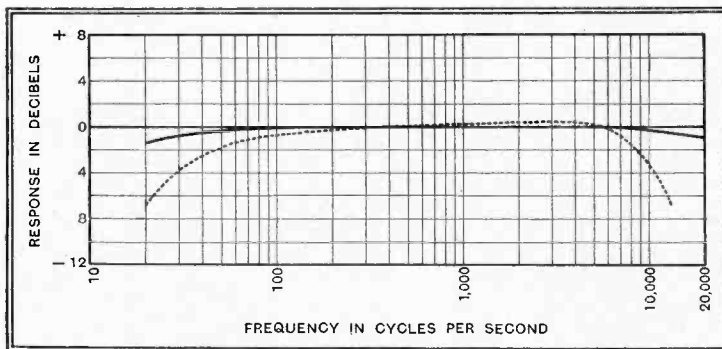
the case when the faulty response is in a pick-up, for the tone-control then merely restores the normal input to the output stage. It is, of course, true that still greater freedom from overload could be obtained with less bass, but there would be some loss of apparent volume through the lack of the lower frequencies.

With the general balance of speech and music these effects are not very marked, but it is, nevertheless, a wise plan to avoid using the tone controls for the correction of defects in response which occur later than the output stage.

An input of about 0.025 volt RMS is needed for full output, and this is ample for all pick-ups, including the needle armature type. If a piezo-electric model is used the input gain control must be kept at a low setting to avoid overloading the first valve. The pick-up leads should, of course, be screened to avoid hum pick-up, and the screening and metal body of the pick-up earthed.

On microphone the amplification is adequate for a good-quality carbon type.

Fig. 3.—The full-line curve shows the performance of the whole equipment with the switches in position 3. The dotted curve illustrates the results without negative feed-back.



is that the system functions purely as a tone-control and not also as a volume control, as do so many tone-control circuits.

Under normal circumstances it will be found desirable to increase the bass response on gramophone to correct for the

response with a rising treble is usually satisfactory, but at large volume it is often advisable to reduce the bass in order to avoid the boominess which results when the human voice is reproduced at unnaturally great volume.

Sometimes a rising treble response assists intelligibility.

The precise positions of the controls must naturally be found by experiment, for they depend largely upon the characteristics of the associated equipment,

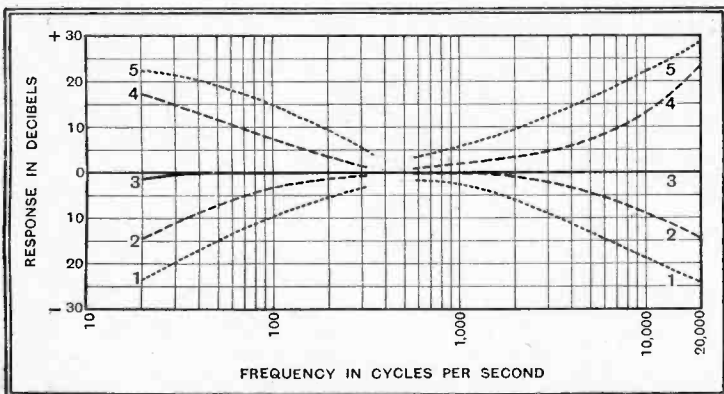
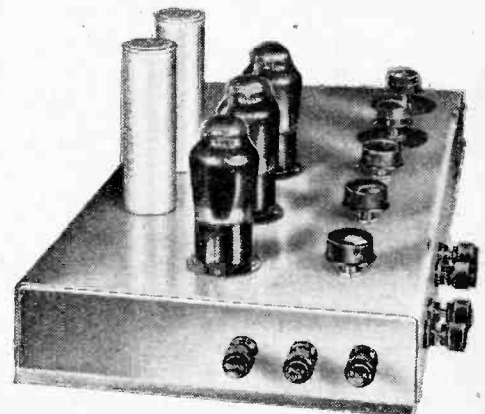
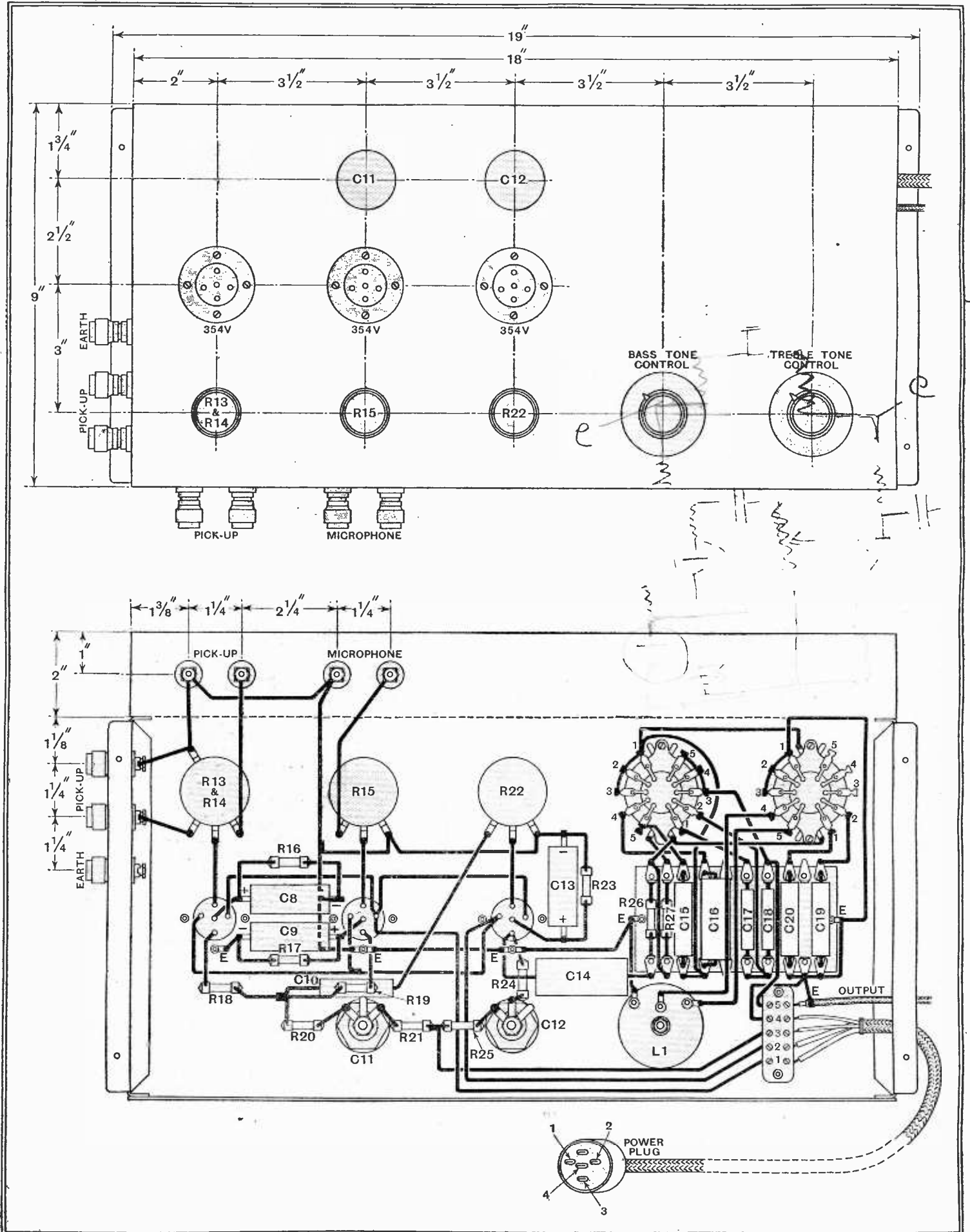


Fig. 4.—These curves show the effects of the tone-controls on the frequency response.



A general view of the tone-control unit.

# Wiring Connections of the Mixing and Tone-control Unit



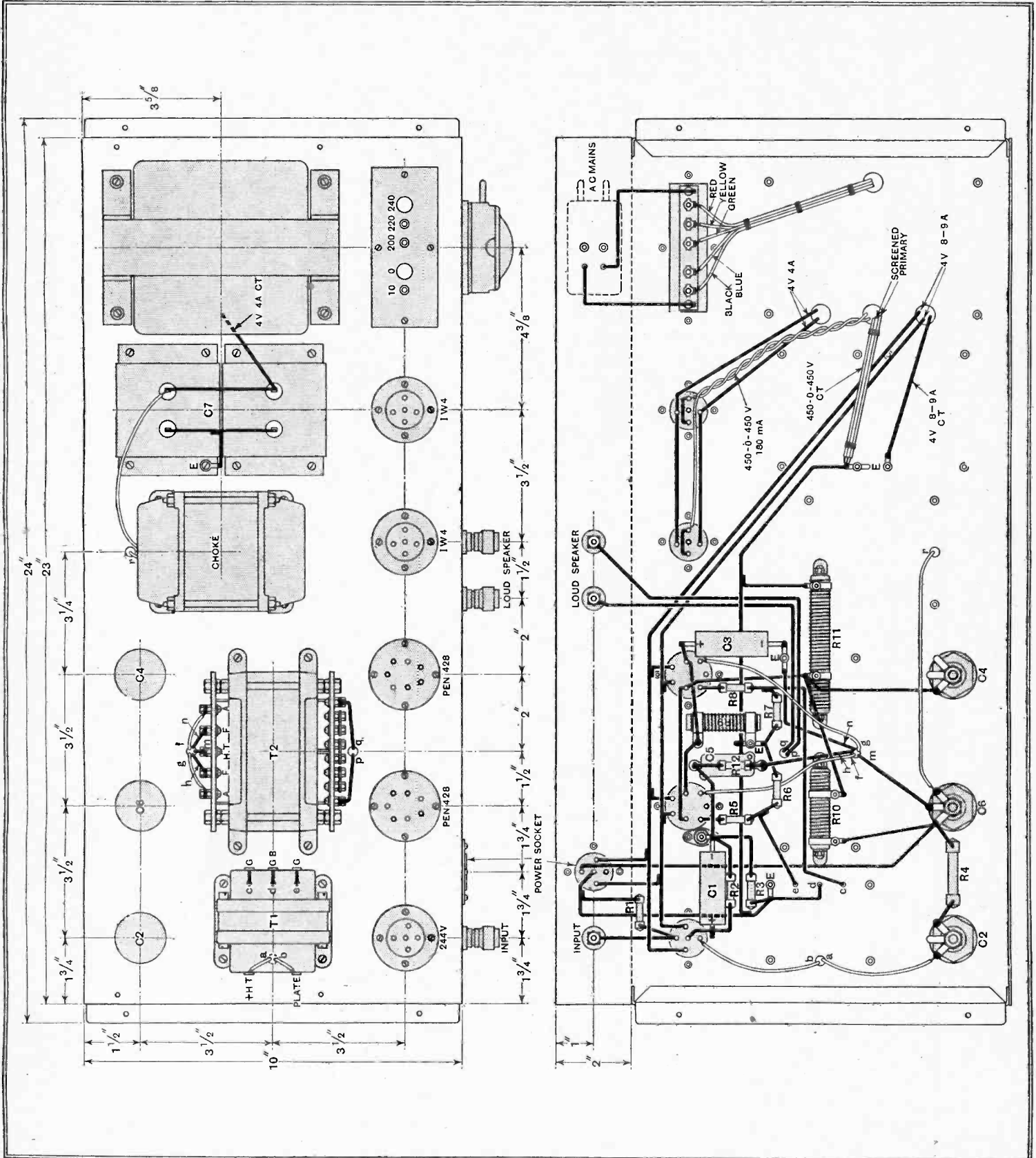
**30-Watt PA Amplifier—**

Thorough screening of all leads is essential for the avoidance of hum pick-up, and for energising the microphone a battery is recommended. With less sensitive microphones a pre-amplifier will be required, and in view of the liability of such ampli-

*A blue print of the combined wiring diagrams is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d., post free.*

fiers to pick up hum, battery operation is to be advised. Mains operation can, of course, be adopted for such an amplifier, but the hum difficulties are considerable. An independent mains unit is often advisable, and great care must be taken over both HT and LT supplies.

**The Amplifier—Wiring, Assembly Details and Dimensions**



# BROADCAST BREVITIES

## The "Little Nats."

THE problem of the "Little Nationals" has been partially solved by the B.B.C.'s decision to open them throughout normal programme hours on Saturdays and Sundays.

Just why it was ever necessary to close them until 5 p.m. is still not clear to many people.

## For Education's Sake

The trouble began with the withdrawal from the Scottish National programme transmitter at Westerglen of the 285.7 metre wavelength to allow for Wales and the West Country each to have a separate programme. Scottish National then had to be synchronised with London and North Nationals on 261.1 metres.

But Scotland, always proud of her educational system, insisted on a separate wavelength at times for the special Scottish schools programme. Manchester and London, however, were in no mood to accept lessons from Scottish dominions as part of their daily entertainment, so the North and London "Nats." had to remain silent during these special transmissions on the 261.1-metre wavelength which take place during term time from Mondays to Fridays.

## Half a Loaf . . .

Not to confuse an already obfuscated public, the B.B.C. thought it would be better to close down the "Little Nats." for the whole week until 5 p.m., when the Scotch teachers had gone home, rather than attempt putting them on the air at odd times when the wavelength was free.

People in England, however, think that half a loaf is better than no bread, hence the decision to reinstate the little National transmissions when there is no Scotch school broadcasting.

## Better Balance and Control

"WIRELESS WORLD" readers—all people, in fact, who approach listening with a technical ear—will be interested to know that the formation of the B.B.C.'s new Music Productions Unit is likely to involve a tightening-up of the balance and control arrangements, with special reference to microphone placing.

## Rival Schools

Hitherto more than one school of thought has aspired to rule the roost. There has been the multi-microphone persuasion which, if guided by its most

## NEWS FROM PORTLAND PLACE

extreme adherents, would have had a separate mike for every instrument and one for the swish of the conductor's baton. The opposition camp has contended for a single microphone so placed that the balance and control panel becomes of secondary importance, merely serving to regulate volume.

The new Music Productions Unit, under its director and conductor, Mr. Stanford Robinson, will strive for technical as well as musical perfection, largely basing its microphone arrangements on experience in St.

## Mikes in the Butts

MICROPHONES may be tested severely to-morrow (Saturday) when they are operated from the butts of the Ham and Petersham rifle range, Twickenham. The occasion will be the finals of the Metropolitan Inter-Borough Shooting Competition, the five surviving teams being Westminster, Wandsworth, Richmond, Hammersmith and Kensington.

Each team consists of eight members, who fire over a distance of 100 yards at twenty-four zinc breakable discs. The



IMPROVISATION. Even the B.B.C. at times resorts to the use of improvised gear. In this photograph, taken during the recent television programmes from the Pet's Corner at the London Zoo, can clearly be seen the head of a pitchfork between the tines of which the microphone has been slung. The pitchfork was held aloft by an assistant not seen in the picture. On the left is Dr. G. M. Vevers, Head Superintendent of the Zoo, and on the right Derek McCulloch, of the B.B.C.

George's Hall, where balance and mixing have been reduced to a fine art.

## A Much-Travelled Chief

In choosing his technical assistants Mr. Robinson has no doubt been helped by his opportunities, denied to most B.B.C. folk, of studying broadcasting conditions on the Continent. He has been an honoured guest at the German and Italian stations, examining their studio technique particularly in relation to large ensemble work like opera and oratorio. As he was originally Music Director in the B.B.C. Variety Department, there are now few types of programme with which he is not familiar.

## Dr. Boulton and Jazz

Actually, the new unit constitutes a "bridge" between the Variety and Music Departments. Mr. Gordon McConnell, musical producer to the unit, will be responsible to Dr. Adrian Boulton, who thus, indirectly, begins to exercise jurisdiction over jazz.

team which breaks all its discs gains one point. There is a time limit of three minutes per head.

Microphones will be arranged at the firing points for the commentators' description and also at the target, so that listeners, if their hearing is acute, can actually count the discs "popping off" one by one. The event will be broadcast nationally at 4.40 p.m.

## Tatsfield Tunes Up

ENGINEERS at Tatsfield receiving station are busy tuning up for the regular reception of variety half-hours from the Columbia network on Monday evenings, beginning October 18th. Tests will be carried out for at least a fortnight before these are relayed as a weekly feature on the National wavelengths.

## Stuart Hibberd for U.S.A.?

ALL-WAVE set owners may soon be tuning in New York to hear . . . Stuart Hibberd, the B.B.C.'s Chief

Announcer. This, at least, is the vision of Mr. Royal, of the American National Broadcasting Company, who is trying to arrange an exchange of "guest announcers" between Europe and the States.

## Oscillations and Reactions

The B.B.C. has not yet declined to consider the suggestion, and the Swedish and Italian authorities are said to be welcoming it. The practice would probably have varying effects on all concerned. B.B.C. announcers would not find it easy to work under the split-second conditions of American broadcasting, nor would they take kindly to sponsored programmes; and the Americans would nearly die of ennui at Portland Place.

## What Might Happen

But the fun would begin when the announcers came back to their old studios. One cannot smash up the habits of a lifetime and then return to the normal in five minutes. "We present the weather forecast, coming to you by courtesy of our nation-wide and universally beloved Air Ministry, guardian of the nation's weather. . . . Folks, it's gonna rain."

## "Sound Sequence"

AMONG Mr. Val Gielgud's "experiments" in radio drama, to be given after 10 p.m. when all the little ones are in bed, will be a "pure sound sequence" without words. The B.B.C.'s Drama Director has given no precise definition of what this means, but the possibilities are promising.

## Spotting the Blind Spots

Certain acoustic phenomena have never yet been broadcast, so it is just possible that the Drama Department will find some blind spots in our loud speakers. It is to be hoped that the technical branch will be asked to help in the experiments, if only because synthetic sounds are usually much more successful than the real thing. Electronic organs have shown what enormous variety of tone colour can now be obtained by these means; it is now up to the engineers to prove that valves can reproduce any noise to order.

The B.B.C. should break away from such outworn absurdities as coconut hooves and tin baths and experiment with an electronic "effects" department.

## In Town To-night

"A.B.C.," the Saturday feature, reaches its foregone conclusion with the letter Z at the beginning of October. "In Town To-night," Eric Maschwitz's biggest winner, returns before November.



# UNBIASED

By  
FREE GRID

## How Is It Done?

I HAVE received a very entertaining letter from a Gosport reader calling my attention to an interesting sideshow at Southsea, and asking my opinion as to how it is done. Perhaps I had better quote from the vital part of his letter which runs as follows:—

"The show consists of a robot containing a loud speaker and an amplifier and possibly some sort of ultra-short wave wireless set. The man in charge of it moves among the crowd asking people to display to him various articles in their possession such as coins, car licences, etc. The robot then describes accurately whatever is shown to the man in the crowd. The voice of the robot seems to be the same as that of this man."

To my mind this savours more of the old-fashioned thought-reading stunt than anything in the nature of wireless, the robot merely taking the place occupied normally by another person on the stage. Nevertheless my correspondent appears to suspect an ultra-short wave wireless link, and possibly he is right, as the whole affair seems very similar to that demonstrated on the stand of one firm (I quite forget which) at Radiolympia two or three years ago, and so far as I am aware details of this were never made public. If, therefore, any of you have any reasonable explanation to offer of either of these demonstrations, I shall be happy to extend to you the hospitality of my column as many readers were, I recollect, puzzled by the Radiolympia demonstration and would probably be interested in the *modus operandi*.

## Trouble in Denmark

IT has often been a source of great astonishment to me what utter fools great and learned men of science are apt to make of themselves when they stray into fields of knowledge outside their own immediate ken. Wireless men are, however, an exception to this rule, and it is so very rare to find one of us dropping a brick when venturing into other branches of science, that I was very surprised recently to come across rather a glaring instance of it, and possibly the rather remarkable circumstances will interest you.

As I told you in these columns the other week (20/8/37), owing to momentary absent-mindedness on my part, I recently found myself in Denmark and decided to take the opportunity of my unintentional visit to give the place the once-over. While in Copenhagen I very naturally made one or two trips round the place in a rubberneck coach and on one of these voyages of exploration we were taken out

to the suburbs to see the latest thing in architecture. Among other places we visited was a colony of dwellings erected by the Tobacco Chewers' Association, or some such body, for the benefit of their members.

### Round the Maypole

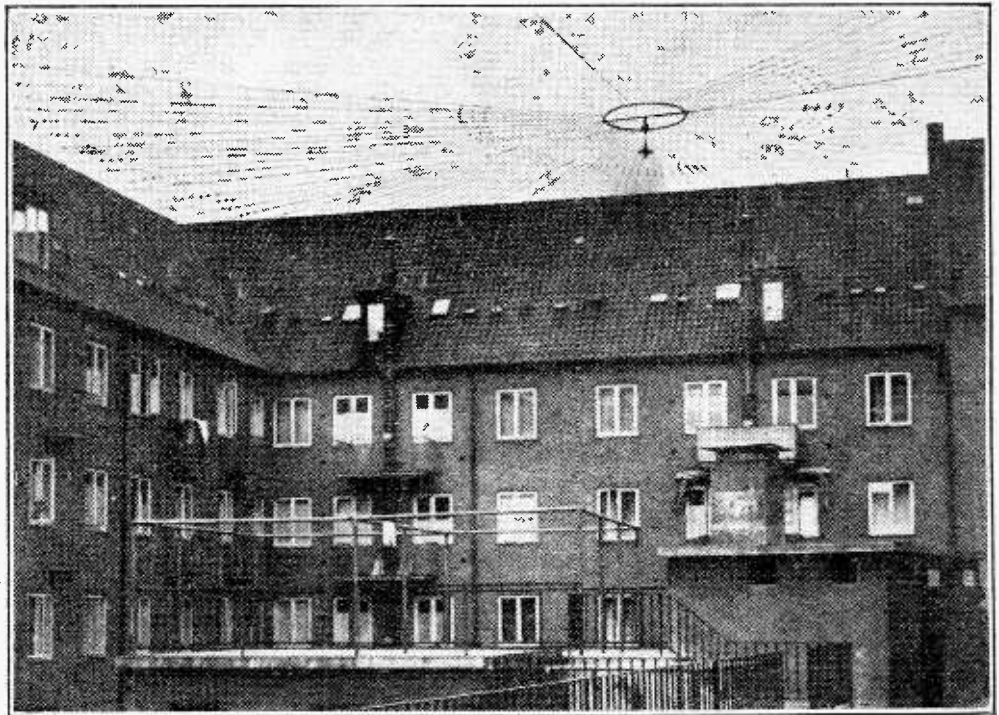
The only thing of interest which struck me at all forcibly was the arrangement of the wireless aerials. The houses were built round the sides of a quadrangle and in the centre of this was a large maypole from the top of which there radiated to the chimney pots of the various houses a veritable host of aerials just like the spokes of a wheel. Actually, the inner end of each aerial was secured to a sort of hoop which was lashed firmly to the top of the maypole.

Needless to say, the lack of common sense portrayed by this arrangement struck me immediately, as I feel sure it has you, and I was very much surprised

completely failed to see my point, nor would he be convinced after half-an-hour's strong argument on my part during which my fellow sightseers became very impatient with him, and expressed in somewhat forcible terms their desire that he should quickly agree with me in order that we might get on with the tour.

### Anglo-Danish Tension

In the end I became so exasperated with him that I approached one of the local inhabitants and in halting Danish requested the loan of an axe. Having secured this I quickly flung off my coat and with a few swift strokes speedily brought the pole crashing to the ground.



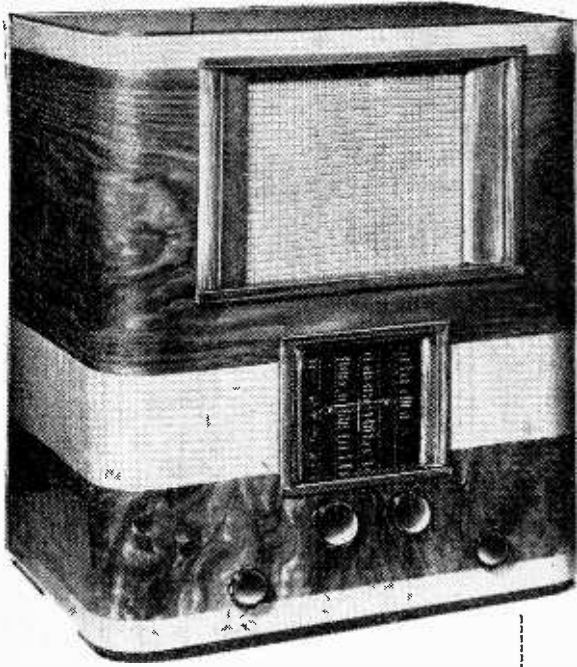
The "maypole" arrangement of the aerials can be clearly seen. The thing in the middle is an electric lamp.

to learn from the guide that the installation had been put in by somebody, who, in the world of wireless, was a very great man indeed and was passionately devoted to the science. As I said to the guide, he was evidently so devoted to it to the exclusion of everything else that he was ignorant of the elementary laws of mechanics, otherwise he would have realised that the pole was quite superfluous, as the aerials would be self-supporting without it.

To my utter astonishment the guide

Unfortunately, in my excitement and anger I had forgotten the fact that the aerials were firmly secured to the top of the pole and a rather embarrassing and unmannerly scene resulted, the outbreak of an Anglo-Danish war being only averted by my extreme tact.

However, the whole affair has been patched up now and as you will see by the accompanying photograph, which the guide has just sent me from Copenhagen, my advice has been taken after all, as the maypole is conspicuous by its absence.



# Bush TYPE SW43

## A WELL-MADE SUPERHETERODYNE WITH A GENEROUS POWER OUTPUT

**FEATURES. Type.**—Table model superheterodyne for AC mains. **Wave-ranges.**—(1) 16.5-51 metres. (2) 198-550 metres. (3) 850-2,000 metres. **Circuit.**—Triode hexode frequency-changer—var.-mu pentode IF amplifier—double-diode-triode second detector—pentode output valve. **Full-wave valve rectifier.** **Controls.**—(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Tone. **Price.**—12 guineas. **Makers.**—Bush Radio Ltd., Power Road, Chiswick, London, W.4.

**T**HIS receiver is of special interest, as it makes use of one of the recently introduced high-power pentode output valves. Whereas the majority of superheterodynes with single output stages have been rated to give an output of, say, 3½ watts (1½ watts undistorted), the output of this set is no less than 8 watts (5 watts undistorted). Even though this power may not always be used, there is no denying the satisfaction of having the reserve at call, and at normal average volume levels in the region of, say, 1 watt, the reserve power handling capacity is capable of dealing with occasional peaks without the feeling of restriction which is present in sets of lower rating.

A high-power output brings, of course, its own special problems, and special attention has been given to the question of rigidity in the cabinet design and to the elimination of microphonic feed-back on short waves. In the particular model tested there was a slight trace of the latter

effect at maximum sensitivity on strong carrier waves, but a reduction of volume of about 10 per cent. from the maximum was sufficient to clear up the trouble.

Actually, the set is remarkably lively on short waves, and, although to a certain extent repeat tuning points are responsible for this impression, there is no doubt that the intrinsic sensitivity of the short-wave range is high. Both Bound Brook and Schenectady were well received during the middle of the afternoon, and we were particularly impressed with the steadiness of these stations and the absence of any tendency towards oscillator drift.

Reception on the medium- and long-wavebands is all that could be desired. Sensitivity is good, there is a complete absence of heterodyne whistles, and the selectivity is sufficient to give good recep-

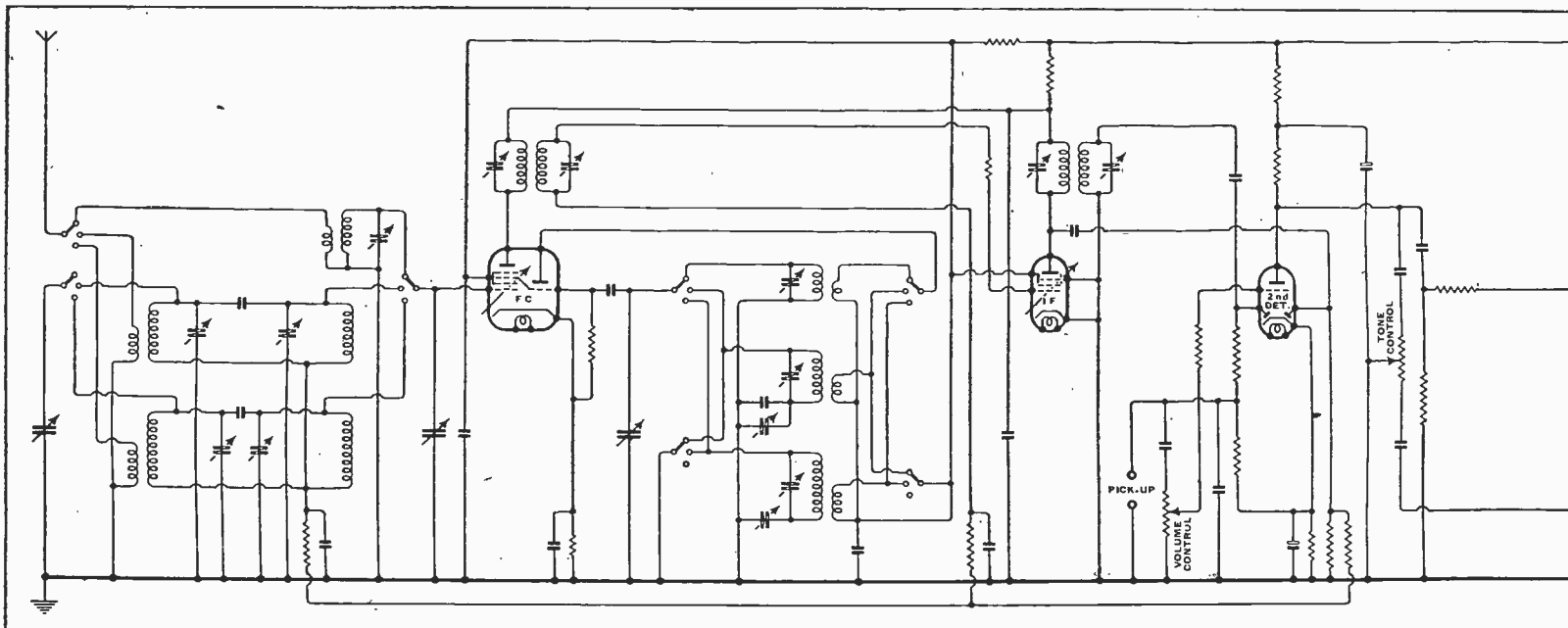
tion of the Deutschlandsender on long waves and freedom from interference outside 1½ channels on either side of the London Regional transmitter when using the set in Central London.

The tuning scale is well arranged with station names marked in vertical columns. The congestion on the medium waveband is relieved by devoting two columns to this waverange, the station names being viewed alternately to right and left through slots cut in the horizontal pointer.

The slow-motion tuning control is of the "reverse vernier" type, which gives quick motion in one direction and slow motion over a limited range when the direction of rotation is reversed. In the particular model tested, the quick-motion drive was on the stiff side, but the range of slow motion is well chosen, and suffices to cover the tuning range of any single long-wave station or a complete broadcast band on the short-wave range.

Quality of reproduction is full-bodied in the middle and lower registers, and the variable tone control provides a reserve of high-frequency response which is capable of investing the reproduction with incisiveness where the programme calls for this kind of treatment. For average listening there is, in our opinion, a slight excess of top with the tone control in the maximum high-note position, but in the absence of a tuning indicator this can be turned to good purpose in arriving at the point of exact tune, as it tends to exaggerate sideband hiss.

Complete circuit diagram. Fixed tone control is applied in the output stage and an additional variable control is connected across the output from the triode AF amplifier.

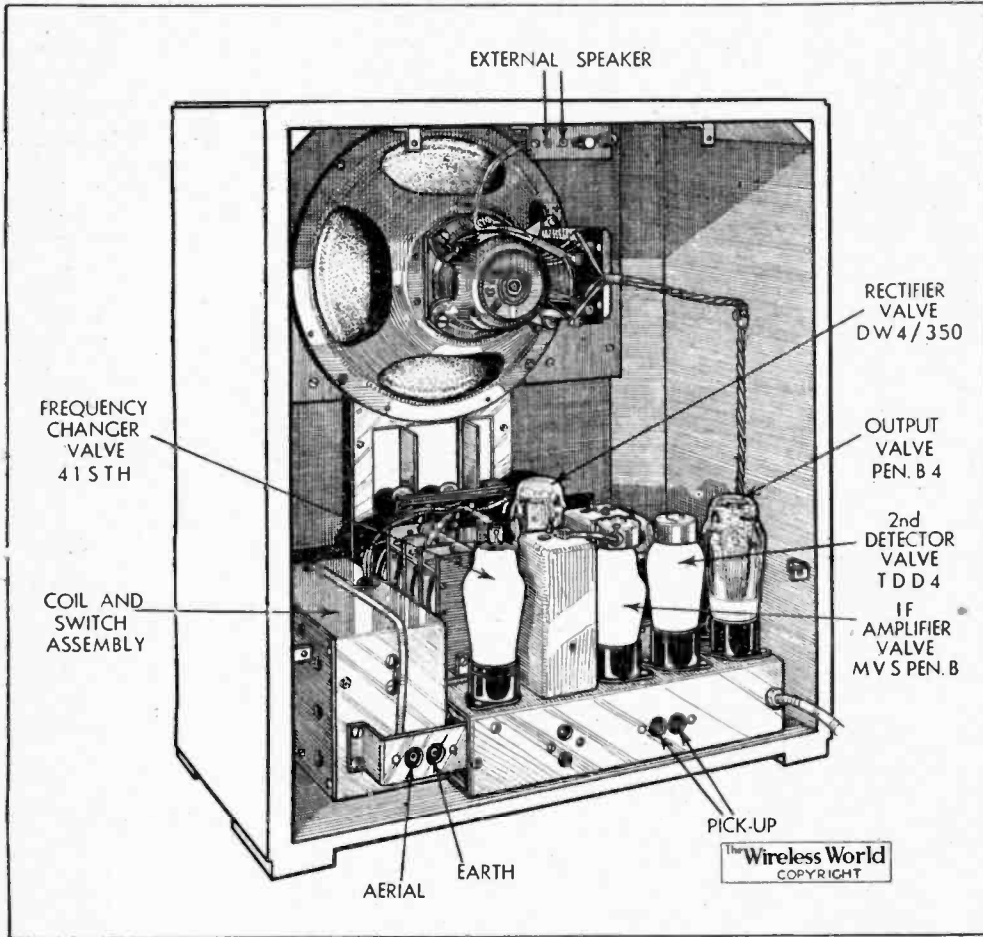


**Bush Type SW43—**

The circuit is of sound design, and, as far as the earlier stages are concerned, follows established practice. Iron-cored coils are used in the band-pass filters for the medium- and long-wave ranges—also for the IF coupling transformers. On short

rived from the primary of the second IF transformer via a separate diode.

Variable tone control is applied across the anode circuit of the triode portion of the second detector, and additional fixed tone control is introduced in the anode circuit of the output valve. Inverse feed-



The tuning coil and waverange switch assembly is mounted as a separate unit at the left-hand side of the chassis.

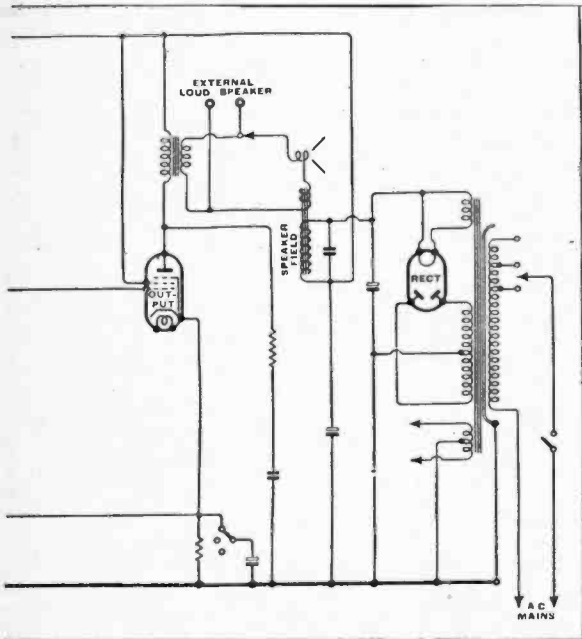
waves a single-tuned circuit precedes the triode hexode frequency-changer. The variable- $\mu$  pentode IF amplifier functions on a frequency of 465 kc/s, and this valve, together with the frequency-changer, is controlled by delayed AVC de-

back is introduced in this stage by the simple expedient of omitting the by-pass condenser across the cathode bias resistance. On short waves, however, a by-pass condenser is introduced, presumably with the object of increasing the overall sensitivity on this range.

There is provision for an external loud speaker and an arrangement of plugs and sockets at the back of the cabinet enables the internal loud speaker to be silenced if desired.

The chassis design is interesting for the fact that the coil assembly, together with the wave-range switch, are mounted as a separate screened unit at the side of the main chassis. A good deal of heat is dissipated in the pentode output valve, but the back of the cabinet is well ventilated, and radiation to the side wall does not cause excessive temperature rise when equilibrium is established after several hours' running.

From every point of view this is an excellent example of efficient receiver design and construction, and there is little doubt that those who have had experience with the results from the high-power output stage will be dissatisfied with the volume levels which have hitherto been accepted as standard.



**THE NORTHERN SHOW**

**T**HE Manchester Radio Exhibition, which opened at the City Hall, Deansgate, last Tuesday, continues until Saturday, September 25th. Hours are from 11 a.m. to 10 p.m. As at Olympia, there is a specially built variety theatre, where visitors can see well-known broadcasting stars.

Admission to the Exhibition, which is under the auspices of the *Manchester Evening Chronicle*, costs 1s. (6d. after 5 p.m., except on Saturdays). Cheap railway tickets (single fare for the return journey) will be issued from stations within a radius of eighty miles from Manchester.

**Television Programmes**

An hour's special film transmission intended for the industry only will be given from 11 a.m. to 12 daily.

Sound: 45 Mc/s. Vision: 41.5 Mc/s.

**FRIDAY, SEPTEMBER 17th.**

3, O.B. from the Arsenal Football Ground at Highbury. 3.20, Gaumont-British News. 3.30, "The Words Upon the Window Pane": a play by W. B. Yeats. Action: in a Dublin lodging-house.

9, Music Makers: Harriet Cohen (pianoforte). 9.10, Talk by Eric Gillett on Dr. Johnson. 9.20, British Movietonews. 9.30, "The Words Upon the Window Pane."

**SATURDAY, SEPTEMBER 18th.**

3, "In Our Garden": Robert Findlay, Keeper of the Royal Horticultural Society's Garden at Wisley, pays a visit to the garden in Alexandra Park. 3.20, British Movietonews. 3.30, "Old Kentucky" with Elizabeth French and Geoffrey Dunn.

9, "The Proposal," a jest in one act by Chekhov. 9.20, Gaumont-British News. 9.30, Douglas Byng in "Fancy That."

**MONDAY, SEPTEMBER 20th.**

3, Television Follies, with Vera Lennox, Pat Denny, Michael North, and Dennis van Thal. 3.20, British Movietonews. 3.30, "Below the Surface" a naval play. This will include shots taken during the production of such naval films as "White Ensign," and "A Naval Occasion."

9, Television Follies. 9.20, Gaumont-British News. 9.30, "Below the Surface."

**TUESDAY, SEPTEMBER 21st.**

3, New Maps for Old: a demonstration in Alexandra Park by members of the Ordnance Survey Department of the methods of Ordnance Survey revision. 3.20, Gaumont-British News. 3.30, Cabaret with Michael Moore; Harold Turner and Mary Honer (from the Vic-Wells Ballet); and the Six Singing Sisters.

9, Music Makers. 9.10, Talk. 9.20, British Movietonews. 9.30, Cabaret, as for 3.30.

**WEDNESDAY, SEPTEMBER 22nd.**

3, "Twenty Minutes": a little show. 3.20, British Movietonews. 3.30, Seventy-ninth edition of Picture Page.

9, "Twenty Minutes." 9.20, Gaumont-British News. 9.30, Eightieth edition of Picture Page.

**THURSDAY, SEPTEMBER 23rd.**

3, O.B. from King George V Dock. 3.15, Ord Hamilton at the piano. 3.25, Gaumont-British News. 3.35, Fashion Forecast. 3.50, Cartoon Film, "Mickey's Mellerdrammer."

9, Fashion Forecast. 9.15, British Movietonews. 9.25, An operetta.

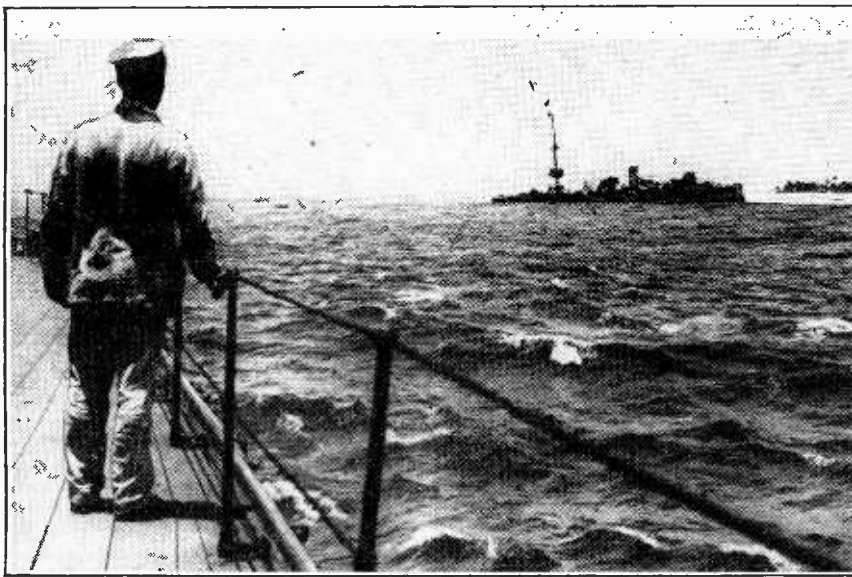
# Listeners' Guide for the

## Outstanding Broadcasts at Home

**D**URING the past week or so feature programmes have been much in the forefront of radio news. This is, of course, because of the statement made by Val Gielgud, B.B.C. Director of Drama and Features, that unless feature programmes improve they will lose their place in future schedules.

The listeners' panel of some 350 men and women from all walks of life who were asked

listeners will, at 9.5, hear a fifty-minute programme on the German cruiser *Emden*. For two months from the outbreak of the Great War this cruiser under Kapitän von Müller ranged the Indian Ocean sinking freighters to the value of some 3½ millions sterling. Her raids, however, were carried out with gallantry and effected with the minimum loss of life to non-combatants. The story of her ultimate destruction is one inseparably



**HOW EFFECTIVELY** the *Sydney* did her work when she engaged the German cruiser *Emden*, can be seen from this Imperial War Museum photograph which was taken from the deck of the Australian cruiser and shows the *Emden* on the reefs at North Keeling.

to answer questions about forty-seven radio plays and feature programmes supported the continuance of the latter, but criticised them on the score of being often too scrappy and disjointed, and that they were invariably not dramatic enough. The number of such programmes is to be reduced during the next three months, but from the list of subjects to be covered there should be little doubt about feature programmes retaining their place, that is, if their construction is good and production is effectively carried out.

Two features are included in this week's programmes. Tonight (Friday) at 8 (Reg.) a programme on Brighton devised by Igor Vinogradoff and H. L. Morrow will be heard. This will deal with the rise of the little eighteenth-century fishing village of Brighthelmstone to the twentieth-century resort of Brighton.

On Sunday National

linked with wireless, for it was in response to a message transmitted from the Cocos Islands that the *Sydney*, a fast cruiser of the Royal Australian Navy, raced to the position, and on November 9th, 1914, put an end to the *Emden's* exploits.

### FROM ST. HILARY

**ANOTHER** broadcast from the little Cornish village of St. Hilary will be heard in the Regional programme on Thursday at 8.20. The St. Hilary Players will perform "Pollie Tregembo," a Cornish comedy by Bernard Walke, who, until recently, was vicar of St. Hilary, and, as such, was the man responsible for the St. Hilary Nativity Play which has so frequently been broadcast. The author will produce the play. The play is a comedy of village life and tells the simple story of the stratagems employed by a young fisherman to win his bride in face of parental disapproval.

### VARIETY ORCHESTRA'S PIANIST

**WHEN** the B.B.C. Variety Orchestra reassembled after its summer holiday, the director, Charles Shadwell, was handed a bulky dispatch case by Arthur Sandford, the pianist. This contained the completed orchestration of a concerto for solo piano and light orchestra upon which Sandford had been engaged during most of his holiday. After a private rehearsal in Broadcasting House, Charles Shadwell described the piece as brilliant, and listeners will have the op-

portunity of forming their own opinion on Thursday during the programme by the Variety Orchestra at 7.15 (Nat.).

The concerto contains an extremely difficult but tuneful piano part, the tunes of which are likely to become generally popular. Many of them contain the spirit of the open air, for most of the composition was done in the summer house at his home near Chesham.

### WATER POLO

**THE** closing stages of the final tie in the County Water Polo Championship will provide a funning commentary for National listeners on Wednesday at 9.40. This year's final is being played at the Corporation Baths, Tunstall, Stoke-on-Trent. The finalists are Essex and Yorkshire, the former having won the title five times in six years and are the present holders. The Essex team is composed entirely of Plaistow United, mostly in-

ternationals, and including E. H. Temme, of Channel fame, and Dr. Sutton, Captain of Britain's Olympic swimming team in Berlin.

### MUSIC HALL AGAIN

**A NUMBER** of established stage and radio favourites are billed for this week's Music Hall. This will be the first show that John Sharman will produce on his return from his Mediterranean holiday. He completed the cast for this a few days prior to his departure. Among the artistes are Issy Bonn, the Hebrew vocal raconteur, who is one of Sharman's own "discoveries," the Viennese Singing Sisters; Major and Minor, who made such a hit with their first broadcast; the Western Brothers; Anona Winn; and the ever-popular Flanagan and Allen. The programme will, as usual, be heard at 8 (Reg.).

### SPIKE HUGHES—CONDUCTOR

**FOR** the first time on Wednesday Spike Hughes will conduct the B.B.C. Theatre Orchestra when they play the background music that he has specially written for Henrik Ege's adaptation of Franz Molnar's comedy, "The Swan," which will be heard at 8 (Reg.). The music and satirical writing of 28-year-old Spike Hughes, who was formerly on the editorial staff of a London newspaper, are becoming well-known to listeners. He is, in fact, a prolific writer for radio, his was the music for "Bianca," broadcast last January, and the book, lyrics and orchestrations of the recent success, "Nikki Makes News." "The Swan" will be heard again by Regional listeners on Thursday at 9.30.

### TWO FARCES

**ALTHOUGH** different in atmosphere and *mise-en-scène*, two short farces, which will be heard twice this week, share in common the pleasant function of "debunking." They will be heard Regionally on Monday at 8 and Nationally on Wednesday at 10. The first, "Villa for Sale," is a one-

# Week id Abroad

act play by Sacha Guitry, and it says concisely and amusingly all that there is to be said about the buying and selling of "desirable residences." This will be followed immediately by "Tin Soldiers," which farcically deals with a war which exists almost entirely on paper.

## PROM. NOTES

OUTSTANDING among this week's Promenade Concert relays is that which will be heard on Thursday at 8 (Nat.). During this Debussy-Stravinsky concert Igor Stravinsky's son, Soulima, whose first appearance at the Proms. this will be, will, at 8.20, play his father's "Capriccio" for



**RICHARD STRAUSS**, the distinguished German composer to whose works Tuesday's Prom. is devoted. During the relay at 8 (Nat.) Elisabeth Schumann will be heard singing a group of his songs. She will also give a recital on Sunday at 9.55 (Reg.).

pianoforte and orchestra. To-morrow's popular programme, part of which will be heard at 8 (Nat.), should have

a wide appeal. It includes Wagner's Overture to "Rienzi" and Grieg's Pianoforte Concerto in A Minor, which will be played by Cyril Smith.

## DANISH-AMERICAN NIGHT

SATURDAY'S evening programmes from the Danish stations, Copenhagen and Kalundborg, can rightly be described as American. A commentary in English on the Merry-making at the Harvest Feast will be given from 8.30. The broadcast, which emanates from a large farm near Roskilde, is to be relayed over the whole of the American N.B.C. network.

This broadcast will be preceded at 7.30 by a programme of music of the late world-famous American composer, Gershwin. From 9 o'clock the Danish stations will give an Americanised non-stop variety show, which concludes this American evening.

## OPERA

THIS style of programme is not very plentiful this week. On Saturday Rome announces Massenet's "Thais" for 9.0, which Milan gave yesterday (Thursday). The story of a monk seduced by a beautiful courtesan was one after Massenet's heart. First produced in 1894, it came to England in 1911, and has been a favourite

and Talmaae," which the B.B.C. broadcast.

On Sunday comes "The Mikado," most delightful of Gilbert and Sullivan operas, in a "potted" version from Athlone at 7.0.

From Milan on Sunday and Rome on Tuesday at 9.0 will be heard a gala concert of the works of Giuseppe Mulé, one of the most distinguished of contemporary Italian composers, who has distinguished himself for his devotion to Greek drama. On Thursday Milan is giving Mascagni's three-act opera, "Isabeau" (first produced in Buenos Aires in 1911) at 9.0, with the veteran composer conducting. Mascagni, despite his 74 years, seems to be still full of plans for the future, and has announced his two next operas, for three and four years ahead respectively.

Hans Pfitzner is, perhaps next to Richard Strauss, the most distinguished living German composer. His whole career and achievement are in the best and soundest tradition of German musicianship. Son of a music director, he has, from the early age of fifteen, worked his way up from position to position in the musical world. Now 69, he has more or less retired from active work, but frequently conducts his own compositions.

## HIGHLIGHTS OF THE WEEK

**FRIDAY, SEPTEMBER 17th.**  
Nat., 6.45, Alec Rowley and Edgar Moy (two pianos). 7.35, Five Hours Back. 8, Feature programme on Brighton. 9, Jack Strachey's Music.  
Reg., 6.45, Variety with Audrey Hyslop and Eddie Pola. 8, Beethoven Prom. 9.35, Cora Goffin in songs from her stage successes.

*Abroad.*  
Luxembourg, 9.45, Clark Gable and Franchot Tone speaking for the first time from Radio Luxembourg.

**SATURDAY, SEPTEMBER 18th.**  
Nat., 1, Recording of President Roosevelt's speech on the occasion of the 150th anniversary of the adoption of the American Constitution. 4.40, Commentary on the Metropolitan Inter-Borough Small Bore Rifle Shooting Competition. 8, Promenade Concert. Reg., 8, Music Hall. 9, Discussion on Domestic Service.

*Abroad.*  
Vienna, 7.25, Lehár's operetta, "Gipsy Love."

**SUNDAY, SEPTEMBER 19th.**  
Nat., 5, English Spirituals sung by Jacques Hopkins and the Maranatha Singers. 5.20, Cello recital: Gaspar Cassadó. 9.5, Feature programme: "The Raider Emden."

Reg., 5, B.B.C. Military Band and William Parsons. 5.45, Light music by the Baden Kursaal Band from Switzerland. 9.55, Recital: Elisabeth Schumann.  
*Abroad.*  
Swiss stations, 8, European concert of Swiss music.

**MONDAY, SEPTEMBER 20th.**  
Nat., 5.40, Recital: Jean Sterling-MacKinlay (disease). 7, "Monday at Seven": including Leslie Hutchinson (Hutch). 8.40, Wagner Prom.

Monday Sept. 20th (continued).  
Reg., 8, Two plays: "Villa for Sale" and "Tin Soldiers." 8.50, Tommy Matthews and his Concert Orchestra.

*Abroad.*  
Deutschlandsender, 7, Concert by the Berlin Philharmonic Orchestra. Soloist: Willi Stech, who will play "The Indian Phantasy" (Busoni).

**TUESDAY, SEPTEMBER 21st.**  
Nat., 7.20, The Metropolitan Police Central Band. 8, Strauss Prom. 9.10, Pianoforte Recital: Lamond. 10, "I Saw the Start": Lt.-Col. C. Jarratt on "Speed."

Reg., 8, Variety from the Winter Gardens, Morecambe. 9.35, Mabel Constanduros and Gladys Young—another "Down Mangel Street" episode.

*Abroad.*  
Brussels I, Messenger's operetta: "Monsieur Beaucaire."

**WEDNESDAY, SEPT. 22nd.**  
Nat., 7.10, Debroy Somers with his Band. 8, "The Swan," a musical play. 10, Two plays: "Villa for Sale" and "Tin Soldiers."

Reg., 6, The Folkestone Municipal Orchestra. 8, Bach Prom. 9.40, County Water Polo Championship.

*Abroad.*  
Brussels II, 8, Stravinsky concert by the Brussels Symphony Orchestra.

**THURSDAY, SEPTEMBER 23rd.**  
Nat., 6.40, Variety: Ronald Gourley, Wee Georgie Wood, Mrs. Murgatroyd and Mrs. Winterbottom. 8, Debussy-Stravinsky Prom.

Reg., 6, Al Collins and his Dance Orchestra. 8.20, The St. Hilary Players in "Pollie Tregembo," a Cornish comedy.

*Abroad.*  
Lyons, 8.30, Offenbach's operetta: "Les Brigands."



SWITZERLAND provides the next European Concert, which will be relayed by many continental stations on Sunday at 8. English listeners will not hear this via the B.B.C., doubtless because of the clash of time with the broadcast evening services. Deutschlandsender is broadcasting recordings of this concert at 11 on Tuesday. This photograph shows a typical Swiss mountainside scene.

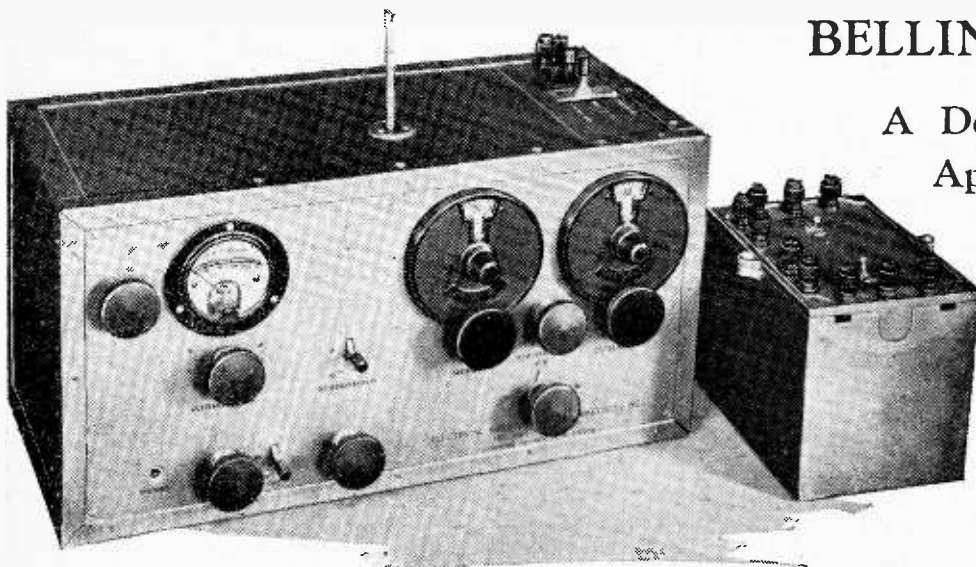
all over the world ever since. Our own composer, Colin Macleod Campbell, has treated the same theme with more restraint in his one-act opera, produced last spring, "Thais

"Das Käthchen von Heilbronn," romantic drama on Kleist's famous play, is his best known stage work. Cologne gives this at 8.30 on Thursday. THE AUDITOR.

# Interference Testing Set

## BELLING-LEE TYPE L301

A Description of the Apparatus  
Approved by the G.P.O. and  
Used for the Measurement  
of Electrical Noise



Belling-Lee P.O. interference measuring set and mains filter unit. A short vertical aerial is fitted for field strength measurements of radiated interference.

Office and associations connected with the electrical industry, the British Standards Institution has published a specification of the apparatus now approved for the measurement of electrical interference.

This equipment is intended to be used for ascertaining the nature of the interference, its intensity, and when the appropriate suppression measures have been taken to measure the amount of interference remaining. It might thus be possible to come to an agreement regarding the maximum amount of interference that can be permitted from electrical appliances without affecting broadcast reception.

According to the B.S.I. specification electrical interference may be divided into two main classes, viz., direct radiation from the source of disturbance and pulsating currents along wires joined to the appliance. Interference from the latter source may not necessarily be restricted only to pulsating currents in the mains leads to the appliance, but currents circulating between the conductors and the earth will also

THE various forms of domestic electrical apparatus may be a boon to the housewife, but there is no doubt that they can and do cause considerable interference with broadcast reception. Though this form of equipment is only a very small part of the total apparatus now electrically operated, it is probably responsible for most of the interference experienced in suburban residential districts.

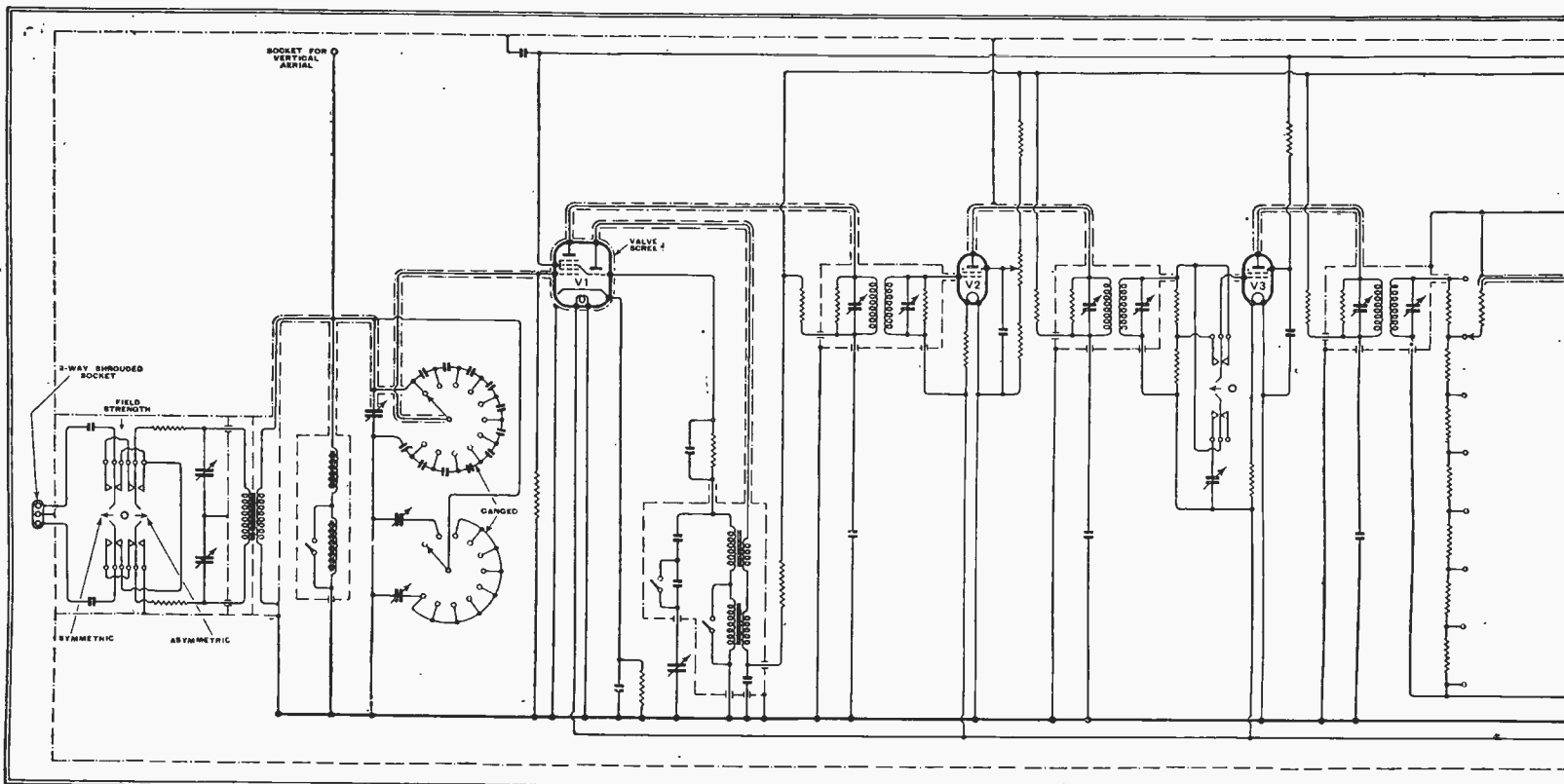
So serious has the interference with broadcast become during recent years that ways and means have had to be found to suppress it, or at least reduce it to a state where its effect is strictly localised. Condensers, resistances, and chokes used either

singly or in combination form the usual remedial measures taken to suppress the more common forms of electrical interference.

As this is a matter which concerns a very large section of the listening public, investigations were put in hand with the view to correlating all the available data on the subject so that all cases of interference could be dealt with on a sound technical basis, and suitable remedies evolved for each.

In conjunction with the British Post

Theoretical circuit of the Belling-Lee P.O. interference measuring set Type L301.



generate interference, since the casing or framework of the apparatus may be joined either to earth directly or have an appreciable capacity to earth.

Thus there can be two components of interfering currents in the appliance, and suppressors that may suffice for the one may not be effective for the other; also both can be present in any one piece of apparatus. When the pulsations are restricted to the conductors themselves it is described as the "Symmetrical" component, and when it circulates *via* earth as the "Asymmetrical" component of the interference. The method of measurement is different in the two cases, also it is essential that the measuring apparatus be able to discriminate between them.

The testing apparatus illustrated here and made by Belling and Lec, Ltd., Cambridge Arterial Road, Enfield, Middlesex, conforms in every detail with the British Standards Specification No. 727 and with the design approved by the British Post Office engineers. The measuring set is battery-operated, as it is required to be portable so that measurements can be made at the source of the interference.

### The Circuit

Five valves are used in a superheterodyne circuit, which consists of a triode-hexode frequency-changer, three IF stages, and a detector-amplifier, the last stage being, in effect, a valve voltmeter.

Attenuators are fitted in the input circuit as well as at the output end of the IF amplifier, the idea of dividing up the attenuation in this way being to avoid any likelihood of overloading the earlier stages on very large input voltage.

The two variable attenuators together give a reduction of 96 dB in steps of 6 dB. In addition, there is a key switch which brings a further 40 dB of attenuation into the circuit should the need arise.

The steady DC through the meter is

backed off by internal batteries, so that it only reads the change in anode current in the triode section of the output valve.

As the measuring set is intended for use on the ordinary broadcast bands, its frequency ranges are approximately 155-390 kc/s (1,940-770 metres) and 550-1,400 kc/s (546-214 metres). Its sensitivity is such that it is suitable for measuring voltages of from 10 microvolts upwards, and field strengths—i.e., radiated interference—above 1 microvolt per metre, with an accuracy better than  $\pm 2$  dB. The band-width of the IF amplifier is approximately 3.5 kc/s, but as the requirements specify a 9 kc/s response a correction is applied to all readings of interference voltages, and this is included in the calibration.

Initially the test set is calibrated for frequency and voltage measurements by injecting signals of known magnitude from a standard signal generator, and by direct comparison with a standard field-strength measuring set for the field-strength calibration.

In order to ensure that the sensitivity of the apparatus is always the same, for being battery-operated it might change slightly from time to time as the battery voltages fall, an initial adjustment is made before any measurements are taken.

No external apparatus is required for this, as the sensitivity is adjusted on the thermal agitation voltage in the signal frequency tuned circuits. This is used as a constant signal, and the gain of the IF amplifier is adjusted by varying the screen potential of the first IF stage to give a predetermined output reading.

Initially adjustments are made with the variable resistance and potentiometer in the meter circuit, so that the steady anode current of the output valve is nearly balanced out by the opposing voltage from the internal battery.

By adopting this scheme a very sensitive meter can be used in the output stage, as only the change in the magnitude of the anode current will be recorded.

The sensitivity of the test set is then adjusted so that, after amplification, the thermal agitation voltage in the tuned signal circuits, plus the valve noise in the frequency-changer together, give an output-meter reading of 100 micro-amperes with all attenuators set to zero and the signal and oscillator circuits correctly tuned.

### Additional Unit for Mains Work

With this test set an additional unit is needed when making measurements on electrical appliances connected to the supply mains.

The unit provides the necessary connecting points, so that the amount of interference produced by the "Symmetrical" and the "Asymmetrical" components of the interference can be measured separately. It also contains chokes of suitable inductance to filter out all mains-borne interference and prevent it reaching the measuring set, the circuit being so arranged that only the interfering voltages generated by the piece of apparatus under test are applied to the input circuit.

The price of the complete equipment is £78. An additional £6 is charged for a Post Office field-strength calibration. It is built into a metal case measuring 18½ in. x 8½ in. x 9½ in., and the whole equipment is completely screened.



# MCCARTHY

## BATTERY ALL-WAVE SUPERHET

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**DE LUXE MODEL**  
**£7. 10. 0**

(Complete with 6 B.V.A. valves)

The only receiver of its type now on the British market. Results on all 3 wavebands equal to mains receivers of equivalent type. Latest technical developments incorporated in circuit. Latest types valves, transformers, tuning coils, switches, etc. Specification in brief: radio frequency amplifier, first detector with separate triode oscillator, I.F. amplifier, double diode detector, L.F. amplifier, low consumption pentode output, D.A.V.C. volume control and tone control both operative on gramophone. Illuminated dial with station names. Wave-ranges: 19-50, 200-550, 900-2,000 metres.

## 9 VALVE FOUR-WAVE SUPERHET DE LUXE

# 14 GNS.



(Complete with 9 B.V.A. valves)

4 wavebands: 12.8-33, 23-80, 190-550, 800-2,000 metres. Illuminated dial with principal station names.

**Controls.**—A feature of the receiver is the number of independent controls fitted, making it extremely interesting to operate. These include: sensitivity control (varying bias on R/F stage), Q.A.V.C. with manual muting control for inter-station noise suppression, 5-position wave-change and gramophone switch. Progressive variable tone control operative on radio and gram.

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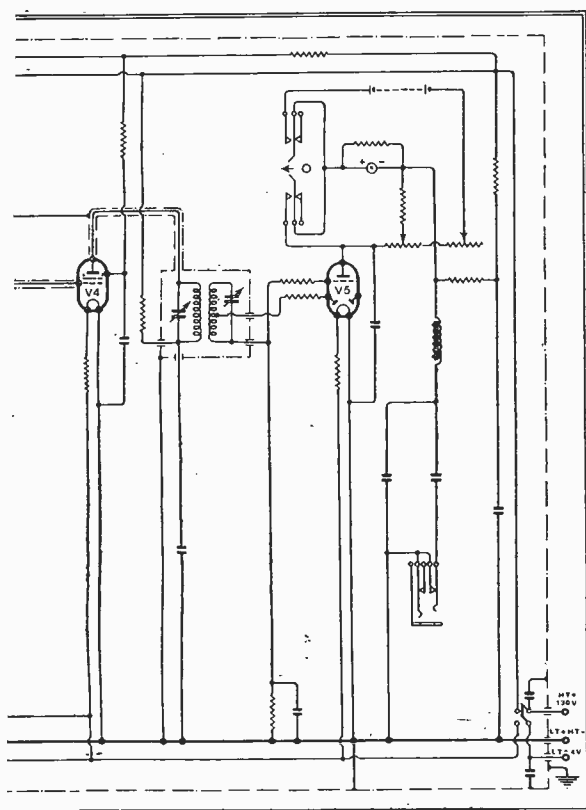
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# Random Radiations

## Technical Information

THE recent leading article in *The Wireless World* on the subject of the failure of radio manufacturers to stress the importance of the technical progress made in their wares made good reading. Talks with a good many of them have served to convince me that there is something amiss with what they are wont to call their sales psychology. Not a few hold that the public is not interested in the least in the working of its sets. It has, they say, just about four questions to ask concerning any set. These are: Does it look nice? Is its tone (!!) good? Will it receive heaps of foreign stations? Is it cheap? Now, if those are the four questions to which the man-in-the-street wants answers, it is very clear that the manufacturers have lamentably neglected the wonderful opportunities that were theirs but a year or two ago. I'm sure that they have, and here's why.

## Throwing Chances Away

SOME three years ago a very big man in the U.S.A. world of wireless said to me when we were dining together after a tour of the Radio Exhibition: "What an enormous advantage your manufacturers have over ours! In my country the ordinary man and his wife know nothing at all of the technical advances made in radio sets because the lay papers tell them nothing. Here the lay papers have simple articles pointing out the meaning and the advantages of such things as AVC, loud speaker fidelity, band-spreading, visual tuning and the like. In the States there's no longer anything of the kind. Your people can understand why the new sets are better; ours just can't." Three years or so ago that was true of this country. Now it isn't; manufacturers seem to have discouraged in the lay papers the simply written technical radio article and to have given their approval to articles by the writer who knows nothing about the working of a wireless set (and generally drops outside bricks if he makes the least essay into the scientific side), but confines himself to criticism of the B.B.C.'s programmes or details of the private lives of broadcasting "stars."

## Unnecessary Misunderstandings

It's a pity, for there's any amount to interest the ordinary man in the progress that wireless reception is making. And he is interested, as you probably know by experience. Don't you find that your uninitiated friends are always bombarding you with questions? There are lots of popular misconceptions that wouldn't exist if the lay papers hadn't been persuaded so largely to abandon the simple technical article and to plump for the "entertainment side" of wireless. Here are just a few. It is still widely believed that the receiving set is responsible for fading; that the mains set is very expensive to run (yes, honestly!); that the battery set is the less susceptible to the effects of atmospheric; that the "all-wave" set is not so good a performer on the medium and the long waves as one designed for those wavelengths only; that you can buy for under £10 as good a set as could be wished for and that if you pay more the extra outlay merely gives you

## By "DIALLIST"

more elaborate cabinet work and a few gadgets that you can perfectly well do without. These and similar misunderstandings are now heavy brakes on the wheels of radio progress in this country.

## A Big Step Forward

IT is good to see that not a few of this year's moderately priced superhets have a signal-frequency stage, for the improvement that it effects, if well designed, upon all-round performance is remarkable. Your little superhet with no signal-frequency stage may be magnificent value for money at to-day's prices, but it can't hope to give to its owner all that the receiving set can give. With no preceding SF stage the IF amplifier has to be screwed up almost to the limit. Hence background noises are apt to be a nuisance on any but strongly received stations. Morse pick-up, second-channel whistles and not very effective AVC are other bugbears of the little superhet, starting with a combined frequency-changer and first detector, that the use of a signal-frequency stage can banish. If only the man-in-the-street were taught (painlessly and without tears!) a little about the advantages of the SF stage there'd be less difficulty about selling the sets that cost a pound or two more than the cheapest available.

## Lets Get On With It!

FOR a long time the B.B.C. has been all ready to radiate the complete Regional or National programmes in the London area on the ultra-short waves. The transmitting apparatus which it possesses can be guaranteed to give genuine high fidelity broadcasting and with suitable receiving sets marvellous reception is possible. For some reason best known to itself the wireless industry has been strongly opposed to regular transmissions of this kind and they have therefore been held up. But now two things have happened to seem to make it desirable for these ultra-short-wave transmissions to start without delay. The first is that the industry is now endeavouring strongly to popularise television. One reason which now makes people hesitate to plank down the price of instruments designed for sound and vision on the ultra-short waves only is that they can be used only for brief periods each day. Were "sound" programmes radiated all day long on a wavelength in the neighbourhood of 7 metres this objection would at once be removed. The second happening is that quite a few of the higher-grade "all-wave" sets of this year's vintage have an ultra-short waverange which could be used for the reception of such broadcasts. High fidelity broadcasting on the ultra-short waves has got to come; to endeavour to hold it up is like trying to keep back the tide with a broom!

## Television Across the Pond

THEY'RE working pretty hard at television in the U.S.A., and quite a few of their big men in that line are making journeys to this country to keep in touch with what we are doing. So far, there's no regular television service over there, and it

does not seem likely that there will be in less than about a couple of years. All transmission and reception at present are confined to experimental work by a few of the radio manufacturing concerns. Recently I met a man who had just returned from the States, where he had had the opportunity of seeing demonstrations of various systems that are being developed in that country. He was emphatic that the best of them was a very long way behind what we can do, in spite of the rather better definition that should, in theory, be given by the use of 441 lines, which is the present U.S.A. standard.

## Standardised Television

It is much to be hoped that the movement for the standardisation of television transmissions by all countries concerned will bear fruit. As things are, each is working independently, and, though the interlaced scanning system bids fair to be adopted everywhere, there is considerable variation in the number of lines and in the number of frames a second. It is quite within the bounds of possibility that long-distance reception of television may be found practicable. Already the "sound" portion of the Alexandra Palace transmissions has been recorded in South Africa and the U.S.A. The "vision" signals, too, have been heard, but, so far, no suitable apparatus has been available in either the States or South Africa for discovering whether reproduction of the images is possible. However, a South African experimenter, now in this country, intends to take a televisor back with him, and we shall wait with interest to hear what results he obtains. If he is successful, a wonderful new field lies open.

## 'Twould be a Fine Thing

But DX television will never have its real chance of becoming popular unless transmissions are standardised so as to make the same receiver suitable for all without alteration or adjustment. A further big advantage of standardisation would be that direct comparisons between one country's service and another's would be possible. That is hardly so now; we have always to make allowances for the differences in the number of lines and frames. With transmissions the same everywhere, the results of experiment and experience could be pooled, which might well mean a speeding up in television progress. Then there's the important gain that the same receiving equipment would work equally well in any country with a television service. This might lead to healthy international competition, and improvement after improvement in televisor design and make-up. World-wide standardisation shouldn't be difficult to achieve, for it involves little giving and much probable taking.

## Old Sport, New Science

RACING is in all probability man's most ancient sport. Mankind being what it is, we can feel pretty sure that the first of our hairy and heavy-jawed ancestors who succeeded in capturing and riding a wild horse soon found all his friends and rivals emulating his feat. And once they had horses under them, what more natural than for each to proclaim that his was the fastest mount and to challenge all-comers to race? And now our oldest sport has been wedded to one of our newest branches of science; wireless has been used, and with the greatest success, to replace such antiquated methods of communication between



the starter at one end of the course and the judge at the other as the waving of flags or the flashing of lamps—neither very useful if the weather is at all misty. Small short-wave apparatus for two-way communication has been tried out and not found wanting. Probably it won't be long before wireless is in use for this and similar purposes on every racecourse in the country.

**Well Prophesied, Sir !**

At this point I must pause to award myself, with blushes befitting the occasion, a pat on the back for having foretold this very thing in an article dealing with the future of wireless, which appeared (*Eheu, fugaces!*) nearly twenty years ago. Another callow effort from my then youthful pen foresaw bookies forsaking the "tic-tac" code, by which the odds are communicated at amazing speed from ring to ring on the racecourse, in favour of the miniature radio transmitter and receiver. So far as I know, that has not come about yet; the condi-

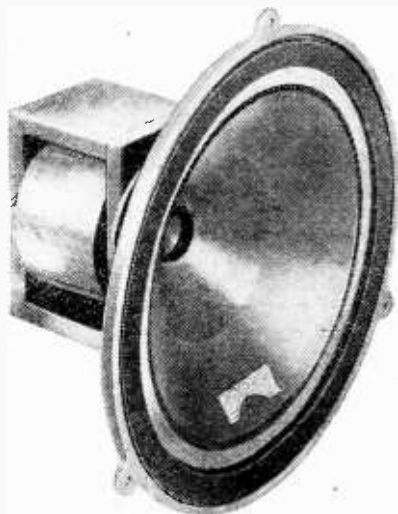
tions under which a transmitting licence is to be obtained are not, perhaps, strongly favourable to this development. But it will come in time. And so will the yoking of wireless into the service of a good many of our other sports, where its varied forms of possible usefulness are manifest. But it won't be just yet, for we are so conservative about our sports that we are slow to adopt new things. The electrical timing of both equine and human racing contests, for example, has been possible for years, but it has not come into general use yet.

**Valve Connections**

OUR description of the Mazda D1 diode (issue of August 20th) may have conveyed the impression that connections can be made to this valve by soldering direct to the pins. This practice would probably introduce trouble, and a holder should be used; fortunately, Belling and Lee have produced a special holder which contributes a minimum of extra stray capacity.

**Epoch "Magnaton" Loud Speaker**

IN many respects this speaker is very similar to the Epoch "Domino" model, but alterations in the magnet construction have enabled the manufacturers to effect a



Bakelised silk is used in the diaphragm surround of the Epoch "Magnaton" loud speaker.

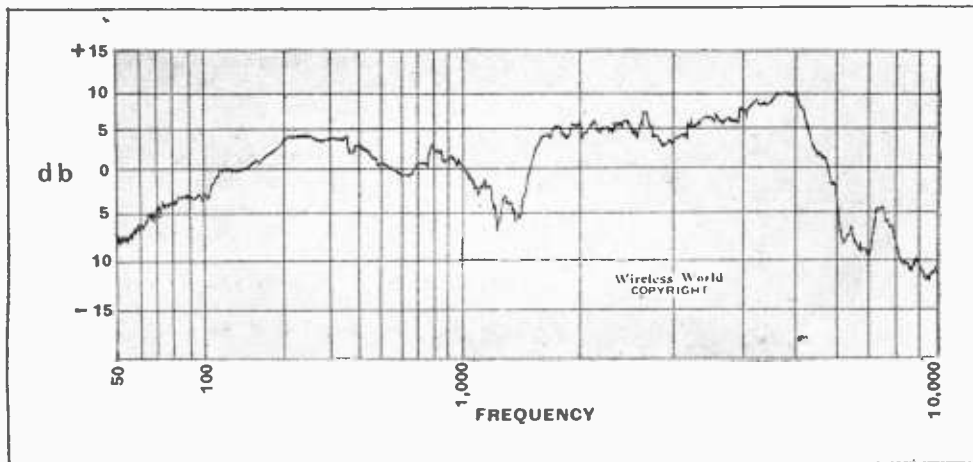
reduction in price. The magnet is built up of heavy rectangular sections with surface-ground faces and is fitted with a taped field coil which can be supplied for 100-110 or 200-240 volts.

The straight-sided cone diaphragm has a reinforced centre and is fitted with a bakelised silk surround which not only gives freedom of action but will withstand deterioration in a humid atmosphere. There is no appreciable bass resonance but the area of the large diaphragm ensures a good output in the lower register. The steady drop of the curve below 200 cycles is due to the baffle and may be taken as evidence that amplitude distortion is absent, since the presence of second harmonic tends to give a false impression of bass.

The reproduction is made crisp by a steady rise of output up to 5,000 cycles, and the cut-off above this frequency is noticeable by the absence of background mush rather than by any serious lack of definition.

The standard speech coil impedance is 15 ohms but other values can be supplied to order. A feature is made of the rapidity with which diaphragm assemblies can be exchanged—an important point in PA maintenance work.

The price of the new speaker is £5 19s. 6d. and the makers are the Radio Development Company, Aldwych House, Aldwych, London, W.C.2.



Axial response curve of Epoch "Magnaton" loud speaker. Microphone distance 4 ft.; input 1 watt.

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# Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

## Rating of Amplifiers

SUCH expressions as "amplifier output 20 watts, gain 100 db.," are occurring with increasing frequency in technical descriptions of PA apparatus (for example, *The Wireless World*, September 3rd, p. 254).

By "a gain of 100 db.," I understand the output watts to be ten thousand million times the input watts.

This would be a very useful piece of information in a telephone repeater, where both input and output are matched to similar lines.

It would also be useful if the output from microphones and pick-ups were commonly given in terms of energy per second.

Almost invariably, however, it is given in terms of the maximum voltage output, on the assumption that, for most practical purposes, the valve can be regarded as a voltage-operated device.

In these circumstances it is difficult to see how the gain in db. can be of any value in deciding the suitability of an amplifier for a specific job. But perhaps there is some convention with which I am unfamiliar. If so, would you be good enough to dispel the fog.

F. CAMPBELL ROSE.

London, W.C.1.

IT is customary to express the gain of an amplifier in decibels. I submit that in the case of PA amplifiers this is meaningless and may be misleading.

The point can be best demonstrated by means of an example. Consider an amplifier, designed for use with a pick-up, which gives an output of 10 watts when the input is connected to a pick-up giving 1 volt, the input being connected across first grid and earth with a grid leak, R, in parallel.

If R is 2 megohms, the power taken from pick-up is 0.5 microwatt and the gain of the amplifier is 73 db. If R be changed to 50,000 ohms, these values become 20 microwatts and 57 db. respectively. The amplifier is the same in each case and from the practical point of view of the user has the same gain, although this gain can be expressed as anything from 73 to 57 db., according to the particular grid leak used. With many pick-ups it is possible to use quite a wide range of values without any serious effect on their performance.

The theoretical point is that while the decibel is a suitable unit for expressing the gain of an amplifier in which output volts are compared with input volts, i.e., a voltage amplifier, or of an amplifier in which output power is compared with input power, as in the case of a telephone repeater, it is not suitable when applied to a PA amplifier, which is essentially a device whereby an output power is obtained from an input voltage. Any power absorbed in the input circuit is incidental. It follows that the logical way of expressing the gain is one by which the output watts are compared with the volts applied to the first grid. In the above example the gain (or sensitivity) would be 10 W/V (watts per volt).

Failing the adoption of some such method as this I should be glad to learn how a relation between power and potential difference can be expressed in terms of decibels.

A. SERNER,

Research Dept., Film Industries, Ltd.  
London, W.1.

## Transient Response.

MR. VOIGT'S article on "Transient Response" (July 30th, 1937) was very interesting, particularly to the present writer, who investigated this type of problem some years ago in connection with television.

The only physical application of Fourier series which needs no important qualification may be expressed in the following statement: "Any infinitely repeated wave-form, however irregular the shape of each single wave, is exactly equivalent to an infinite series of sine and cosine waves, whose individual magnitudes can be calculated."\* But the series can never fully represent an absolutely instantaneous change, for the mathematicians tell us that at a discontinuity the value of the series is the mean of the values on both sides of the discontinuity. Thus, suppose we draw a wave-form such as Fig. 1, in which the quantity under observation, such as sound pressure, is represented as changing abruptly between +1 and -1 every second, calculate the Fourier series for this, and then use the series to find the value of pressure at  $t=1$  second exactly. Actually the value is both +1 and -1 at each exact second; but the series can only give a single answer, so it takes the mean and says the value is 0. (This is perfectly true of physical realities, since the quantity presumably passes through 0 in going from +1 to -1; but it is not very helpful).

We may, however, ask the series what is the value of the quantity at 1.00001 sec., or at 0.99999 sec., and obtain the right answer provided we go to terms of high enough frequency in the series. It would appear that the Fourier series is more practical than those who regard an absolutely square wave-form as the ideal type, for it tells us plainly that the steepest slope we can get is not infinitely steep, but merely corresponds to the highest frequency we can use. For acoustical purposes we can set the upper limit of frequency by omitting all frequencies which are too high for the ear to detect; and for television we may neglect all frequencies which would represent a distance on the screen much less than the diameter of the scanning spot. (If someone produces a television system of extraordinarily high definition we shall have to modify the second statement by replacing "diameter of the scanning spot" by "smallest distance which can be detected by the eye.") Thus the upper limit of frequency required for all practical transients is finite.

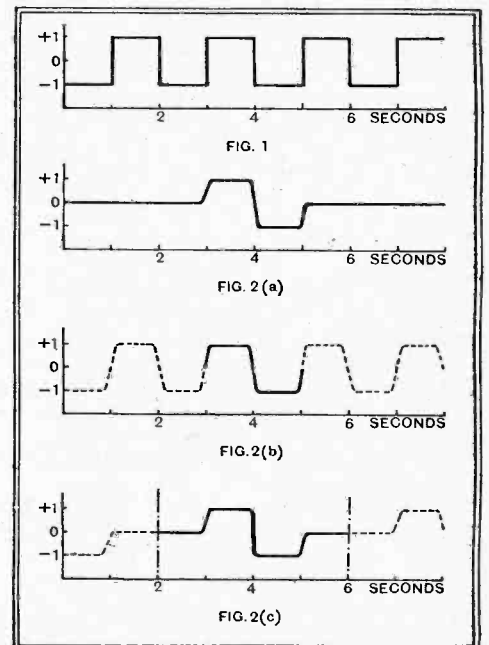
The next point to notice is that we specified a series of sine and cosine waves in which the magnitudes of the individual members of the series can be calculated according to specified rules; but this does not exclude the possibility that in any particular case the answer may be zero for a

\* To be rigorous, one should mention the restriction that the amplitude of the wave-form must be finite throughout, and have only a finite number of discontinuities and turning values; but these conditions will be satisfied by every practical wave-form.

number of components, i.e., these components do not exist. In place of an infinite series of frequencies, therefore, we now have a number of selected frequencies scattered over the frequency range up to a certain upper limit.

Having set an upper limit to the frequency band required, our next aim is to find a lower limit; this is the most difficult step, for it is bound up with the question of the transition from an infinitely repeated series of waves to a single isolated disturbance—the true transient. The mathematicians first tackled this by saying that whereas the period of repetition of a wave-form such as that shown in Fig. 1 is two seconds, the period of repetition of an isolated transient is infinity. But this leads to practical difficulties.

Take, for example, a television programme consisting of moving pictures in which the scene does not repeat itself during the whole hour's transmission; this should, presumably, be regarded as one transient spreading over a period of an hour. But then if our Fourier analysis is extending to infinity, what about the next day's programme? Are we to construct one gigantic Fourier series



to represent everything that is radiated from Alexandra Palace, from its opening to whatever date may see its final close? The same argument really applies to sound broadcasting, for a pure sine wave is of infinite duration, so that, strictly speaking, even the old-fashioned tuning signal should be regarded as a "transient."

Obviously we must call a halt somewhere, so the next step is to say that over a specified finite time any wave-form may be replaced by a Fourier series of the corresponding period, the magnitudes of the terms being calculated according to the usual rules; but outside the specified period the equivalence does not hold good. Take, for example, the wave in Fig. 2 (a); this is one cycle extracted from Fig. 1, but with the vertical slopes slightly eased to correspond with practical possibilities. A Fourier series which will represent this over a period of two seconds is graphed out in Fig. 2 (b); it is shown dotted outside the two-second period for which it was calculated, and there does not correspond with the original event given in Fig. 2 (a).

As a better approximation, we might calculate the series which is equivalent to the

given wave over a period of four seconds; this is plotted in Fig. 2 (c). If we could by some means cut off both actual wave and Fourier series at the times indicated by the dotted lines at seconds numbers 2 and 6, the two would be identical over the whole period for which the real quantity existed, and we should have found a way of representing a single transient by a Fourier series whose period does not extend to infinity.

The most obvious way of securing this result in an electrical amplifier would be to switch off at the second dotted line; the Fourier series can go on repeating itself to infinity, but the real apparatus obviously will not repeat the transient if it has been switched off. However, the only convenient way of doing this in practice would be to make the whole of a listening period of several hours the period for which the series is to be valid; this is impracticable because the lowest frequency in the Fourier series corresponds to the period for which the series was calculated, and we do not want to handle frequencies corresponding to a period of hours. We wish to represent each separate transient by its own short-period Fourier series, and be able to dispose of each series as soon as it has done its job.

Now in Fig. 2 (c) the dotted lines represent good places at which to interrupt the series, because (a) the graph is on the zero line and (b) it is steadily on zero, i.e., has zero slope; in terms of acoustics we should say that both sound pressure and velocity are zero. If, then, our receiver and loud speaker faithfully follow this graph, so that at this instant the loud speaker diaphragm is at rest in its undisplaced position, all condensers in AC circuits are discharged, and all inductances are free from varying currents, the system is just as dead as though we had actually switched it off and on again; although our mathematical fiction—the Fourier series—presently repeats itself, the real apparatus will reproduce the single transient and then remain quiescent until the next signal arrives. If the whole of the apparatus will rapidly come to rest in this way the lowest frequency we require is only the duration of the shortest sections into which we can break up the signal; that is fixed experimentally as the shortest period required for the signal occurring in practice to perform a cycle such that its average value is zero. (This is only a way of saying that we must work with alternating currents and do not wish to have DC components).

Do you realise what this means? We can limit the low-frequency response of the reproducing system without harming the reproduction of practical transients provided we have sufficient damping, so that everything will come to rest between the different sections into which we wish to break up a complicated signal, i.e., in a time which is less than the period of the lowest frequency which the system handles. We cannot put in the dotted line in Fig. 2 (c) to mark the end of the period for which one particular Fourier series is effective until the system has come to rest; if we have to wait a long time for it to come to rest, we can only work with a long-period series involving very low frequencies.

Consider, for example, Mr. Voigt's hypothetical loud speaker system with perfect frequency response but a reverberation period of 1 second. The present writer believes that it would reproduce transients provided that (a) it included in its perfect frequency response frequencies of the order of 0.1 c/s, and (b) there was no relative phase

change between the frequencies which could be detected by ear. The transient would, of course, emerge from the system about a second late. Obviously it is easier to build a loud speaker with better damping than to extend the frequency response below the audible range. Something of the order of 30 to 50 c/s is the lowest frequency which can be of value as a sound on its own, so the ideal loud speaker might have a lower frequency limit of, say, 40 c/s, and damping such that at any frequency if the input ceases as the diaphragm reaches its normal position at the end of a cycle, the free oscillations of the diaphragm will be finished in about 1/400th second. Perhaps Mr. Voigt will tell us when he has built it!

So far we have reduced our frequency range from the mathematicians' infinity to the compass of the human ear. But Mr. Voigt hopes that we may be even more lucky; he suggests that when typical transients are analysed they may actually contain only a very few of the components within the frequency band. That is probably excessive optimism; the evidence is that speech, for example, contains a good assortment of components spread over the audible frequency band. It is, however, rare in acoustics for both upper and lower limits of the frequency band to be required for the same transient; probably 150 c/s upwards would suffice for most of the sounds normally classed as transients—speech consonants, rattle of coins, etc. "Transients" which have a very low frequency component are not likely, if produced by mechanical means, to have a steeply rising wave-form involving very high frequencies; they are, therefore, sounds which would be described colloquially as "boom" rather than "snap."

There remains only the question of phase distortion; certainly the ear is not critically conscious of phase displacements, so its importance is not very great in acoustical work. But in any case, a system which has both good frequency response and good aperiodicity is unlikely to introduce serious phase distortion.

The conclusion is, then, that transient response as distinct from infinite frequency response would be a myth; but transient response with a realisable limited frequency response depends upon adequate damping of every oscillatory portion of the system.

D. A. BELL.

Little Baddow.

## The Radio Industry

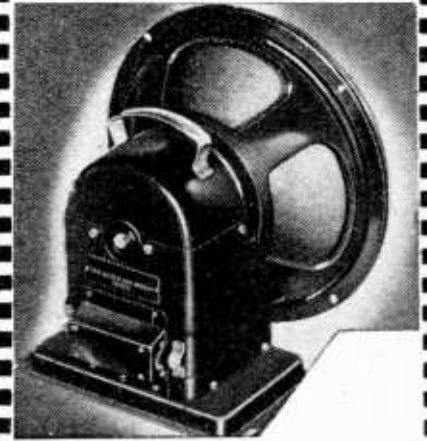
HENNING WERNSTRÖM, of Ulricehamn, Sweden, has been appointed sole selling agent for "Ridco" short-wave converters in Sweden.

Mr. H. V. Slade has been appointed joint managing director of the Garrard Engineering Company, manufacturers of the well-known record-changing apparatus, etc. Major H. S. Garrard becomes chairman of the company.

A booklet giving advance details of Invicta television receivers is now available from Invicta Radio, Radio Works, Parkhurst Road, N.7.

Brief mention was made in last week's issue of the fact that an interesting wide-range Marconi receiver is being shown at the Engineering and Marine Exhibition, Olympia. The set, which covers a waverange of 12-20,000 metres, has been developed for the marine service, and is designed to provide exceptionally high selectivity.

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# Recent Inventions

The British abstracts published here are prepared with the permission of the controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

## AUTOMATIC TUNING CONTROL

A PART of the output voltage from one of the IF stages of a superhet set is tapped off to a rectifier D, which feeds an amplifier V. The resulting voltage across the potentiometer R is applied to the grid of the local oscillator valve V<sub>1</sub>, which is of the variable- $\mu$  type, and alters its frequency so that it accurately "beats" with the incoming signals.

The action of the variable- $\mu$  valve is equivalent to broadening one side of the resonance curve of the receiver circuits, so that as soon as the set is brought inside

tween the cathode and negative high tension, the alternative positions allowing a negative picture to be changed into a positive one.

Ferranti, Ltd., and M. R. Taylor. Application date October 2nd, 1935. No. 465495.

## MODULATING CIRCUITS

WHEN transmitting television signals it is usual to apply the signal frequencies across the

electrons which approach the slot, and come under the attraction of the positively charged anode, move out towards it in a series of groups or "puffs," and so generate a fluctuating current of the frequency desired.

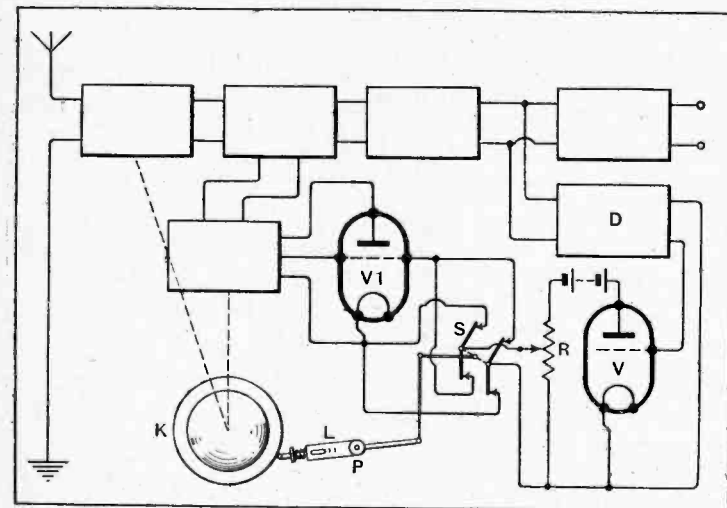
The arrangement is said to be capable of generating waves of the order of one thousand megacycles at an output level of over a kilowatt.

Marconi's W.T. Co., Ltd. (assignees of C. W. Hansell). Convention date (U.S.A.) November 28th, 1934. No. 465482.

## TUNED COUPLINGS

THE Figure shows a tuned coupling, such as the band-pass circuit of a wireless receiver, in which part of the total inductance consists of two coils L, L<sub>1</sub> enclosed inside a screening case C. One of the coils L<sub>1</sub> is movable relatively to the other, so as to vary the degree of coupling, and thus alter the frequency response or band-width.

In order to maintain the response curve symmetrical at all settings, it is necessary to prevent any substantial capacity variations between the screening case and the coil L<sub>1</sub>, consequent on the movement of the latter. For this purpose an extra screen S is placed between the two coils. As shown more clearly in Fig. 2, the screen



System for automatically correcting mistuning in a radio receiver.

the broadened curve, the control operates automatically to complete the tuning.

A change-over switch S, actuated by a lever L pivoted at P and controlled by the tuning-knob K, serves to reverse the biasing potential applied to the local oscillator V<sub>1</sub>, so that the resonance curve can be broadened in both directions from its peak. The automatic control thus comes into action in whatever direction the tuning-knob is turned.

J. Robinson. Application date October 7th, 1935. No. 465515.

## TELEVISION RECEIVERS

A TUNED-ANODE coupling between a high-frequency amplifier and a detector stage includes an additional inductance, so as to ensure that the effective impedance is kept large over the entire range of frequencies to be handled. The extra inductance is connected between the tuned circuit and the anode of the HF valve. It prevents the input circuit of the following detector valve from being shunted, as regards the modulation frequencies, by the tuned-anode circuit in series with the coupling condenser.

The load resistance of the detector stage can be placed either in series with the anode, or be-

grid and cathode of a valve, and to take off the resulting modulation frequencies from a resistance in the cathode lead of the valve. Difficulties then arise in heating the valve filament in the ordinary way, because the capacity to earth of the energising source tends to shunt away some of the higher modulating frequencies.

According to the invention, the problem is solved by heating the filament with a high-frequency current which is generated by a valve oscillator, at a frequency higher than the highest signal frequency. Preferably it should be greater than twice that frequency, so that any beats that may be produced fall outside the tuning range of the television receiver.

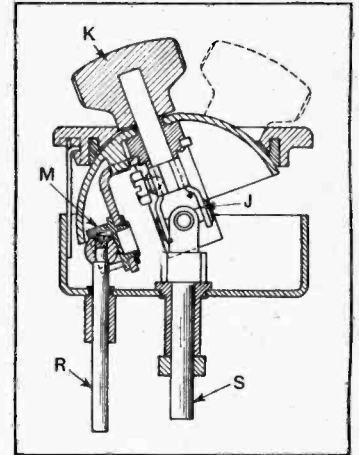
Marconi's Wireless Telegraph Co., Ltd., and N. S. H. Clough. Application date November 9th, 1935. No. 465613.

## SHORT-WAVE GENERATORS

A SHORT-WAVE oscillator, which may be of the magnetron type, is characterised by the use of a circular electrode which surrounds the filament, except for a slot cut in its periphery at a point opposite the positively charged anode. When the electron stream is under the influence of an applied magnetic field, those

## TUNING CONTROL

THE control knob K of a wireless set is connected through a universal joint J to the shaft S of the tuning condenser, so that a simple rotation varies the setting



Constructional details of tuning mechanism for operating two or more variable components in a radio set.

of the latter. In addition the knob can be rocked to and fro in any direction over a cone-shaped area, as indicated in full and dotted lines.

An extension M engages the ball-shaped end of a rod R so as to move it up and down, as the knob K is swung over from one position to the other. This is used to operate any other adjustable part of the set, such as the volume control. A second rod can be similarly linked up to the knob, so that a rolling movement, at right angles to the first, serves to control say the selectivity of the set.

N. V. Philips' Gloeilampenfabrieken. Convention date (Germany) August 19th, 1935. No. 465703.

## INDUCTANCE COILS

IN wireless receivers it is often necessary to use screened coils, the inductance of which must either be of a fixed value, or else bear a definite relation to one or more other coils. Owing to the presence of the screening box, it is difficult to adjust the inductance to the desired value, once the coil has been placed in situ.

The difficulty is overcome by mounting the coil eccentrically inside the screening case, and providing the lid of the latter with a "short-circuit" ring, which is also set eccentrically. By rotating the lid, the coupling between the short-circuit ring and the enclosed coil can be varied sufficiently to allow the inductance of the coil to be increased or diminished to the extent necessary for "trimming" the circuits.

Telefunken Ges für drahtlose Telegraphie m.b.h. Convention date (Germany) November 13th, 1934. No. 465746.

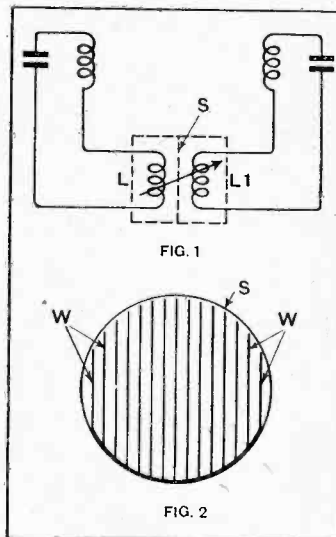


Fig. 1.—Arrangement of coils in variable-selectivity coupling unit.

Fig. 2.—Construction of electrostatic screen mounted between the coils in Fig. 1.

consists of a number of rods or wires W soldered at one end only to a circular frame.

P. D. Tyers. Application date October 3rd, 1935. No. 465593.

# The Wireless World

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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

# Educational Broadcasting

## Disorganising the National Service

**B**Y reinstating the medium-wave National transmissions at such times as there is no Scottish school broadcasting, as well as during the evenings and at week-ends, the B.B.C. has made a concession to listeners which, for the moment, seems to have had the effect of silencing protests from those who have suffered from the curtailment of National broadcasting hours. The flood of protests from our readers has certainly abated since the official announcement, mentioned in last week's issue, was made.

But few will agree that the arrangement which comes into force to-morrow is satisfactory enough to be permanent. Though *The Wireless World* is anything but indifferent to the more serious aspects of broadcasting and is in complete sympathy with the aspirations of the Scottish educational authorities, whose pride in their system is proverbial, we cannot help feeling that the B.B.C. is lacking in a sense of proportion when it allows the requirements of a few Scottish dominies to disorganise the broadcast service of half the country. "Disorganise" is not too strong a word, in view of the changes that have been, and are being, made.

Without entirely endorsing the parallel drawn this week by our contributor "Diallist," who maintains that it is no more the concern of the B.B.C. to provide lessons for children than it is the business of the Board of Education to organise entertainments for grown-ups, it must be admitted that his point of view is at least provocative of thought.

Our attention has been drawn to one objectionable aspect of the present arrangement which we and most of our readers might easily have overlooked. This present erratic functioning of National stations is extremely confusing to many elderly listeners who, after all, form a large proportion of the B.B.C.'s daytime audience. Even in this, the

fifteenth year of broadcasting, there are still many people who find it difficult enough to tune even the simplest set, and are utterly confounded by the need for combining this operation with that of changing wavebands. Such people have no alternative but to listen to Droitwich all the time, and, although there are doubtless many cases where the transmissions of that station are satisfactory enough, none of the many readers who have written to us on the subject have expressed anything but disagreement with the B.B.C.'s statement that the quality of Droitwich is now comparable with that of the best medium-wave transmitters. Again, many wireless dealers, and particularly those who handle high-quality apparatus, must surely labour under a disadvantage in that the opportunities for demonstrating sets under the best conditions during ordinary business hours are severely restricted, even under the new arrangement.

Assuming that it is finally decided that the Scottish school broadcasting arrangements are so vitally important that they must stand, it can only be concluded that it is impossible to devise any better use of the strictly limited number of medium- and long-wave channels available to the B.B.C.

For a more permanent solution of the problem one's mind turns naturally towards the use of ultra-short waves for all specialised broadcasts such as those in question, although it would hardly be practicable to serve the remote and sparsely populated areas of Scotland by these means. Be this as it may, the possible use of such wavelengths for broadcasting, must be borne prominently in mind when anti-interference legislation is framed, and more thought than ever should be devoted to the need for compulsory suppression of those kinds of interference which particularly affect ultra-short-wave reception.

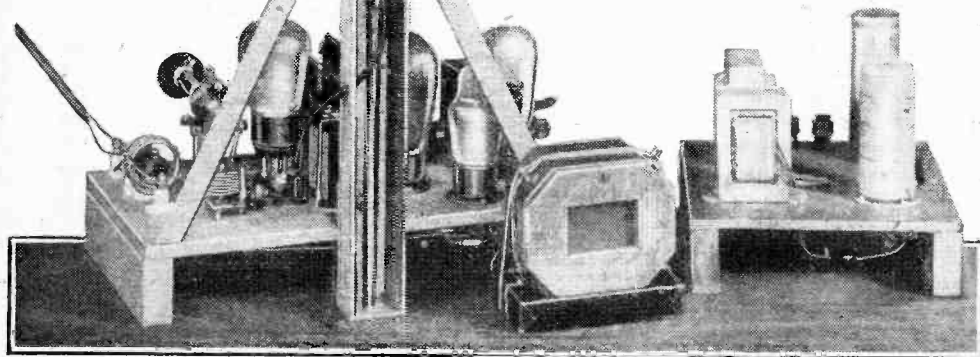
# Portable Five-metre Transmitter

**D**URING the past few months there has been considerable amateur activity in the five-metre band and from the steadiness of many of the signals heard it is apparent that crystal control and other forms of frequency stabilisation are being employed. Also it is learnt that the super-regenerative receiver, once the most popular for ultra-short-wave reception, is being replaced by straight sets and superheterodynes.

All this is to the good since the more amateur activity there is on the ultra-short waves the greater will be the opportunities for improving and developing the equipment, as well as for studying wave propagation. Even portable equipment is following the same trend though very few amateurs are as yet using crystal control for their portable transmitters. This is quite understandable since so many frequency doubling stages are needed that the apparatus becomes too complicated and bulky to transport with comfort. Added to this the all-important question of power supply has to be taken into account.

On the other hand, as many amateurs no doubt wish to try out battery superheterodynes on this wavelength it is imperative that something better than the self-excited transmitter be available for field-day use.

Portable five-metre transmitter with a concentric line for the stabilisation of frequency. A vibrator HT supply unit used with this set is also included.



*THE obvious advantages to be gained by employing some form of frequency stabilisation for five-metre transmitters has led amateurs to consider including this feature in portable sets for field-day use. In this article a brief description is given of a set stabilised by a concentric line that has proved to be very satisfactory for this purpose.*

Though several alternatives to crystal control could be suggested the one that appears the most attractive—at least, on the score of simplicity—is a resonant line.

Two kinds of resonant line find application in the control of ultra-short-wave oscillators. One consists of two parallel conductors while the other takes the form of two concentric tubes, in either case the line is approximately a quarter wavelength long.

Where two parallel tubes are used the spacing between them, measured centre to centre, should be about twice the diameter of the tubes. With the concentric assembly the best performance is generally obtained when the ratio of the inner to the outer tube is 3.6, taking the outside diameter of the inner tube and the inside diameter of the outer tube.

The concentric line has the advantage that the outer conductor is at earth potential while the inner is well screened so that it should prove the better of the two arrangements.

## The Resonant Line

In order to obtain some first-hand information regarding the usefulness of this form of frequency control for ultra-short-wave transmitters a set with a modified form of concentric line stabiliser was constructed and tried out recently on a five-metre field day organised by the Golders Green and Hendon Radio Society.

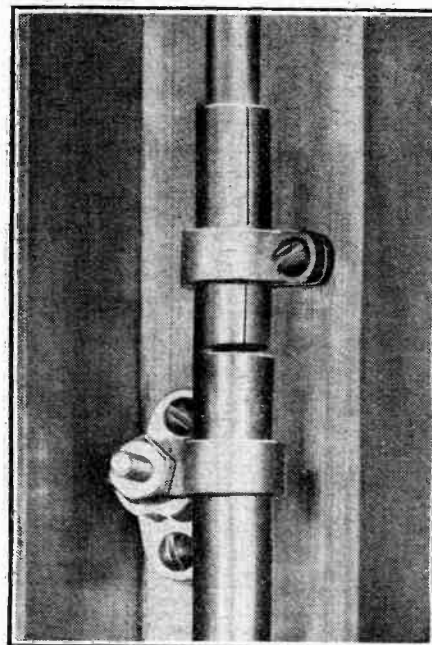
The results obtained were most satisfactory and the portable transmitter was received quite well on superheterodyne receivers.

## Frequency Stabilisation

The resonant line used for this transmitter consisted of a square section outer conductor with one side open and an inner copper tube of  $\frac{3}{8}$  in. diameter. The outer conductor was of brass, a channel-section piece with  $1\frac{1}{2}$  in. sides and 4ft. long being obtained since copper in this form was not available at the time.

Channel-section material was used since it was considered impractical to bend a 4ft. length of copper sheet into the shape required, especially as the metal had to be at least  $\frac{1}{8}$  in. thick to give it rigidity.

The inner conductor was made up of a 3ft. length of  $\frac{3}{8}$  in. outside diameter cop-



A small stand-off insulator supports the free end of the  $\frac{3}{8}$  in. copper tube. The method of securing the adjustable section of the line can be seen in this close-up view.

per tube and a 15in. piece of smaller diameter was telescoped into the end to enable the length of the centre tube to be adjusted so that it resonated at the correct frequency.

One end of the channel-section brass was closed with a piece of brass soldered in place while the end of the  $\frac{3}{8}$  in. copper tube was plugged, then drilled and tapped 4BA. It was then screwed to the centre of the brass end-piece. The other end of the outer conductor was left open.

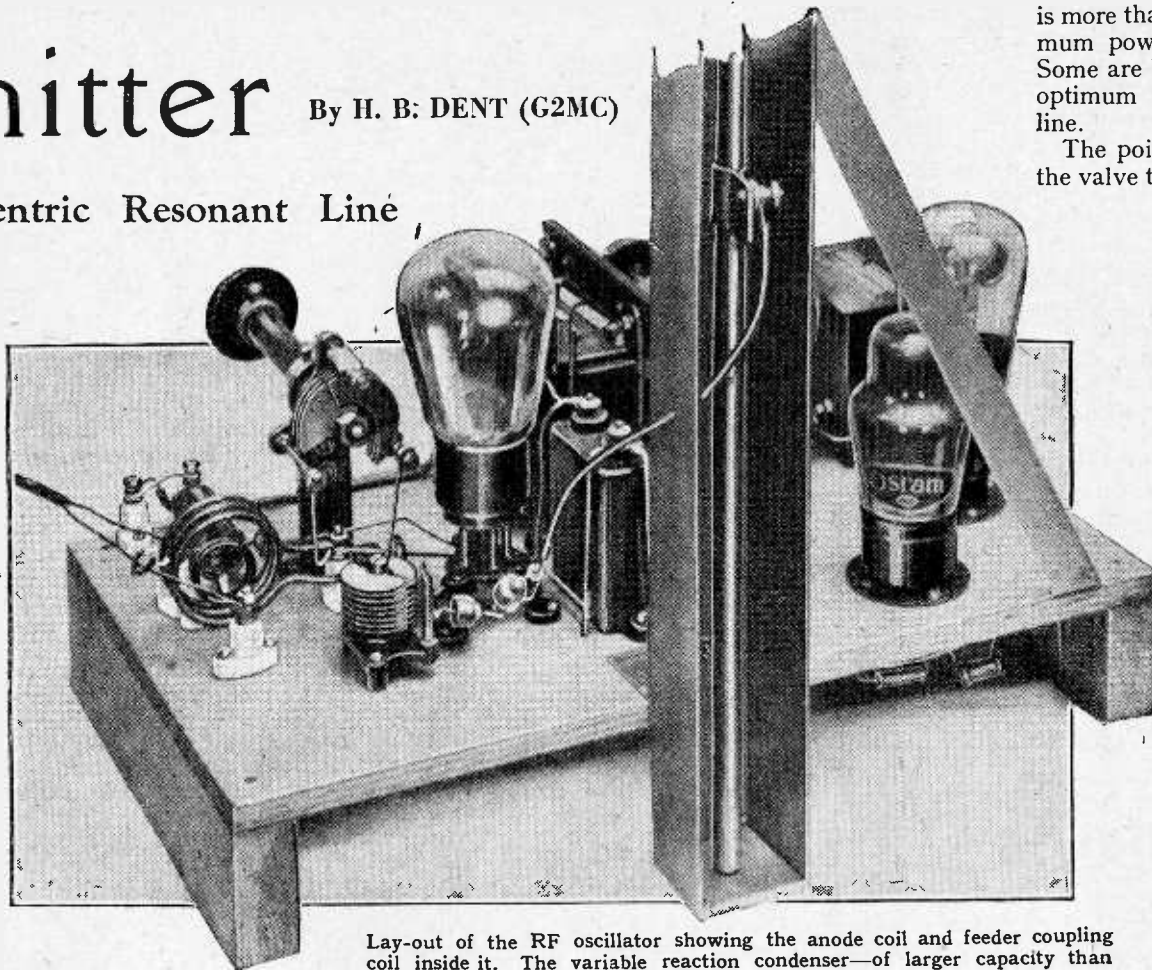
In order to securely position the inner tube a small Eddystone stand-off insulator was fixed to the inside of the channel-brass, and the end of the  $\frac{3}{8}$  in. copper tube fixed to it by a metal band. This made a very rigid assembly.

This method of constructing a resonant line is admittedly unorthodox, but it was adopted so that the length of the inner tube and the tapping point for the

# mitter

By H. B. DENT (G2MC)

## Concentric Resonant Line



Lay-out of the RF oscillator showing the anode coil and feeder coupling coil inside it. The variable reaction condenser—of larger capacity than really necessary—is seen in the foreground.

is more than one frequency at which maximum power can be fed into the aerial. Some are higher and some lower than the optimum frequency of the grid resonant line.

The point of attachment of the grid of the valve to the inner conductor of the line was not found to be critical, and with this particular valve it is 12 in. up from the earth end. If the inner conductor is adjusted to be about 1 in. shorter than the outer the optimum working frequency is of the order of 57 Mc/s.

The actual frequency is not governed entirely by the concentric line, which would be the desirable condition, since with small diameter tubes the Q factor is not sufficiently high for it to take full control of the frequency, but to some extent it is controlled by the tuning of the anode circuit, L1 C4.

It is essential that this fact be fully appreciated as otherwise much time will be wasted in lining up the set at the required frequency.

The optimum frequency of the line can always be found at any position of the grid tapping and with any length of inner conductor by reducing C6 so that the valve just oscillates, and then measuring the wavelength with an absorption or heterodyne wavemeter.

All initial adjustments should be made with about 100 volts HT only, and with the modulator removed. The resistance R2 is set to minimum. The grid tapping can be moved up and down the line, the object being to locate the position where the valve oscillates with minimum feed

grid of the valve could be found experimentally. It appears to be quite satisfactory in practice and obviates the necessity of dismantling the line every time an adjustment has to be made.

### Transmitter Circuit

The oscillator circuit with which this form of control was used is shown in Fig. 1. Only the essential portion of the circuit is given though actually there were two additional AF amplifying stages between the microphone and the modulating valve, an Osram N41. These extra stages were needed as *The Wireless World* transverse current carbon microphone was employed and its output is only of the order of 0.05 to 0.1 volt RMS.

The resistance R2, about 3,000 to 5,000 ohms maximum, may or may not be required; its function is to cut down carrier power and so increase the depth of modulation. It is a useful adjunct since it enables tests to be made to ascertain the maximum depth of modulation possible without upsetting the stability of the oscillator. Condenser C2 should be two to four mfd.

The RF choke must be effective at 5 metres and the modulation choke may be of from 20 to 30 henrys.

The principal interest in this circuit is the oscillator as the modulator is quite orthodox and straightforward.

After many tests the Brimar PA1 was found to be very suitable for use in this type of circuit. Its close electrode spac-

ing probably accounts for the good performance on 5 metres.

As will be seen from the circuit, regeneration is employed. This has to be used with care and when adjusting the circuit initially only sufficient capacity is required at C6, the reaction condenser, to cause the valve to oscillate. If too much capacity is used the valve will oscillate over too wide a band of frequencies, and on investigation it will be found that there

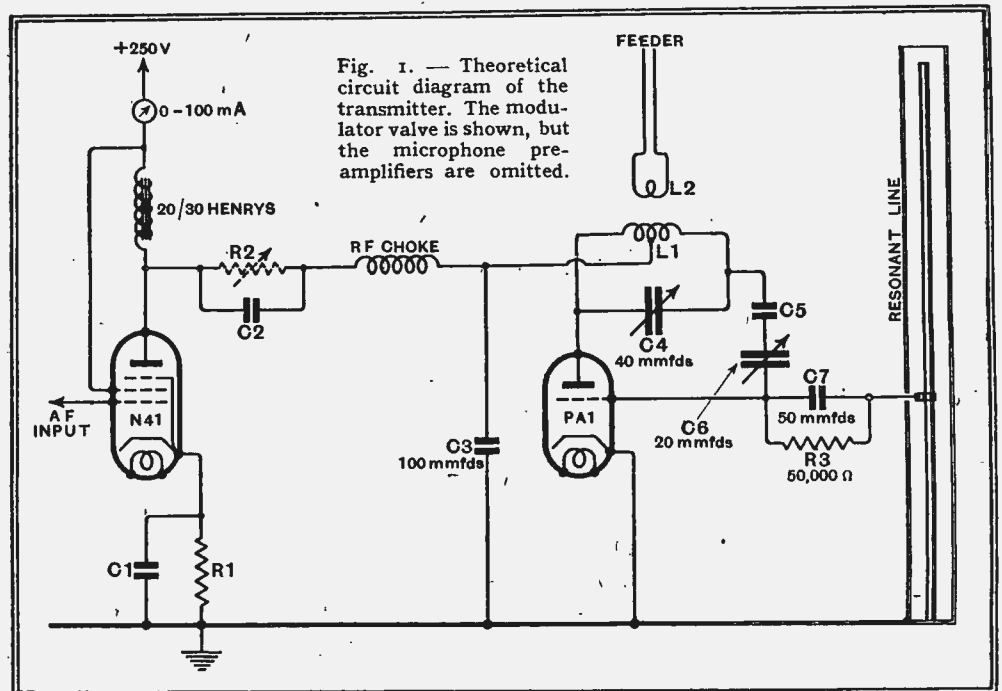


Fig. 1. — Theoretical circuit diagram of the transmitter. The modulator valve is shown, but the microphone pre-amplifiers are omitted.

**Portable Five-metre Transmitter—**

current and with the smallest capacity at C6. Incidentally, the fixed condenser C5 in series with C6 is only included to avoid damage to the valve should by any mischance the plates of C6 short-circuit, for C6 is a miniature air-dielectric type.

The HT can now be increased to full amount, i.e., 200 to 250 volts, and the aerial coupling adjusted. With this set an 80-ohm low-impedance feeder, Belling-Lee No. 344 cable, was used, joined into the centre of a half-wave dipole aerial. For 57 Mc/s the length of the dipole should be 8ft.

At the transmitter the feeder coupling coil L2 is located inside L1, and at the "earthy" point. It has two  $\frac{3}{4}$ in. in diameter turns of No. 16SWG wire. L1 has three turns of  $\frac{1}{2}$ in. copper tube spaced  $\frac{1}{4}$ in., and it is  $1\frac{1}{2}$ in. in diameter.

With a hot-wire ammeter, or a thermocouple meter if available joined in the feeder where it connects to the aerial, final adjustments are made to the coupling L1-L2, to the dipole for correct length, to C6

for maximum output at the working frequency, and to the grid tap on the line to give the maximum power in the aerial. A novel form of HT supply was used with this portable set. It was obtained from a Bulgian Electronic HT Vibrator, Type HTV1, and one of their MT5 transformers. The supply unit gave 250 volts at 60 mA after smoothing and proved a most reliable and convenient form of power for portable use. This enabled indirectly heated valves to be employed, and the whole set was powered by a 6-volt car battery.

In order to keep the total HT current within the limits of 60 mA the grid bias on the N41 modulator was increased slightly by fitting a cathode resistance, R1, of 150 ohms.

Though this transmitter is still in the experimental stage the results so far obtained are interesting, and it would appear well worth while following up the idea of using a concentric line as a frequency stabiliser in transportable 5-metre field equipment.

Strange that these two stations keep on playing dog-in-the-manger to one another! Hilversum *did* try a lower wavelength experimentally, but wasn't satisfied with the results.

Curious to notice how the reception of Athlone varies from place to place. At my home, some 30 miles North-West of London, I receive it quite clear of interference as a rule; but in Devonshire, where one would expect it to be stronger and equally clear, I found it badly interfered with by both Beromünster and Stuttgart when I was there a week prior to the writing of this note.

Jerusalem seems now to be troubling our North Regional much less than it did a year or so ago, when it interfered with local reception in places in north-eastern England; but I find that the 20-kilowatt Cairo is often to be heard after dark breaking, sometimes faintly, sometimes not so faintly, into the transmissions of Brussels No. 1. Those who worked out the Lucerne scheme had probably little idea that the Near East would make itself so strongly felt on Western European transmissions!

There is a third Hilversum station testing at present on 415.4 metres. The power rating is not stated, but I imagine that it must be modest, as the wavelength is shared with Bergen, Kharkov and Fredrikstad. I haven't yet heard "Hilversum Minimus," but I understand that it's sometimes to be picked up late at night, and I am hopeful of logging it before very long.

Another new transmitter still in the test stage is the 10-kilowatt Naples, which is to share the 271.7-metre channel with Kuldiga. This replaces the old 1.5-kilowatt plant which has long relayed the Rome programmes. D. EXER.

## Distant Reception Notes

SO, after all, Genoa has joined Turin and Trieste in a synchronised partnership on 263.2 metres; Radio Marconi (Bologna) has moved from 245.5 metres to share the 304.3-metre channel with Torun, and, for the moment, at any rate, there is no Italian station on 245.5 metres.

When I first heard that these changes were projected I gave the news with some reserve in these notes. I hardly thought that the Italian authorities would care to have the 24-kilowatt Torun as a wavelength partner for their 50-kilowatt Radio Marconi. The geographical distance between the stations is much the same as that between London and Leipzig and I have been told that the field strength of Torun in Northern Italy is considerable after dark.

In the circumstances it seems that mutual interference between these two bigish stations is unavoidable, even in their own service areas.

Under the Lucerne agreement the wavelength is shared by Italy and Poland. When the agreement was signed, Genoa, the then Italian occupant, was rated at 10 kilowatts and Torun at two. Poland had the option of using it for the 1.7-kilowatt Cracow.

According to the Lucerne terms "the power (as stated in the lists) will be modified, after agreement of the interested administrations, if experience, supported by measurements, shows that this modification is useful or necessary." One can't help wondering whether Poland *has* agreed!

In this country, after dark, the two stations jam one another hopelessly. But on 263.2 metres an extraordinary degree of perfection has been attained in the synchronisation of Genoa, Trieste and Turin No. 1: these stations can be heard with hardly a trace of "common-wave wobble."

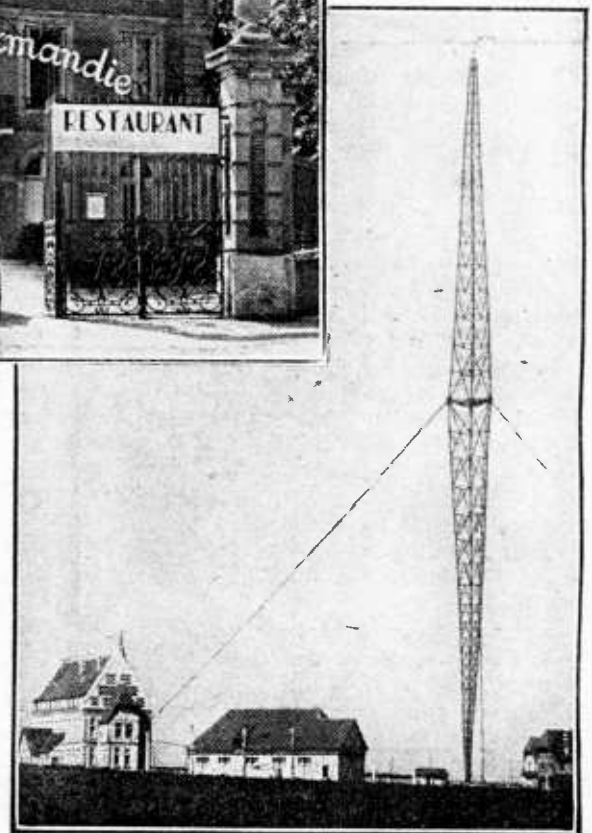
On 1,875 metres Hilversum No. 1 and Brasov still continue to make strange bed-fellows. The Dutch station is the more strongly heard here, but Brasov comes

through as a poisonous background and I hear that even in the Hilversum service area the interference is pretty bad. It must be fairly severe in Brasov's service area.



The new transmitter of the famous Radio Normandie station is situated at Louvetot, near the mouth of the Seine, some twenty miles from the old one at Fécamp. The studios are in the old-world town of Caudebec, not far from the transmitter. The new station is completely modern in every respect and, as will be seen from the photograph, employs an anti-fading aerial. The station buildings have been designed to follow what is known locally as "The Norman Style." Permission to put the new transmitter into action has not yet been granted by the French Government. M. Le Grand, who owns the station, is already famous in the district; his grandfather revived the distilling of the well-known Benedictine liqueur.

AN OLD FRIEND  
IN  
NEW GUISE





# Wired-Wireless Intercommunication Systems



OFFICE  
EQUIPMENT USING  
A MODULATED RF  
CARRIER

**T**HERE is a system of communication based on radio technique and of which very little has been heard in recent years. It will be familiar to readers as wired-wireless. It has now suddenly jumped into prominence, at least in the U.S.A., where the idea is being used for inter-office communication.

Two types of the carrier-current system, as it is called, are now available. One uses the electric light or power wiring as the conducting medium, while the other employs a two-wire transmission line. According to an article in *Electronics* of May last, the former type appears to be the more popular.

The circuit of a typical carrier-current system for use on the electric light wiring is shown in Fig. 1. As can be seen, it may be divided into three distinct units, viz., A, an RF oscillator, B, an AF amplifier, and C, an HT supply unit embodying a filter.

The necessary changes in the circuit for sending and receiving are effected by a three-position switch marked C, T and R; call, transmit and receive, respectively. It is thus a simplex-working system, and resembles a trans-receiver in its operation. Ultra-short-wave experimenters would probably recognise it as such if the output from the oscillator were coupled to a dipole aerial. The main difference, and this is an interesting point and which could possibly be embodied in a trans-receiver, is that the loud speaker is also used as the microphone. By adopting this arrangement the switching is considerably simplified.

It should be mentioned that when the switch is set to the receive position the oscillator valve is converted into a non-

oscillating grid detector and not used as a super-regenerative detector, as is usually the case in ultra-short-wave trans-receiving sets.

The limitation of the apparatus built to the circuit of Fig. 1 is that though any of the extension points can reply to the master control point only the latter can call them, and, of course, the change-over from send to receive has to be effected here also. Extension points cannot communicate with each other using this particular apparatus since it is not intended for that purpose, yet by suitable arrangement of the various units a complete inter-communication system could no doubt be evolved. The circuit in Fig. 1 will serve, however, to illustrate the basic idea of the system.

To attract the attention of the extension points an audio calling tone is generated, sometimes by feed-back in the AF amplifier, as employed in the circuit shown, or by using a neon lamp to generate the audio tone.

The function of the filter embodied in the HT supply unit is to keep mains hum out of the system, the various devices

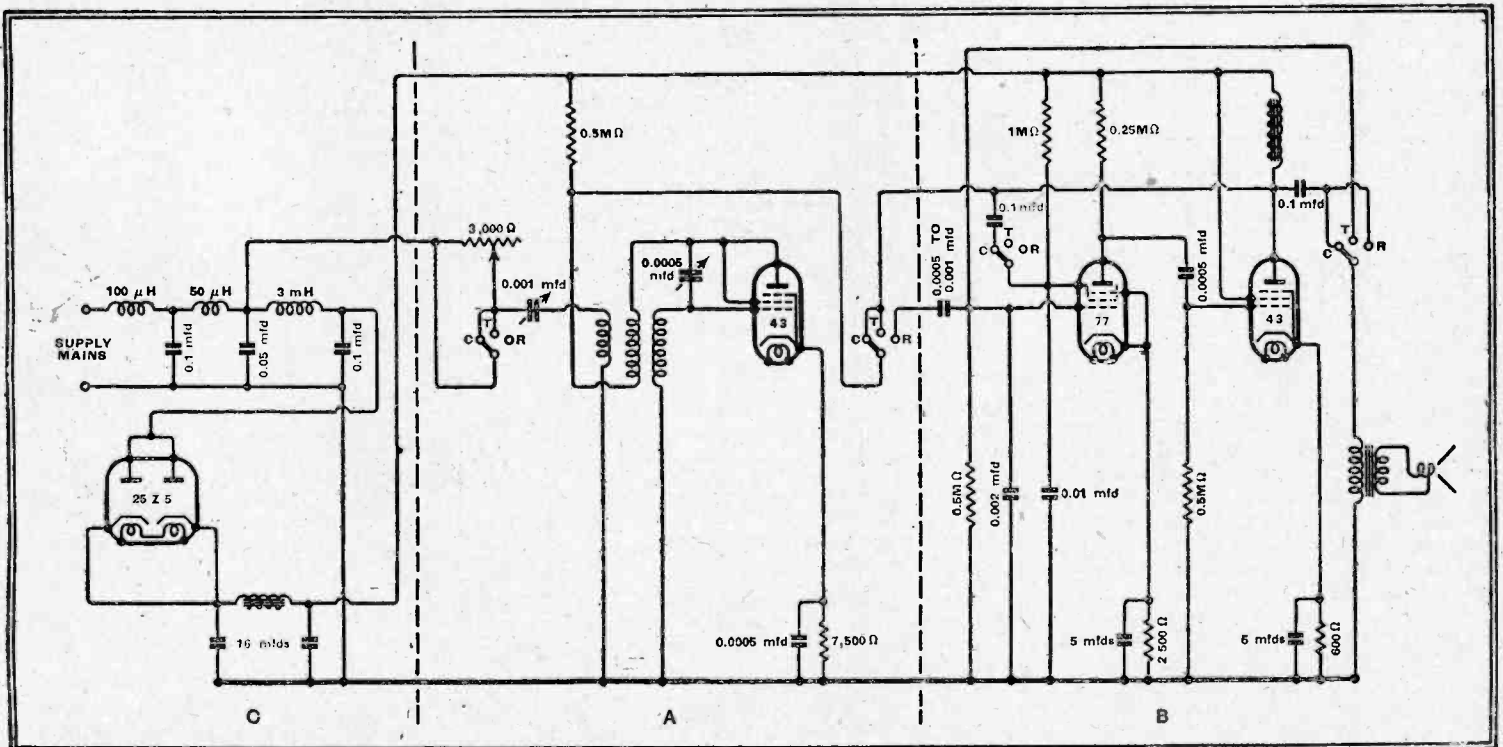


Fig. 1.—Theoretical circuit diagram of a carrier-current intercommunication system using the electric light wiring. Reproduced from *Electronics* of May, 1937.

**Wired-Wireless Intercommunication Systems**—used being either a high-pass filter or a band-pass filter.

One of the main advantages of the "power-line" carrier-phone system is that it is portable. It can be used anywhere, for it is entirely self-contained and independent of connecting leads other than the supply mains.

With an oscillator generating one watt or less of RF communication over power lines up to 2,500ft. or so can be assured, though much greater distances can be accomplished where the shunt resistance loading effect of electrical appliances connected to the circuit is reasonably high.

The electric lighting circuit cannot be regarded as a transmission line of known impedance since its impedance is continually changing as apparatus is switched on and off, so that the efficiency of the carrier-phone is not as a rule very good, hence the need for about a watt of RF to communicate over half a mile of wiring.

The "wired-carrier" system, to employ a term to distinguish it from the power-line type, employs a two-wire transmission line. Such a line will have a known impedance, and consequently greater efficiency is obtained, since the output circuit of the oscillator can be arranged to feed power into its optimum impedance. Lower RF power is needed and also less AF modulation power.

Precautions to keep the modulated RF within the bounds of the offices or building in which the system is installed are essential when the power-lines are employed, as anyone within a reasonable distance could "tap" the line and listen-in to the conversation. A suitable filter close to the mains switch or point where they enter the building or suite of offices will ensure secrecy. With the "wired-carrier" system this is, of course, quite unnecessary. It has not the advantage of portability, though if the transmission line is taken to each room this system would be as flexible as the other. H. B. D.

## TELEVISION-TELEPHONY IN GERMANY

THE success of the phonovision service originally inaugurated by the German Post Office in March, 1936, was very forcibly brought home to the public on the occasion of the recent rally of the National Socialist Party in Nürnberg. Eleven public televiewing rooms have been opened in Berlin and one in Potsdam, and in these the public were able to watch Herr Hitler leaving his car over 300 miles away and, a little later, saluting the crowd from the balcony of his hotel. These events were transmitted along the television cable to the Berlin television transmitter and radiated from there in the ordinary manner.

The television cable used was the ordinary one which was laid for the Television-Telephone service. It was laid originally between Berlin and Leipzig, but has now been extended to Nürnberg, and a recently completed extension to Munich is now undergoing tests. One hundred and eighty lines and twenty-five frames per second are used, and for this purpose a repeater station

is necessary every twenty-one miles. When eventually the higher definition of 441 lines is used, it is calculated that a greater number of repeater stations will be necessary, although the present cable is quite capable of dealing with the higher standard of definition.

In a recent experimental transmission a

distance of 1,100 miles was covered with forty-eight repeater stations. The sending and receiving ends were both in Berlin, the signals going to Leipzig and back. The cost of a television conversation between Berlin and any other place on the existing route is double that of an ordinary trunk call. It is proving exceedingly popular.

# Eavesdroppers in Albania

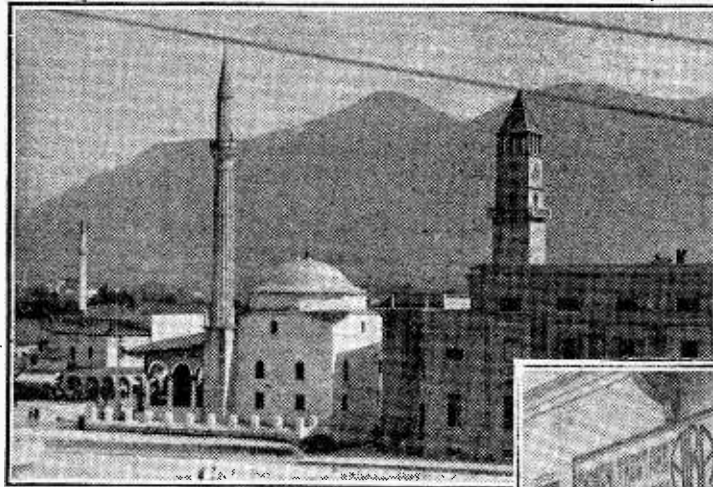
## IN SEARCH OF BROADCASTING

THERE are about two thousand listeners in Albania. This is a conservative estimate given me by the postal authorities. The Albanian listener does not pay a licence fee nor does he require to register his receiving set. Comparatively high rates of duty have to be paid on the sets imported, but even here the Government has recognised that broadcast listening has become a necessity and the duty is not as high as on purely luxury articles.

return on his capital. The Albanian peasant is too poor to buy a set, and community receivers in villages would again have to be paid for by the State.

There remains the possibility of a publicity station on the lines of Radio-Luxembourg. But there is no wavelength available, and it is doubtful if Italy would support Albania if it followed the Luxembourg precedent and "pirated" a wavelength.

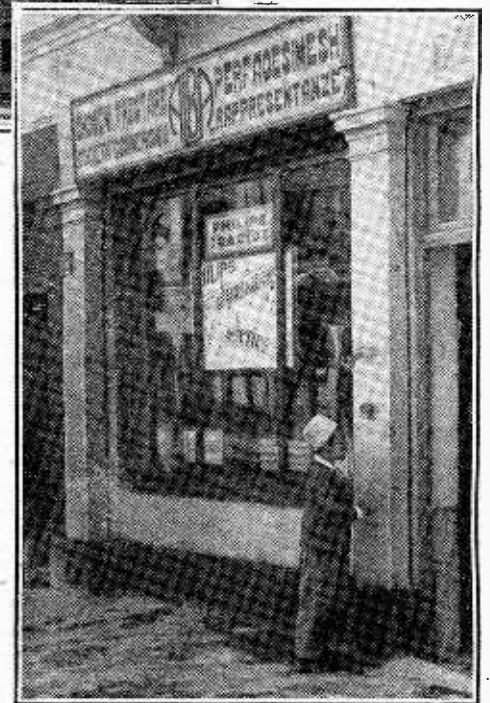
Most Albanian listeners are concentrated in towns where an electricity supply is available. Broadcast listening plays a very important part in the life of town dwellers, as it is their only means of direct contact with the artistic and cultural life outside the country, which



THE OLD AND NEW. Moslem mosques with their towering minarets rub shoulders with the modern buildings which house some of the Albania Government departments in Tirana.

With the completion of the new Bulgarian high-power station, and the new Greek station well under way, Albania remains isolated in the concert of European stations. To the great joy of the Albanian population who gather in front of the radio dealers' shops in the evening, the Italian station at Bari broadcasts a news bulletin in Albanian every day. Otherwise the Albanian listener would have to rely entirely on programmes in foreign languages.

The Government are open to suggestions for the erection of broadcasting stations, but under existing conditions it does not seem likely that Albania will obtain a station of its own for many years yet. The State has no money for investment in a broadcasting service. On the other hand, it would hardly be worth a private concessionary's while to invest capital in a station as the number of potential listeners would, for many years, be too small to enable him to secure an adequate



This radio dealer's shop was found in the old quarters of the capital.

itself possesses neither a theatre nor an opera-house. Occasional performances by amateurs and visitors to the capital are therefore the only distractions apart from the cinema.

"WANDERING WAVE."

# CURRENT TOPICS

## New Australian Naval Stations

AS part of Australia's re-armament scheme, new naval wireless stations are to be erected at Darwin and Canberra.

## Lightning Destroys Station

THE broadcasting station at Sordavala, Finland, has been completely destroyed by fire as the result of lightning striking the aerial. The only parts of the station to escape the flames were the aerial masts.

## Iceland Broadcasts in English

THOSE who possess all-wave receivers will be interested to learn that the Reykjavik station broadcasts in English every Sunday at 18.40 G.M.T. Apart from musical items, the programme consists of news from Iceland and a talk on a subject which is of interest to English listeners. The director of the Icelandic State Broadcasting Service would be very pleased to have reports from listeners in Great Britain, as well as suggestions for the improvement of the programmes.

## New Scandinavian Stations

THE 100-kW. transmitter at Horby, Sweden, has now been completed and is carrying out special tests after midnight. The date of the official opening has not yet been fixed. The new 6-kW. short-wave station at Skamlebaek, Denmark, will transmit daily from 19.00 to 21.00 G.M.T. on aerials which are directional on S. America and the Far East. From 21.15 to 23.30 G.M.T., transmissions will be made on aerials directed towards N. America and Greenland. On Sundays additional transmissions will be made from 13.00 to 15.50 G.M.T. in the case of the S. American and Far Eastern transmissions, and from 16.00 to 18.30 G.M.T. in the case of the others.

## The Single-Span Officially Banned

FURTHER trouble has arisen in Denmark over the fact that, as reported in *The Wireless World* of August 20th, a Copenhagen manufacturer has produced a single-span-type receiver which is advertised as being capable of receiving aviation, shipping, and military wireless transmissions. The Danish P.M.G. has now ordered

that the advertising of this type of set be stopped and its manufacture discontinued. In the event of the firm disregarding this order, it is likely that all sets of this type will be made illegal, even if home-constructed.

## New W/T Beacons

AT a recent Russo-Finnish conference held in Leningrad it was decided to erect a number of wireless beacon stations in the Gulf of Finland.

## Disharmony in Denmark

A SERIOUS dispute has arisen between the broadcasting authorities and the managers of the leading Copenhagen hotels and restaurants. The latter are claiming special fees for each broadcast from their establishments. Their demand has been turned down by the broadcasting authorities, with the result that a "strike" is threatened by the hotels. A similar dispute broke out two years ago in Sweden, where the restaurant proprietors were victorious.

## Holidays with Pay

SOME interesting revelations have been made to the Government Select Committee which is enquiring into this matter. Many important manufacturing firms, among which are numbered Philco and Columbia of wireless fame, have already arranged by voluntary agreement with the Trades Union Congress, to concede to all their employees one week's holiday with pay after twelve months' service.

The operatives from the Marconi works at Chelmsford have recently enjoyed a week's holiday with pay, this being introduced for the first time this year, together with many improved working conditions, including a pensions scheme.

## How Old is Your Set ?

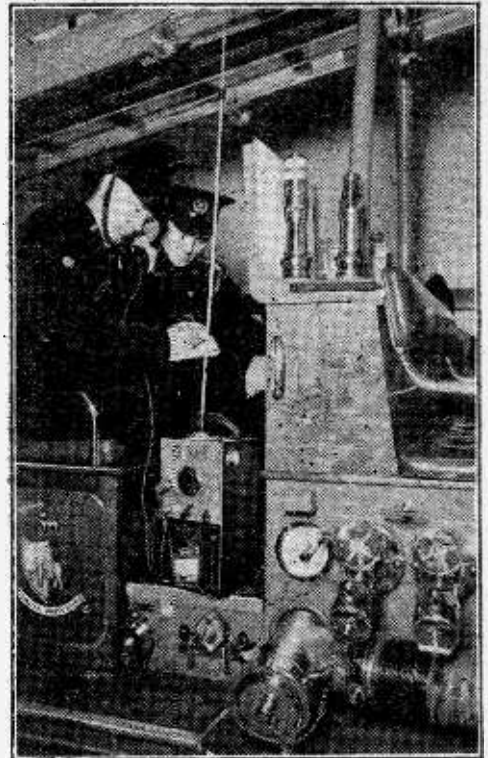
DURING the past year the Philco concern has carried out a novel house-to-house canvass to obtain information from people concerning their wireless sets. Over 5,000 families were visited in seventeen different towns and cities.

Of those questioned who possessed receivers, 14.5 per cent. used home-made sets. The remaining receivers were produced by 213 different manufacturers, although 80 per cent. of them were made by twenty manufacturers. Nearly 5 per cent. of the people did not know what make of set they used. Sixty per cent. of the

## EVENTS OF THE WEEK IN BRIEF REVIEW

### RADIO AID TO FIRE-FIGHTERS.

Small 1½-watt five-metre transmitter and receiver used by the Coventry City Fire Brigade to effect two-way communication with headquarters. The experimental sets have proved so satisfactory that permanent installations are now contemplated. The headquarters station G8YH operates on a fixed frequency of 56 Mc/s.



sets were more than two years old. Seventy-five per cent. of the people visited had never bought a new valve; does this prove either the great reliability of valves or the atrocious quality of reproduction which satisfies many people.

Probably the most interesting thing of all was that 42 per cent. of the people voted for quality of reproduction as being the most important feature of a set, while only 5 per cent. voted for long-range and 7 per cent. for high selectivity.

### Trawlers on the 'Phone

OWNERS of all-wave sets have for some time past been able to hear telephony on 163.3 metres between the shore and certain small coastwise craft such as trawlers. This has now been made part of the ordinary telephone service, and anybody can call up a trawler which is equipped with wireless telephony and is within a hundred miles or so of Liverpool or Grimsby. The cost is 7s. for a three-minute conversation, 2s. 4d. being charged for every additional minute. It is only necessary to ask the exchange for the Seaforth or Humber Ships Telephone Service according to whether the vessel is off the West or the East coast.

### Germany and Components

WIRELESS manufacturers in Germany, following the lead of other industrialists, are making great efforts to produce synthetic substitutes for the various raw materials which they have been accustomed to rely upon. In the course of their researches industrial chemists and metallurgists have evolved many substances of

considerable value in wireless work. This particularly applies to ceramic materials. A new substance known as Condensa has been produced having an exceedingly high dielectric constant, thus enabling high-capacity condensers to be made with very small physical dimensions. Another useful insulating material that has been produced is known as Ergon.

The German Government is making a big effort to take the world lead in the ratio of wireless listeners to population, and with this end in view the price of the People's Set has been reduced by some 25 per cent.

### The Copenhagen Show

OVER 60,000 people visited the recently held wireless exhibition in the Danish capital. This figure is equal to 7½ per cent. of the population of the city, a record which even Radiolympia cannot equal. Twenty-five Danish firms exhibited. On the whole, sets were more costly than those shown at Olympia.

### Classes in Moulding Technology

EVENING technical classes dealing with synthetic resins and plastics generally are to be conducted by the Borough Polytechnic, Borough Road, London, S.E.1. Elementary courses are arranged for those who have little or no knowledge of chemistry but wish to learn something of the possibilities and applications of plastics in industry. More advanced courses are available for students who have had some training in chemistry and engineering. The session begins on September 27th.

# Resistance-Coupled

**PROPERLY** used, the resistance-coupled pentode is highly satisfactory in intermediate stages for wide-range amplification at both audio and vision frequencies. Correct operating conditions are discussed at length in this article.

## THEIR USES IN AF AND VF AMPLIFIERS

Contributed by the Laboratory Staff of the Amalgamated Wireless Valve Company Ltd. (Australia)

**T**HE increasing interest in television has brought with it a flood of new ideas, and not a few older schemes have found themselves applied in a newer and brighter environment. When it was found necessary to amplify complex waves having harmonics with frequencies up to many thousands, even millions, of cycles per second, the triode let us down. It was too sluggish. There was an input capacity to charge before it thought of real work, and it was generally ruled out. Ordinary screened grid valves had less input capacity but suffered from another serious defect; their output voltage was limited. It was a case for the screened pentode.

Though everyone recognises the virtues of the pentode at high radio frequencies, its possibilities as a resistance-coupled audio amplifier seem to have been overlooked. The universal belief in "Triodes for Quality," while true enough in relation to the power valve, has doubtful significance elsewhere. Is it realised that a pentode can deliver more volts undistorted output over a wider band of frequencies—extending both ways—with a gain comparable with a triode and a half? To provide a core of truth to such apparently hollow statements, they must be proved.

Any readers who may be doubtful as to the superiority of the pentode at higher frequencies are referred to Cocking's recent articles in this paper. The amplification at very low frequencies presents a more complex problem.

The basic formula for the stage gain of

an amplifier is founded on the fact that, hypothetically within the valve, a voltage is developed equal to the product of the alternating voltage on the grid ( $E_g$ ) and the amplification factor ( $\mu$ ) of the valve. Due to the anode resistance ( $R_a$ ), a certain voltage is lost on the way to the anode load impedance ( $Z_L$ ). The gain ( $m$ ) is the ratio of the voltage output ( $E_o$ ) to the voltage on the grid ( $E_i$ ) and the formula may be set out:

$$m = \frac{E_o}{E_i} = \frac{\mu Z_L}{Z_L + R_a}$$

which may also be written

$$m = \frac{gm}{\frac{1}{Z_L} + \frac{1}{R_a}} \quad (1)$$

where  $gm$  is the mutual conductance of the valve.

There is also a potential drop across the coupling condenser tending to reduce the gain still more. However, as the factor is the same for triodes as for pentodes, it is sufficient to recognise its presence and pass on.

When triodes are used,  $R_a$  is (or should be) less than  $Z_L$ , making the term  $1/R_a$  greater than  $1/Z_L$ . Small increases in  $Z_L$  under such circumstances make little change in the gain  $m$ . However, the anode resistance of a pentode, when resistance coupled, is generally in the order of megohms, and the term  $1/R_a$  is very much less than  $1/Z_L$ . The value of the load thus takes charge, and at low frequencies, when the reactance of the coupling condenser rises, there is a definite increase in the alternating voltage  $E_o$  on the anode due to the increase in the load impedance. Of course, the drop in the coupling condenser tends to increase more rapidly than the gain, but the pentode continues to amplify at lower frequencies than the triode under the same conditions.

If an amplifier were free from amplitude distortion, the anode voltage would vary in strict proportion to the grid voltage. If the anode voltage were plotted against the grid voltage, the resulting "curve"

would be a straight line as shown in Fig. 1.

When the anode voltage is plotted against the grid voltage of a practical amplifier, the shape of the characteristic is a measure of the distortion introduced. J. A. Hutcheson\* of Westinghouse in U.S.A., has described a method of calculating the individual distortion factors of all harmonics from direct measurements on such a dynamic characteristic.

If the load is assumed to be a pure

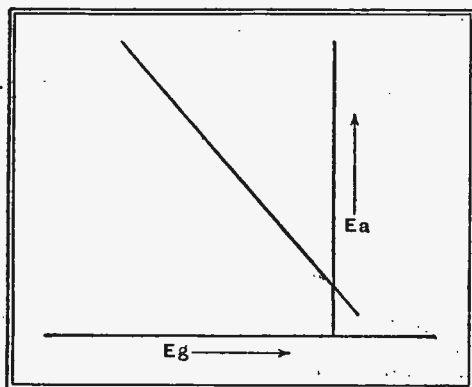


Fig. 1.—Anode volts/grid volts curve of an ideal amplifier free of amplitude distortion.

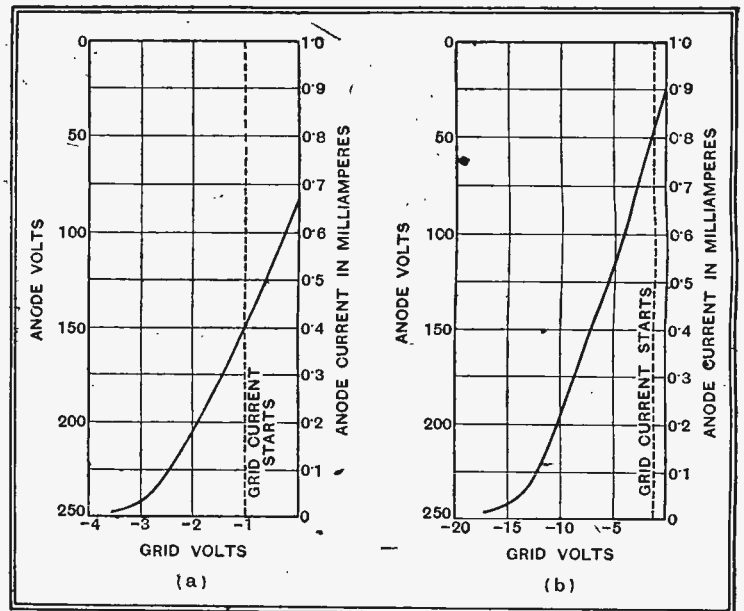


Fig. 2.—Characteristics of low-impedance (a) and high-impedance triodes, (b) showing both anode current and anode voltage.

resistance, it is sufficient to measure the anode current, with which its voltage drop will vary in exact accordance. The actual anode voltage is the difference between the supply voltage (less the decoupling drop, if any) and the drop in the load. The anode current scale may be calibrated in volts as well as milliamps, as has been done in Fig. 2 (a) and (b) for high and low impedance triodes. Grid current commences to flow at approximately one volt negative in most oxide coated cathode valves and the respective peak voltage outputs at 3% distortion in the two valves (a and b) are 39 and 88 volts, both without additional AC loading.

When an attempt is made to plot such a curve for a pentode, another variable is encountered—the screen potential. A family of curves is the result. It is seen from Fig. 3 that the gain and anode bend

\* J. A. Hutcheson; "Graphical Harmonic Analysis," *Electronics*, January 1936, p. 16.

# Pentodes

distortion vary very little with changes of grid voltage. There is, moreover, a correct grid bias for any screen voltage one may choose. This points out an important fact about pentodes—that the mutual conductance is better plotted as a function of anode current than of screen or control grid voltage.

It must be observed that by operating the screen grid of this valve at a voltage of about 40 or more, one may escape the effects of grid current and enjoy the full benefit of the straight part of the characteristic. On the other hand, as the screen voltage is increased, so the characteristic becomes more and more curved, and the available undistorted voltage output becomes correspondingly less. Further, high screen voltages require high values of bias voltage. Bias costs money, even so-called "free" bias being provided at the expense of HT voltage. It is advisable to compromise and the 40V curve satisfies the case.

## Advantages of the Pentode

The gain may be taken as the ratio of the output to input voltages. In Fig. 2 the stage gain factors of valves (a) and (b) are 55 and 17.2 respectively. In Fig. 3, the factor is 150, which is vastly greater. When one considers the extra loss at both high and low frequencies incurred by the use of two triodes, the pentode appears even more advantageous.

To avoid the plotting of families of curves like Fig. 3 for all valves and all loads, a more expeditious general method was developed to determine the correct screen voltage for a given bias voltage, and vice versa.

It is obvious from Fig. 3 that the plate current is the criterion for correct working.

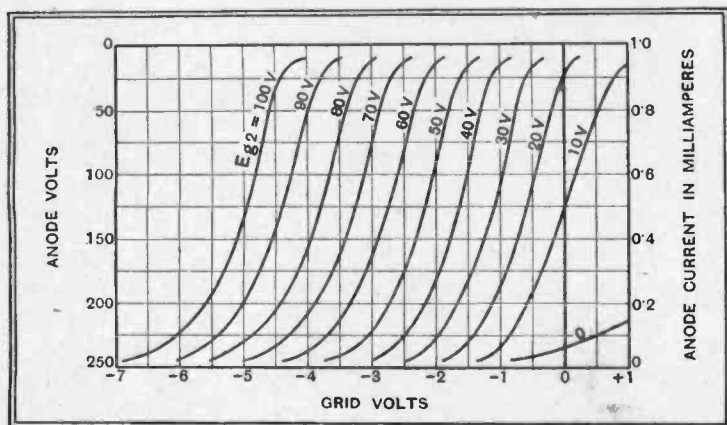


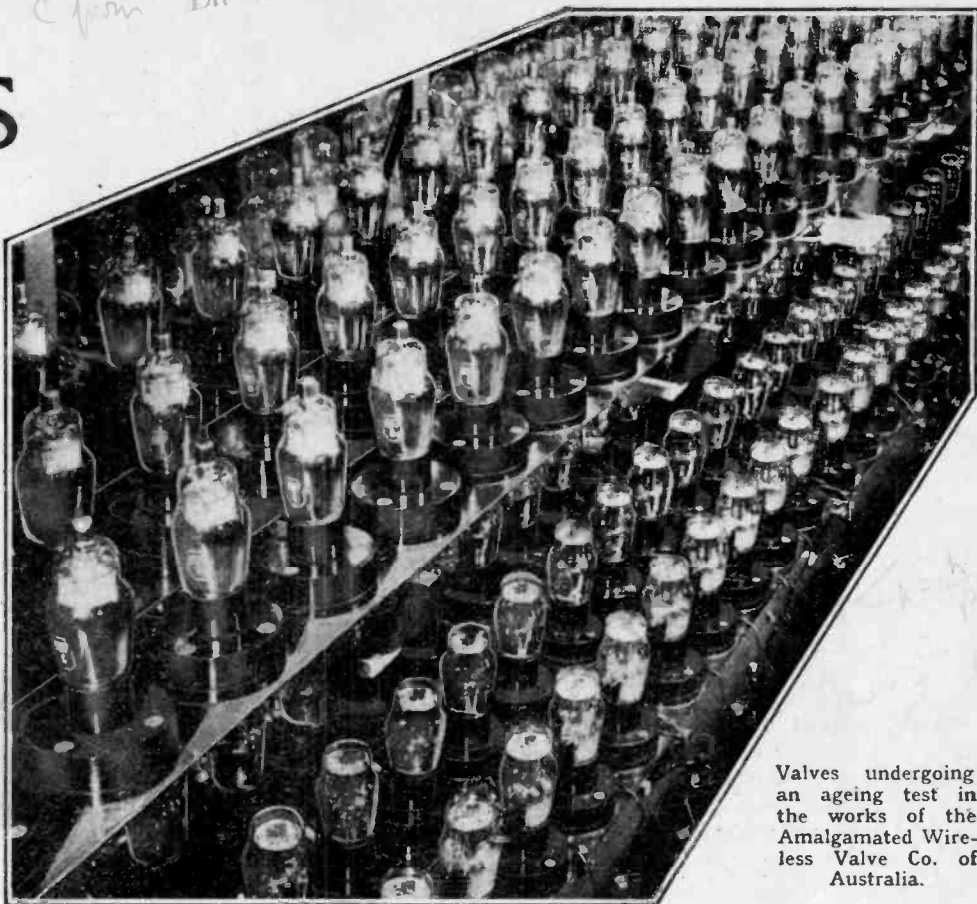
Fig. 3.—Family of curves for a pentode valve with various screen potentials (Eg2). Load resistance, 0.25 megohm; anode supply voltage, 250.

As the bottom, or cut off, bend is longer than the sharper top, or "saturation" bend, the straightest part of the curve is found to extend equally about a point

corresponding to a little over half the maximum plate current. A satisfactory arbitrary point appears to be 0.55 of the maximum plate current. It is necessary to fix a relation between control and screen grid voltages for that current.

First consider some pentode peculiarities. Pentodes have been called "constant current" valves, by which the engineer understands that large changes in anode voltage result in small changes in anode current, or, more briefly, that the valves have high anode resistance. It may be said that the anode current is practically independent of changes in anode voltage. If, however, the screen voltage is varied the change in anode current is considerable. The control and screen grid voltages tend to fix the anode current independently of anode voltage. Another important pentode feature is the almost constant ratio of the screen and anode currents. When the screen grid is connected to the anode, we have a triode in which the total cathode current is divided between the plate and screen in a known ratio.

If a family of anode current/anode voltage curves are plotted for such a triode, the cathode current may be found for any control and screen grid voltages.



Valves undergoing an ageing test in the works of the Amalgamated Wireless Valve Co. of Australia.

It is a simple matter of proportion to determine the anode current. Say a pentode passes an anode current equal to  $I_{a1}$  under the manufacturers' "standard" rating conditions of perhaps — 3 volts bias and 100 volts on the screen grid. Call its screen current  $I_{s1}$  under the same conditions. Its cathode current is  $I_{a1} + I_{s1}$ , and the ratio of plate to cathode current will be  $I_{a1}/(I_{a1} + I_{s1})$ .

For the purposes under consideration, it is necessary to fix the converse—the grid and screen voltages for a given anode current.

The cathode current should be

$$I_k = \{(I_{a1} + I_{s1})/I_{a1}\} \times 0.55 \frac{E_s}{R_L} \quad (2)$$

where  $E_s$  = supply voltage

$R_L$  = load resistance.

In Fig. 4 is a family of "triode"  $I_a - E_a$  curves for the 6C6 valve used in Fig. 3. A straight line drawn parallel to the  $E_a$  axis at  $I_a = I_k$  cuts the grid voltage curves at the optimum screen voltages.

## Correct Bias Voltage

As mentioned before, for the sake of linearity and economy, the grid bias voltage should be kept to a minimum. Its value should be the sum of the grid current commencement voltage and the maximum peak input signal voltage. The output peak voltage may be taken as approximately 40% of the HT supply voltage for most pentodes. Knowing the gain ( $m$ ) from the equation (1), the peak input voltage may be calculated:

$$E_i = \frac{E_o}{m} = 0.4 \frac{E_s}{m} \text{ volts}$$

*C from I<sub>s</sub> curves = I<sub>A</sub> + I<sub>S</sub>*

**Resistance Coupled Pentodes—**

The minimum bias is thus (for AC valves)

$$E_{g1} = 1 + 0.4 E_s/m \text{ volts} \quad (3)$$

from which the screen voltage may be determined by reference to the "triode" curves of Fig. 4.

If the screen grid is supplied from the HT supply voltage through a dropping resistor, the stage tends better to adjust itself for loss of valve emission or change of valve. As the plate and screen currents tend to fall, so the screen voltage rises, finding for the valve a new operating point close to the optimum. Self bias is a further help, and when operated with both screen dropping and cathode bias resistors, the anode current remains almost constant while the emission may vary within fairly wide limits.

Knowing the required screen voltage ( $E_{g2}$ ) and screen current (from its ratio of  $I_k$ ) the value of the dropping resistor ( $R_s$ ) is calculable:

$$R_s = (E_s - E_{g2}) R_L I_{a1} / 0.55 E_s I_{s1} \quad (4)$$

Very often it is found that the resistance thus determined is of some fractional value well in the order of megohms. Whereas it is comparatively easy to wind a bias resistance of an odd value it is not often as easy to buy or make some non-standard value of high resistance.

Knowing our calculated values of screen and grid bias potentials to be the *minima*, and that we may increase them together slightly without disturbing the characteristic of the stage, it is sometimes easier

the voltage axis at  $E_s$  and the current axis at

$$I = E_s(I_{s1} + I_{a1}) / I_{s1} R_{s1}$$

The bias resistance ( $R_k$ ) is calculated:

$$R_k = E_{g1} / I_k$$

Where  $E_{g1}$  is the bias voltage. Let us take the 6C6 valve (Figs. 3 and 4) as our example.

Under the standard conditions of  $E_a = 250$ ,  $E_{g1} = 3$ ,  $E_{g2} = 100$  volts, we have the ratings.

$$I_{a1} = 2.3 \text{ mA}, I_{s1} = 0.6 \text{ mA}$$

If the supply voltage,  $E_s = 250$ V and the load  $R_L = 0.25$  megohm

$$I_k = \frac{2.9 \times .55 \times 250}{2.3 \times 250} \text{ (from (2))} = .68 \text{ mA}$$

To find the gain we have

$$m = \frac{gm}{\frac{1}{R_p} + \frac{1}{R_L}}$$

From published curves,

$$gm = 680 \text{ micromhos at } I_a = 0.55 \text{ mA}$$

$$R_a = 2 \text{ megohms}$$

$$m = \frac{580 \times 10^{-6}}{(0.5 + 4) \times 10^{-6}} = 150$$

The minimum bias

$$E_{g1} = \frac{1 + (0.40 \times 250)}{150} = 1.6 \text{ volts}$$

From Fig. 4,  $E_s = 39$  volts

The dropping resistor (from (4))

$$R_s = \frac{(250 - 39) \times 0.25 \times 10^6 \times 2.3}{0.55 \times 250 \times 0.6} = 1.47 \text{ megohm}$$

which is an odd value.

Let us say  $R_s = 1.25$  megohm.

Its load line should be plotted through the points 250V, 0 mA and 0V,  $250 \times 2.9 / (0.6 \times 1.25 \times 10^6) = .96$  mA.

It is seen to intersect the line ( $I_k = 0.68$ ) at  $-3.5$ V.

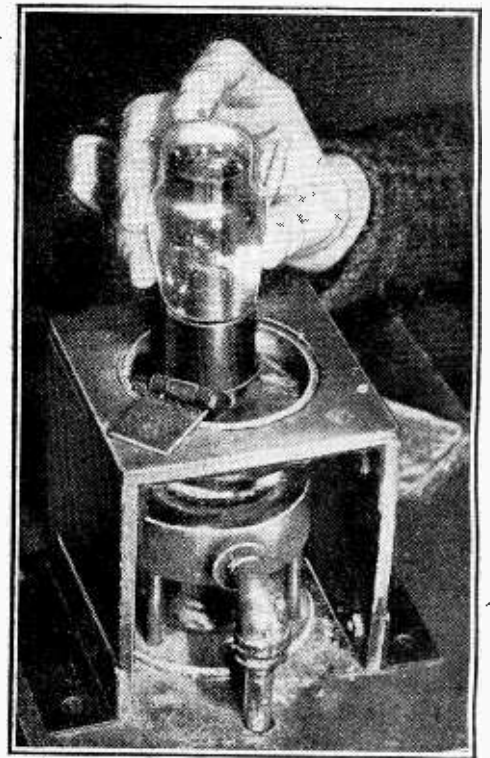
The cathode resistor,

$$R_k = \frac{3.5}{(6.8 \times 10^{-3})} = 5150 \text{ ohms}$$

Although the pentode provides "bigger and better" amplification than the resistance coupled triode, its application is not without difficulties. In Fig. 5 we have an outline circuit of a resistance coupled stage.

If there is any ripple in the HT supply, either due to lack of filtering or signal voltage finding its way into the supply, a certain portion of the voltages will appear at the grid of V2. It must make its way to the grid through  $R_L$ , where it meets the alternative paths of  $R_g$  and the  $R_a$  of V1. There is, in effect, a voltage divider between HT positive and negative.

When  $R_a$  is low, there is only a small ratio of the total ripple on the grid of V2. The pentode plate resistance may easily be greater than the grid resistor of  $R_g$ , and much greater than  $R_L$ , causing a large part of the total ripple to be injected.



Soldering the valve pins in one simple operation.

When a pentode is used, more elaborate decoupling is therefore required, and in multi-stage amplifiers, such as those used for television, it may be necessary to use some voltage stabilising device such as a gas-discharge tube to avoid instability.

Though the "triode" anode current/anode voltage curves for high plate resistance pentodes find ready application in the graphical method of analysis described, the reader should note their other, and equally important use for determining the operation of such valves as triodes, when their anodes and screen grids are connected. They will usually be found quite as useful as ordinary low impedance triodes, with the additional advantage of a top-cap grid connection. Thus the number of valve types may be reduced and standardisation improved. It was with that idea that the curves were originally drawn. They have proved doubly useful.

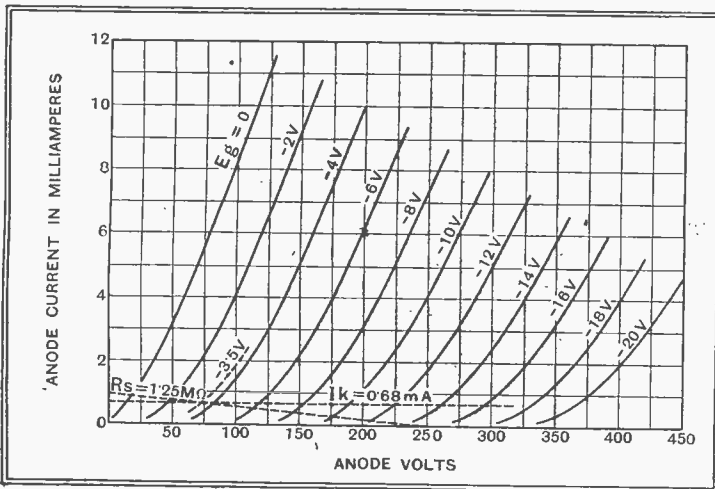


Fig. 4.—Family of curves for a 6C6 pentode connected as a triode.

to employ some standard value (less than the calculated value) of screen resistance, and establish a grid voltage to suit.

As the screen current is a definite fraction of the cathode current, the curves of Fig. 4 hold good for the screen as well as the total current, and one need only divide the currents of the curves by  $I_{s1} / (I_{s1} + I_{a1})$  to find screen currents in terms of control and screen grid voltages. By plotting a load line for the dropping resistance using the new scale of current, the required bias is found from its intersection with the optimum current line.

The process is simplified by plotting an equivalent load line without recalibrating the current axis. It is drawn through

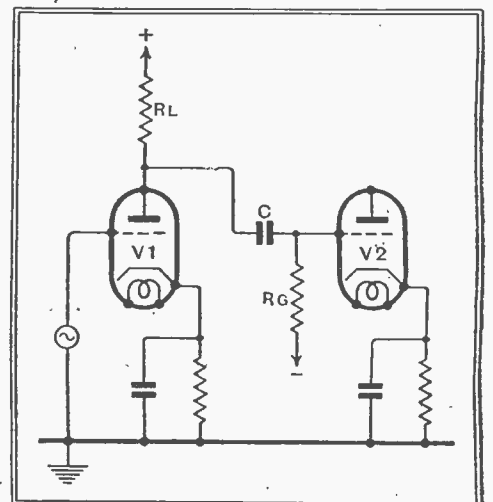


Fig. 5.—Skeleton circuit diagram of a resistance-coupled stage.

# BROADCAST BREVITIES

## Stagshaw Wakes Up

THE B.B.C. engineers, as recommended in these columns a fortnight ago, have pepped up the work on North-East Regional, and Novocastrian listeners will soon lose that anxious look which comes from straining to hear a 1-kilo-watt transmitter of 1923 vintage.

## Opening Date

Stagshaw, to give the new station its waggish-sounding title, will be opened officially by Her Grace the Duchess of Northumberland on October 19th. On the previous day a handful of Press representatives—the station premises are too small to admit many people—will see the works and hear the generators warming up.

## And Now . . . East Anglia

Taking Newcastle's wavelength of 267.4 metres, Stagshaw will officially serve the counties of Westmorland, Durham, Cumberland, Northumberland and North Yorkshire, all of which have been lamentably outside the pale since broadcasting started. Indeed, the only comparable dark areas must be places like Madagascar and East Anglia, both of which rely on propaganda broadcasts from abroad.

## Why Not a Relay?

By the way, what has become of that reassuring rumour of a 5 kW. relay station at Norwich?

## Daventry and South America

LORD HAILSHAM has been suggesting that British nationals in South America are badly served by the B.B.C. Empire station.

In justice to the B.B.C. it should be emphasised that the Daventry transmitters are intended primarily to cover the red portions of the world map. Happily enough, great chunks of the rest of the world come within the Daventry orbit, but this is largely fortuitous.

## An Evening Programme

As it happens, South America gets fairly reliable reception from the Empire Station for four and a half hours per diem. One of the Daventry aerial arrays is directed towards South America each night from 10 p.m. to 2.30 a.m. (B.S.T.) for the transmissions B4 and 5, which are received during the South American evening between teatime and bed.

## Extended Service?

Since the middle of May reception reports have been con-

sistently good. In fact, the results have been so encouraging that Portland Place is considering an extension of hours for South America. Which is a good thing, for Germany is already giving a South American service of nearly eight hours a day.

## A Fifteen-second "O.B."

A TRANSATLANTIC broadcast lasting only fifteen seconds was staged at Croydon last week by arrangement with the American National Broadcasting Company.

For their Magic Key programme on September 19th N.B.C. wanted an authentic conversation between a 'plane pilot and the Croydon control tower. A 'plane was chartered, lines were engaged, and the conversation was tapped at the control tower receiving point, conveyed by landline to Rugby and transmitted by beam to America. The thrill lasted only a quarter of a minute, but America was happy.

## Symphonies Are so Exciting

PEOPLE who can't tell the difference between the National Anthem and "Rule, Britannia" will never hear ear to ear with Sir Walford Davies, but as the vast majority of listeners are not in this category it is a pity that a forthcoming series of talks by Sir Walford will be restricted to the school broadcasts.

His main thesis will be that music can talk, and it will be evident that, to Sir Walford at least, a symphony can be as exciting as a gangster play.

## Beethoven's Expletives

By means of examples he will show that the great composers not only made definite remarks, but indulged in innuendo and repartee. Nay, more than this, they gave vent to expletives!

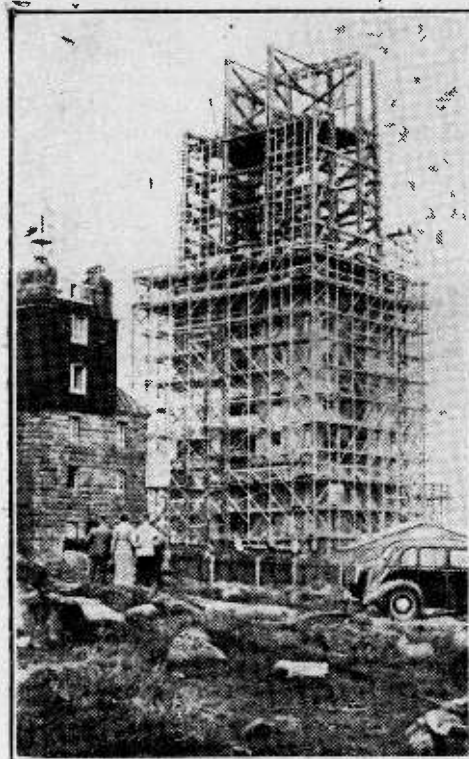
Sir Walford has found some beautiful expletives in Beethoven's sonatas, not to mention a few of the milder sort in the works of Chopin.

## Speech Waveforms

Children will also score over their elders on October 5th, when Professor Lloyd James gives a schools broadcast on "How We Talk." The artificial production of human speech waveforms has been attempted in laboratories with very little success. Professor Lloyd James will show why. He has col-

## NEWS FROM PORTLAND PLACE

GERMANY'S A.P. As this photo shows, work is proceeding apace on the German television station which is being erected on the Brocken, the highest point in the Hartz Mountains. This is one of three transmitters to be built, the others being on a peak near Frankfurt and in the Witzleben tower in the Berlin exhibition grounds.



lected a number of interesting records of animal cries which will be broadcast during the talk. These demonstrate that most animals are physically incapable of creating any of the complex waveforms which go to make even the simplest word in human use.

The voices of certain primitive tribesmen, records of which will also be heard, suggest that they, too, would be unable to "get their tongues round" many of the words which a B.B.C. announcer could utter with a mouth full of canteen biscuits.

## Television Signal Strength

ALTHOUGH the Pinewood Film Studios at Iver, which are to be televised from September 30th onwards, are at least 17 miles from Alexandra Palace, the engineers in charge of the mobile television unit have satisfied themselves that there will be no repetition of the trouble experienced at Hatfield, only 12 miles from the Palace.

In the case of the King's Cup Air Race television was working over an unknown territory, full of "pretty" country from the landscape artist's point of view, but bristling with screening of all kinds, especially hills and woodland. The plain fact was that the ratio of signal strength to interference was not good enough.

## Better Aerials

The country around Iver is familiar ground to Marconi-E.M.I. engineers (Hayes is not so very far away), and transmission tests have yielded good results. Moreover, improved aerial arrangements, both transmitting and receiving, are now in hand.

## Records and Copyright

GRAMOPHONE connoisseurs should make a point of listening to the late gramophone recitals between 11.30 and midnight. Regional is often devoted to the latest and most bizarre "hot" records from America, and National to foreign records not usually met with in this country.

Copyright difficulties are highly ticklish in the case of these exotic importations, and announcers have to be extremely careful to see that all interests are satisfied before the most innocuous-looking record is put on the turntable.

Always there is the possibility that a Balkan or Mediterranean poet and/or musician is listening in and can prove plagiarism.

## A Viewer's Gratitude

A GRATEFUL viewer in Brighton recently offered the B.B.C. half a guinea "towards the Television Programmes Fund, if such exists." In a 'phone message to Alexandra Palace he said: "I have always thought that the B.B.C. gave us pretty good value for ten shillings a year; now that we get vision as well as sound it would be a good idea if viewers could subscribe, if they wish, towards the cost of the programmes."

Unfortunately, perhaps, the B.B.C. has been forced regretfully to decline the offer. Under its Licence, "the Corporation shall not, without the consent in writing of the Postmaster-General, receive money or any valuable consideration from any person in respect of the transmission of messages."

A television picture must be regarded as a message.

# Broadcast Propaganda

## A PLEA FOR THE PEACEFUL EXPRESSION OF THE OTHER MAN'S POINT OF VIEW

By "WANDERING WAVE"

*IN this article "Wandering Wave" discusses the vexed question of broadcast propaganda and puts forward suggestions of his own for dealing with the abuses which arise. How far his ideas would help, if put into practice, is an interesting subject for conjecture.*

**T**O some people the very word "propaganda" has a nasty sound. They seem to think it synonymous with violent political agitation. To be accurate the word propaganda means no more than publicity. It is derived from the verb to propagate, and commercial publicity and propaganda are really the same, except that publicity sets out to make goods sound and look attractive to would-be buyers, whereas propaganda concerns itself with ideas and other less tangible things.

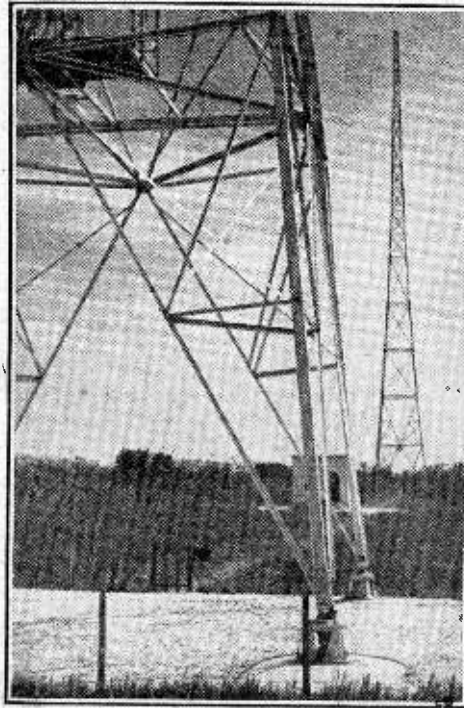
In the very early days of broadcasting only a comparatively small number of people realised the full value of the new medium. Wireless waves are not limited by boundaries or frontiers. Idealists, appreciating this, welcomed radio as a great power for peace. They believed, and I think some of them still believe to-day, that from the very fact that a man in A can listen to the voice of a man in B they will never want to fight against each other, because the man in A realises that the man in B is the same as he is, with the same troubles and problems—in fact, just a human being. So far, developments have shown that the effect of propaganda broadcasts directed against others has been enormously greater than the effect of "good will" broadcasts at New Year and

other times, and of greater influence than European or other concerts. It is very nice to hear an opera from New York relayed by the London station. But the propaganda value for peace of such a programme is remarkably small compared with the effect of a political broadcast from one country listened-in to by a revolutionary community in another.

If broadcasting is to be used in the cause of peace, the pro-peace programmes must be just as efficient as others.

Members of the International Broadcasting Union at Geneva realised that radio could easily be used by nations for furthering their foreign policy. A gentleman's agreement was arranged according to which members undertook not to broadcast "unfriendly" propaganda; the exact term used was "propaganda inadmis-

sible." This agreement broke down at the Amsterdam Conference in 1933, but even before that some broadcasting authorities had found it more expedient to make separate arrangements with the broadcasters in neighbouring countries regarding certain differences rather than rely on the operation of a general agreement.



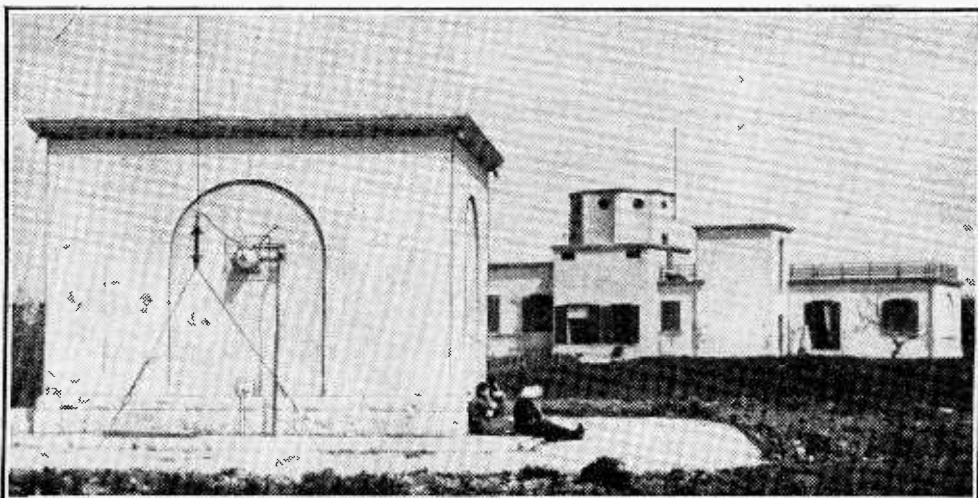
The aerial masts, and between them the tuning hut in which the aerial down lead terminates, of the Bari station.

The League of Nations took up the matter, and last September an international covenant concerning the "Use of Broadcasting in the Cause of Peace" was elaborated and signed at Geneva on September 23rd, 1936, by the representatives of eighteen nations without reservations, and by three more with the reservation that they should retain for themselves the right "to jam offensive transmissions

emanating from another country." Since then six other countries have added their signatures. As far as Europe is concerned, Germany, Hungary, Poland, Latvia, Sweden, Finland, Italy, Yugoslavia, Bulgaria, are among those countries which have not signed. Greece, Albania, and Luxembourg are among the signatories, which include Chili, Mexico, the Argentine Republic, the Dominican Republic, Columbia, Brazil, Egypt, New Zealand, British India, Uruguay, Great Britain and Northern Ireland, France, Rumania, Holland, Switzerland, Czechoslovakia, Turkey, Estonia, Lithuania, Norway, and Belgium, Spain and the U.S.S.R. with reservations. But, as only three of the six ratifications necessary to give effect to the Convention have as yet been obtained, there is no valid international agreement at the moment regarding the use of broadcasting stations for international propaganda.

### Distasteful Publicity Programmes

Aggressive broadcasts draw protests from the nation they are directed against, but these protests are not always effective. British officials have frequently protested against the publicity programmes directed to British listeners from French stations,



The transmitter buildings of the Bari station which operates on 283.3 metres and has a rated output of 20 kW.



**Broadcast Propaganda—**

but they still continue. As far as principle is concerned, commercial publicity broadcasts from a foreign station in the language of a neighbouring country are just as much an interference with the nation's internal policy as political broadcasts.

But commercial and tourist broadcasting is not made aggressive, as it would then not be effective. Political propaganda intended for foreigners is seldom crudely broadcast. It is usually carefully wrapped up. Some stations indulge in press reviews, naturally only selecting those news items which suit their purpose. The object is in such cases to mislead; in other instances the bulletins may seem unbiased, yet an occasional item creeps in which presents an international event in a purely one-sided light. One set of stations in Southern Europe specialises from time to time in contradicting statements broadcast from British stations.

The use of broadcasting stations for propaganda purposes at present are mainly as follows:

International political propaganda.

Propaganda for a given country, its attractions to tourists, and its national outlook.

Commercial publicity.

Alteration of statements broadcast by others.

In these four cases stations directly address foreign listeners, very often in their own language.

Then there are those broadcasts which are directly addressed to the country's own nationals living abroad.

In all cases the wise broadcaster will attempt to build up good will among his foreign listeners by providing interesting and amusing programmes and by awakening interest in the happenings of the station's home country. To put it very briefly, by selecting three examples: Russian programmes appeal to communists. German programmes as far as they are directed out of the country appeal first and foremost to German nationals abroad and then to all foreigners interested in Germany. The broadcasts are compiled to awaken interest in German affairs and to inform listeners of the German point of view on all kinds of subjects.

Italy attracts listeners by giving them free Italian language lessons and provides the foreign listener with news as Rome would see it. The Italian stations are also used to expand and strengthen Italian influence in near-by countries. France and Yugoslavia, among others,

use their own language for news broadcasts.

Use of the gentle art of jamming is the most obvious retort to propaganda of all kinds. But surely this should only be resorted to when a foreign station starts preaching revolution to a neighbouring people.

The very best way to counteract undue effects of propaganda, whether pleasant or unpleasant, is to keep the listener informed. If some countries do it, then let us all do it. Let the stations, notably on the short waves answer the other man and let them all hear all points of view, clearly and forcibly. Every really good

title. But each one is seen from a different angle, and to get the truth you must listen to them all.

As long as broadcast propaganda continues without direct aggression it is a good thing, as we then really can hear the other man's point of view on things that matter. But it is a bad thing for the country that stays out of it. To make them all stop seems impossible, so let us tell the world of the touristic attractions of Britain, of the Londoners' views on the latest article in a Rome paper, but tell them in Italian just as they talk to us in English. Unfortunately, we have not got the wavelengths or the stations and we have more listeners than Italy or we could sacrifice medium-wave time to it, but the short-waves are nearly as good. Daven-try roars in like a local in Rome.

## Television Programmes

An hour's special film transmission intended for the Industry only will be given from 11 a.m. to 12 daily.

Sound	Vision
45 Mc/s.	41.5 Mc/s.

FRIDAY, SEPTEMBER 24th.

3, O.B. from King George V Dock. 3.15, British Movietonews. 3.25, Elizabeth Allen in "Michael and Mary" by A. A. Milne.

9, Guelda Waller and Vera Maconochie in "A Chelsea China Pastoral." 9.10, Gaumont-British News. 9.20, "Michael and Mary."

SATURDAY, SEPTEMBER 25th.

3, O.B. from King George V Dock. 3.15, In Our Garden: C. H. Middleton gives some more practical advice. 3.25, "La Serva Padrona": one-act opera by Pergolesi. 3.50, Gaumont-British News.

9, Cabaret including Howard Rogers (comedian) and Michael Moore (impressionist). 9.30, British Movietonews. 9.50, Play.

MONDAY, SEPTEMBER 27th.

3, A Little Show. 3.25, Gaumont-British News. 3.35, "Victorian Afternoon": a sentimental journey into the 'sixties.

9, Cabaret with Sheila Douglas-Pennant (comère), Rudi Grasi (musical impressions), and The Six Clevettes (acrobatic dancing). 9.25, James Stephens speaking some of his own poems. 9.35, British Movietonews. 9.45, Ballet: William Walton's "Siesta" and "Portsmouth Point."

TUESDAY, SEPTEMBER 28th.

3, Roy Fox and his Band. 3.20, British Movietonews. 3.30, "Turn Round": a dramatisation by S. E. Reynolds illustrating the life of a liner in port. Film sequences photographed at Southampton Docks.

9, Speaking personally—2. Dame Ethel Smythe, D.B.E. 9.10, Music Makers: Lina Menova in continental songs. 9.20, Gaumont-British News. 9.30, "Turn Round."

WEDNESDAY, SEPTEMBER 29th.

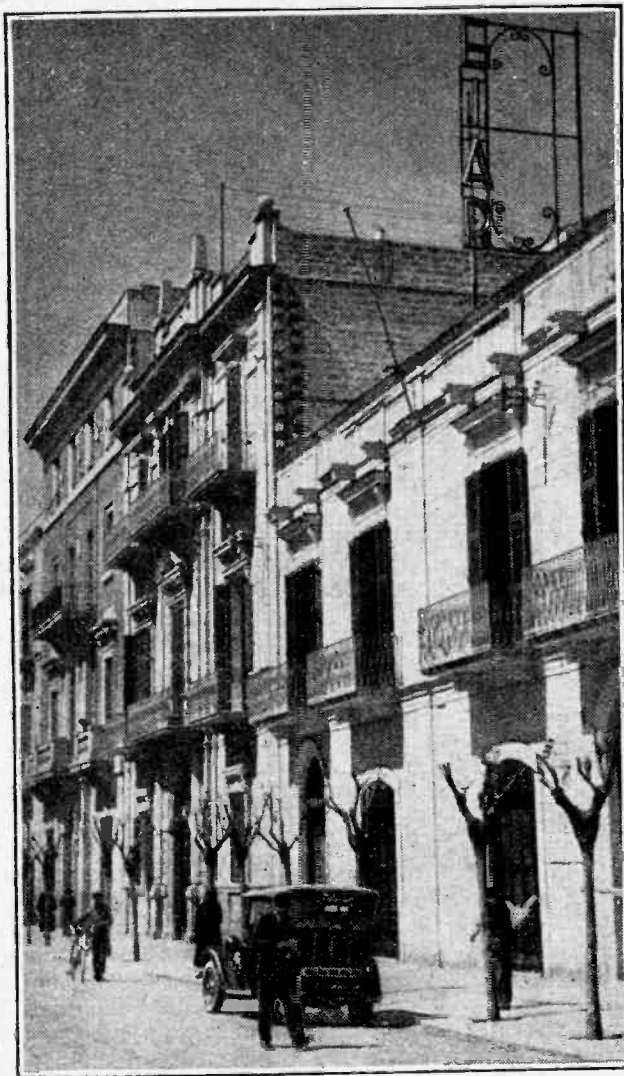
3, Mixed Comedy Programme. 3.25, Gaumont-British News. 3.35, Eighty-first edition of Picture Page.

9, A Little Show. 9.25, British Movietonews. 9.35, Eighty-second edition of Picture Page.

THURSDAY, SEPTEMBER 30th.

3, O.B. from Pinewood Film Studios. 3.10, Marc Anthony in selections from his repertoire. 3.20, British Movietonews. 3.30, 100% Broadway.

9, O.B. from Pinewood Film Studios. 9.15, Marc Anthony. 9.20, Clothesline, No. 1. First of a series of programmes in which it will be shown how important dress has been, is and will be. 9.35, Gaumont-British News. 9.45, Sports Review No. 4. Howard Marshall interviews some of those who have distinguished themselves in the sporting world this summer.



Broadcasting House in Bari has little in the way of architectural variation from its surroundings to attract immediate attention.

listener hears several stations, from many countries. If they don't lose faith immediately after hearing three or four versions about Madrid, they will be able to laugh as I did once when I heard of revolution and streets full of soldiers in a city where I was living. The news came out of the loud speaker from a station many hundreds of miles away. I was intrigued and went out to see the steel-helmeted and heavily armed soldiers guarding the streets. They were but phantoms in the imagination of the broadcaster.

I do not wish to shake my reader's faith in the veracity of broadcast news bulle-

# UNBIASED

By  
FREE GRID

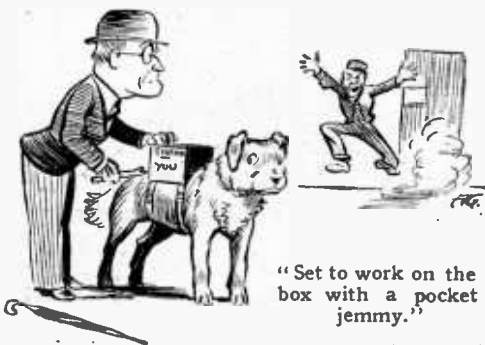
## Are We a Back Number?

WE, in this country, frequently pride ourselves upon our long history, our old traditions and our old-fashioned ways, but there ought, I think, to be some sort of limit set to this kind of thing, otherwise we are apt to produce in the minds of foreign visitors the opposite effect to that which we desire. In other words, instead of impressing them with our antiquity, we are apt to cause them to think that we are a back number.

This was somewhat forcibly brought to my notice the other day when I happened to be in a large railway station in one of the most go-ahead of European countries. Walking about among the passengers on the various platforms was a large dog with a collecting box strapped to its back for the purpose of receiving subscriptions to some charity or other. Now there is, of course, nothing new in this idea and no doubt many of you have seen it from time to time in certain British stations.

I should have thought no more of the matter, but as I strolled up to the dog, I was momentarily taken aback by the fact that it appeared to address me in a foreign tongue. Alarmed for the moment, I hastily ran over in my mind a catalogue of the food and drink which I had consumed for lunch. This, I suppose, gave my brain the necessary momentary spell to realise that the effect was due to some concealed loud speaker probably attached to an automatic gramophone, and skilfully hidden somewhere inside the money box on the dog's back.

I immediately bent down to investigate, and as I was patting the dog, I addressed a few words to it as one frequently does to animals. To my surprise the dog at once appeared to reply to me in English, drawing my attention to the needs of the charity he represented and inviting me to put my contribution in the box. I made an immediate reply and found myself able to carry on an ordinary



"Set to work on the box with a pocket jemmy."

conversation with the dog, or rather with the apparatus inside the big money box on its back. I was naturally all agog to learn how it was done, but the voice in the box was extremely reluctant to give away any information and insisted rather

foolishly that it was the "magic Djinn inside the box."

I flatter myself that I know a thing or two about Djinnns and how to make them appear when desired, and I immediately set to work on the box with a pocket jemmy which I always carry about with me for the purpose of opening wireless sets. As I expected, "the Djinn of the box" immediately appeared and took the form of an indignant railway official dashing across the platform from the direction of the stationmaster's office.

The promise of a little publicity in this journal immediately put the Djinn in a much better frame of mind than when he started to address me, and he took me along to the office where I found several exceedingly compact; one-metre trans-receivers, counterparts of the one on the dog's back.

Both microphone and loud speaker were very cleverly concealed in the harness worn by the dog, and it certainly gave the impression that the dog itself was speaking. Actually the dog wandered about the platform at will while invitations to contribute were broadcast by the announcer on duty in the office. As soon as any passenger spoke to the dog, his voice was, of course, immediately heard by the announcer. When a coin dropped into the box it also was heard by the announcer and to the donor's astonishment, he was immediately thanked. Similarly, if any person spoke to the dog, the announcer immediately commenced a personal conversation with him, and in most cases in his own language, as all announcers on this job have to possess a working knowledge of the most important European tongues as well as American.

## An Idea for Theatres

LIKE myself, I suppose that a goodly number of you fellows were badly shaken by the financial blizzard which swept over the world a few years back, and shook Wall Street and Tattersall's Ring to their foundations. I know that in my own particular case I was almost completely engulfed by the flood, and from dining in the Lucullan restaurants of the West End I descended to a humble snack at a coffee stall, a pair of roller skates taking the place hitherto held by my Rolls-Royce.

Although, of course, things are vastly improved nowadays, I have found it very difficult to return to my old ways of life, and quite often when in a strange town I find myself at eventide unconsciously bending my footsteps in the direction of the casual ward of the local workhouse instead of to an hotel. One of the particular activities of life in which I find it exceptionally difficult to return to normal is theatre-going. I still find myself quite



Shades of the Wall Street Slump.

frequently right at the back of the gallery or pit instead of in a flower-embowered box.

Now one of the curses of the gallery and pit in the average theatre in this country is undoubtedly the great difficulty of understanding what on earth the actors on the stage are talking about. As a result of this I have become quite adept at interpreting what the play is about by carefully studying the actions of the players. This has stood me in very good stead when I have been attending a theatre in certain foreign countries where I have been completely ignorant of the local lingo.

On a recent visit abroad I happened to be whiling away an idle hour in a theatre and occupying my usual back seat when I suddenly realised that I was hearing the voices of the actors as clearly as though I were in the best part of the stalls. It did not take me long to realise that a particularly good PA system was at work which, as I discovered afterwards, was indeed the case. The microphones were carefully concealed in the "flies" and among the footlights, while special types of directional loud speakers were built into the ceilings and walls.

The whole thing had been very ingeniously worked out as the designer had borne in mind the fact that the acoustic properties of the theatre would vary greatly according to the number of people in the audience, and provision was made for cutting out loud speakers when necessary, and for varying the frequency response of the remainder in order to secure intelligible speech at all times.

I recollect many years ago seeing an arrangement designed to secure the same results tried out in a New York theatre. In this case, however, each seat was provided with a pair of headphones and a volume control, which is, perhaps, not so convenient, as many people would find the wearing of headphones to be very irksome.

Possibly we shall eventually see one of the London theatres trying out a good PA system to enable the patrons of their cheaper seats to secure value for their money but, knowing the smug self-satisfaction of many theatre managers, some of whom have not so very long ago replaced their gas footlights by electric ones, I doubt if it will occur in our lifetime unless we all greatly exceed our allotted span.

# New Apparatus Reviewed

Recent Products of  
the Manufacturers

## TORTOISE HOME CHARGER

A DIMINUTIVE battery charger for use on AC mains and designed to charge 2- or 4-volt batteries has been introduced by Makers Agents, Ltd., High Holborn House, High Holborn, London, W.C.1. Though it contains a transformer, metal rectifier, and a limiting resistance, the overall size is only  $3\frac{1}{8}$  in.  $\times$   $2\frac{1}{2}$  in.  $\times$   $2\frac{1}{2}$  in.

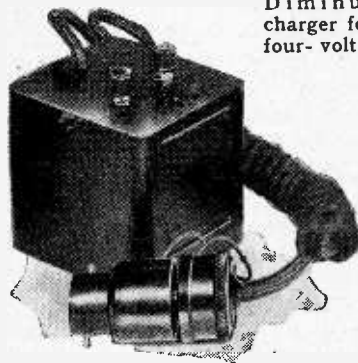
The unit is stated to be suitable for use on supply mains of 200 to 250 volts AC, and some measurements made show that at 210 volts input the charging rate is 0.53 amp., at 220 volts it is 0.56 amp., and at 230 volts 0.6 amp. These measurements were made with a run-down 2-volt accumulator.

As the accumulator comes up to full charge the current decreases, but it did not fall below 0.5 amp. at any period of this test, the lower limit being obtained with 210 volts AC input.

A 4-volt battery received a charge of 0.25 amp. from a 230-volt AC supply.

Other uses for this charger are stated to be the lighting of small lamps in doll's-houses and on Christmas trees, etc., direct from the AC mains.

Diminutive LT charger for two- or four-volt batteries.



In order to ascertain the output voltage under this condition of use some measurements were made with current loads of 0.1 to 0.5 amp. It was found that the voltage varied from 4.25 at 0.1 amp., to 2.5 at 0.5 amp., so that it will be necessary to choose lamps of suitable voltage. If the total consumption amounts to 0.5 amp., then 2.5-volt lamps may be used, but if one or two low-consumption lamps are employed, it would be advisable to fit the 4-volt variety.

The charger is quite silent in operation and is perfectly safe for any of the alternative uses suggested, as it is entirely enclosed in a bakelite case and only the low-voltage output terminals are accessible.

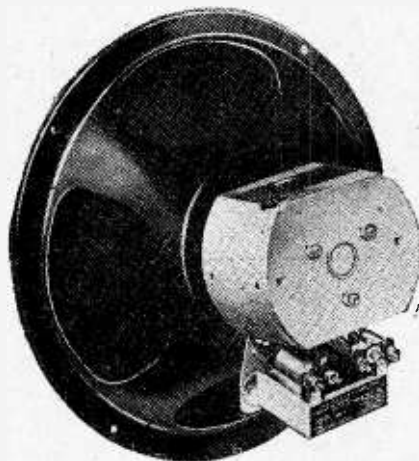
Though ventilating slots are cut in the side of the case, we did not observe any rise in temperature; indeed, the case remained quite cool even after a lengthy test.

The price of this miniature versatile charger is 12s. 6d.

## ROLA F742-PM LOUD SPEAKER

DESIGNED specifically for use with battery sets, this unit has a large Alnico magnet giving a flux density of 11,500 lines per sq. cm., and is not only very sensitive, but has a power-handling capacity well in excess of the output of the majority of battery power valves.

There is no appreciable fundamental resonance, as the magnetic damping is high. Reproduction is full and round in the middle register, with a well-sustained high-



Good quality of reproduction is combined with high sensitivity in the Rola F742-PM.

note response up to 5,000 or 6,000 cycles, which gives good intelligibility on speech. There is a remarkable freedom from "mush," and the distinct trough at 9,000 cycles effectively filters out heterodyne whistles. For these reasons the unit should be of special interest to short-wave amateurs, and the shielded and impregnated transformer is well suited to tropical conditions. The price, including transformer, is 49s. 6d., and the makers are The British Rola Co. Ltd., Minerva Road, Park Royal, London, N.W.10.

## WAVEMASTER FULL-VISION DRIVE TYPE 129

THIS new condenser drive is fitted with a rectangular dial measuring  $3\frac{1}{2}$   $\times$   $7\frac{1}{2}$  in. and engraved on it are separate scales for the medium and the long waves. Since the medium waveband contains the greater number of stations, it occupies the outer position, and although thirty-three station names are printed in full it does not give the appearance of being overcrowded. There is also a wavelength scale covering 200 to 550 metres.

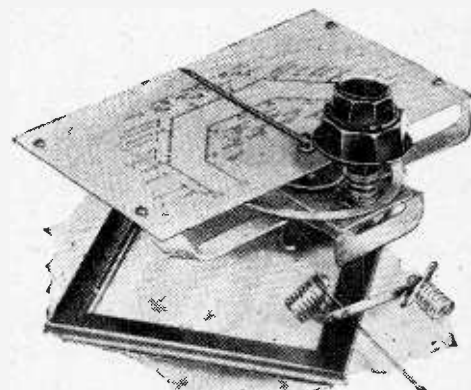
Thirteen names of stations in the long-wave band are included, also a scale of

wavelengths from 1,000 to 2,000 metres. For easy identification the medium- and long-wave station names and scales are widely separated and different colours are used. The dual-colour scheme also serves to enhance the appearance of the dial.

It can be illuminated from the rear, and in view of its size two lamp holders are provided. The driving mechanism, which is of the friction type and very sturdily made, is quite free from slip and backlash.

Provision has been made for mounting the drive either on the condenser fixing bush or for securing it to the chassis, and suitable brackets with means for fixing them are included. The two reduction ratios are 8 to 1 and 100 to 1.

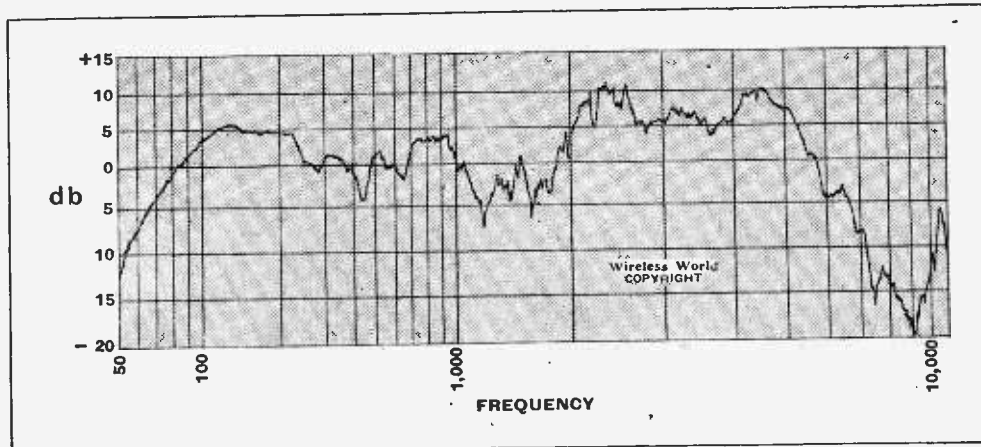
The price is 8s. 6d., including a large walnut escutcheon with glass front, and the makers are the Webb Condenser Co., Ltd., 32, Hatton Garden, London, E.C.1.



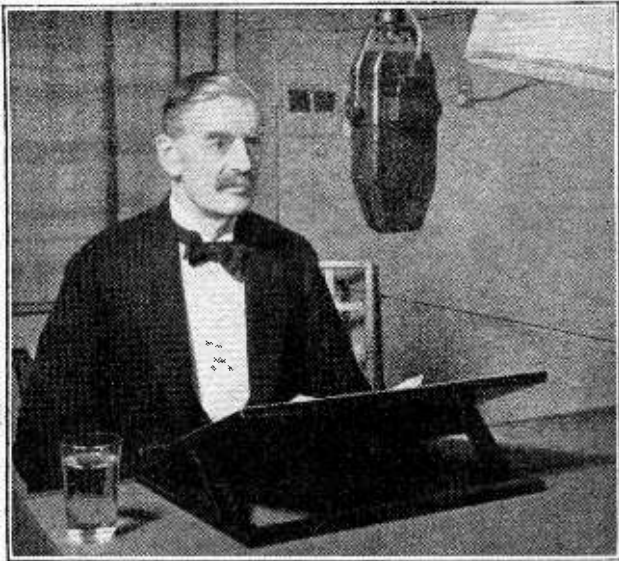
New Wavemaster dual-ratio full-vision condenser drive.

## NEW BULGIN PUBLICATIONS

THE latest edition of *Radio Progress* contains full constructional details of 10 different pieces of apparatus, ranging from a 12-valve all-wave superhet to a single-valve deaf aid. A vibratory HT generator unit is of especial interest. The *Bulgin Radio Service Manual* describes methods of fault-finding and the uses and construction of test apparatus, etc. Each book costs 1s. from A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex.



Axial response curve of Rola F742-PM. Microphone distance 4ft. Input 1 watt.



**T**WO heads of departments of the B.B.C. will come to the microphone during this week to give listeners some idea of their programme plans for the October-December quarter. To-night (Friday) John Watt, the Director of Variety, who succeeded Eric Maschwitz, will be heard by National listeners at 10 o'clock. When he took over the reins of the Variety Department in July he said that he could not "blow the lid off" the variety programmes even if he wished to, as they were already arranged for three months ahead. We shall now have the opportunity of hearing if he has any revolutionary ideas on variety presentation when he speaks this evening.

Val Gielgud, Director of Features and Drama, will be heard twice during this week, the first occasion being on Sunday at 9.45 (Nat.) during the programme "Music for Radio." This will be a broadcast recollection of some of the music specially composed for radio drama, which will include a discussion between Val Gielgud and Grace Wyndham Goldie, drama critic of *The Listener*, on the use of music in radio drama.

On Tuesday at 10 (Nat.) he will talk for a quarter of an hour on his plans for the autumn. He has been much in the news of late because of his statement that he has no more intention of being guided entirely by the Listeners' Panel than by any other symptom of public opinion. When he comes to the microphone on Tuesday we shall have the opportunity of hearing directly from him what are his ideas for Drama and Features.

#### NATIONAL HEALTH

LISTENERS will hear the Rt. Hon. Neville Chamberlain, M.P., speaking for the first time as Premier on Thursday, when his speech at a reception given by the Central Council for Health Education at the London School of Hygiene is relayed at 9.30 (Nat.). He has been heard on eight previous occasions, the last being in April, when, as Chancellor of the Exchequer, he explained his budget.

In his speech on Thursday he will talk on "National Health," and his speech will inaugurate a six months' campaign designed to stimulate the use of public health services and to promote fitness in Great Britain.

#### FIFTY YEARS ON THE STAGE

THE cast for the fifth "Star Gazing" programme, which will feature the career of the celebrated stage comedian Huntley Wright, will include, in addition to Huntley Wright himself, José Collins, Harry Welchman, and Gracie Leigh. Listeners will remember that the "Star Gazing" programmes which are presented by the "Scrapbook" collaborators, Leslie Baily and Charles Brewer, are radio biographies of famous stage and screen stars. The three stars who will be in this programme with Huntley Wright have each played with him in one or more of his many successes.

Another interesting name in the cast is that of Betty Huntley Wright, the well-known radio musical comedy singer, who is, of course, Huntley Wright's daughter. The programme will be heard on Wednesday at 8 (Nat.), and Regionally on Friday next.

# Listeners' Guide

## Outstanding Broadcasts at H

**THE PRIME MINISTER**, who will be heard by National listeners on Thursday, is seen here in one of the talks studios for his broadcast last April.

#### AERIAL DRAMA

LANCE SIEVEKING has created from J. E. Gurdon's story, "The Peaslake Crash," an amusing aerial drama for radio production. Briefly, the story is based on the action of Mr. William Peaslake, a millionaire who, whilst inspecting an aeroplane landed in his park by his ward's fiancé, is carried up into the air by the machine starting on its own. The millionaire, knowing nothing of aeronautics, is borne away into the blue, and that part of the play which deals with him alone in the cockpit, ignorant of the functions of any of the controls, is particularly good. It should give Lance Sieveking splendid opportunities for using complicated sound effects, in which he has frequently proved himself a specialist.

Those listeners who wish to know how the millionaire gets back to *terra firma* should listen to this fantastic story of the air, which will be broadcast on Tuesday at 8.30 (Reg.), and again Nationally on Thursday at 7.35.

#### ELECTRONIC MUSIC

THERE is an item in Tuesday's Children's Hour which will probably be of interest to grown-ups, too. Martin Taubmann will, during a variety programme, demonstrate his *Electronde*. This instrument, as *Wireless World* readers will doubtless know, produces music by means of hand-capacity effect on the antenna of the instrument.

#### SCHOOL BROADCASTS

WHO listens to School Broadcasts? This is the question which Mr. A. C. Cameron, Secretary of the Central Council of School Broadcasting, wants answered. He wants to know if parents share their children's listening, and, if so, to what particular items in the curriculum. He will explain the aims of the School programme for 1937-38 in a talk on Thursday at 5.45 (Nat.), and will probably seek the help of listeners to answer the above question.

#### FROM THE QUEEN'S HALL

DURING five of the relays from the Promenade Concerts this week will be heard pianoforte solos. To-night (Friday) Lamond will be heard playing Beethoven's Pianoforte Concerto No. 5. Pouishnoff will be soloist during the Tchaikovsky concert on Saturday, and at 8.16



**DEPARTMENTAL HEADS.** Val Gielgud, who is here seen in the rôle of himself as Director of Drama in the film "Death at Broadcasting House" which was shown last year, and John Watt (inset) will be heard this week talking on the Autumn plans for their departments.



# For the Week and Abroad

(Reg.) will be heard playing the Pianoforte Concerto No. 1. Myra Hess will, during the



was left unfinished at his death. Yet another composer of the last century is revived, by Berlin, on Sunday at 8, when Lortzing's "Der Wildschütz" is broadcast. Lortzing combined an arduous career as an actor with the composition of some dozen excellent operas, natural and pleasing in sentiment and expression.

**HENRY HALL**, whose contract with the B.B.C. ends on September 25th, will say good-bye to listeners when he and his orchestra broadcast on Saturday, at 10.25 (Reg.) He will, however, be heard, from time to time, with his new orchestra, broadcasting during his music hall tour.

Schubert-Schumann concert on Tuesday, be heard at 8.21 (Nat.) playing the latter's Pianoforte Concerto. Brahms' Concerto No. 2 will be played by Egon Petri at 8.12 (Reg.) during the relay on Wednesday, and Rachmaninov's Rhapsody on a Theme of Paganini for pianoforte and orchestra will be heard on Thursday at 8.28 (Nat.), with Moiseiwitsch as soloist.

## OPERA

The week is rich in opera of every sort. Mascagni's "Isabeau," which comes from Rome at 8 on Saturday and is conducted by the veteran composer, is based upon the story of Lady Godiva. Its combination of expressive melody with dramatic orchestration is typical of the modern Italian school.

Hermann Goetz, whose "Francesca da Rimini" comes from Munich on Sunday at 8, is known almost solely as the composer of a very fine, rollicking opera version of "The Taming of the Shrew." Some of his admirers classed him with Brahms, and doubtless had he lived longer (he died in 1876 at the age of 36) he would have come to the very front rank. The present opera

Brussels I gives Bizet's "Pearl Fishers" on Monday at 7.55. This opera has proved ideal for radio production, until the advent of which it was rarely heard and lay almost forgotten.

Two modern Italian operas, "Primavera Fiorentina" (Pedrollo) and "Notturmo Romanico" (Pick-Mangiagalli), come from Rome at 9 on Tuesday. Pedrollo has won fame in recent years by his musical celebration of Mussolini's March on Rome, and Pick-Mangiagalli, half Czech, half Italian, has a Puckish quality all his own. The Italians say he might very well be called "Puck"-Mangiagalli.

The major event of Thursday is the great Paris production of "Pelléas et Mélisande," Debussy's only opera, which will be relayed by many French stations at 8.30. The occasion which calls for this gala production is the seventy-fifth birthday of Maeterlinck on October 2nd. The dream-like tale is something quite off the beaten track of opera, and Debussy has done it full justice, though it is said that Maeterlinck does not very much like his drama in its opera dress, but the rest of the world does.

## HIGHLIGHTS OF THE WEEK

**FRIDAY, SEPTEMBER 24th.**  
Nat., 7.30, Five Hours Back. 8, Hero and Heroine: songs and duets from famous operettas. 9.5, Organ recital—Harold Darke. Reg., 8, Beethoven Prom. 9.25, Gilbert and Sullivan music.

**Abroad.**  
Rome, 9, Lehár's operetta "The Merry Widow."

**SATURDAY, SEPTEMBER 25th.**  
Nat., 8, Past, Present and Future: Eddie Polar and Jack Hylton. 9, Discussion: Should Trespassers be Prosecuted? 10, Compton Mackenzie in the series Men Talking.

Reg., 8, Tchaikovsky Prom. 9.40, Intermission: the Variety Orchestra. 10.25, Henry Hall and his dance orchestra.

**Abroad.**  
Rome, 9, Mascagni conducts his opera "Isabeau."

**SUNDAY, SEPTEMBER 26th.**  
Nat., 3.15, The Fleet Street Choir, singing Vaughan Williams' songs. 4.15, The winning band of the Alexandra Palace National Championship. 7.55, Harvest Thanksgiving Service from Farnham Parish Church. 9.45, Music for Radio: a programme of recollections.

Reg., 5 The Bad Neuheim Spa Orchestra: relay from Germany. 7, The Folkestone Municipal Orchestra.

**Abroad.**  
Berlin, 8, Lortzing's opera "Der Wildschütz."

**MONDAY, SEPTEMBER 27th.**  
Nat., 5.40, Recital: Carmen del Rio. 9, Favourites of the Famous: Jack Payne and his band.

Monday, Sept. 27th (continued).  
Reg., 8, Ord Hamilton at the piano. 8.20, Wagner Prom.

**Abroad.**  
Leipzig, 7, Recording of the performance of Wagner's opera "Tannhäuser" in the Dresden Opera House on Saturday, September 25th.

**TUESDAY, SEPTEMBER 28th.**  
Nat., 8, Schubert-Schumann Prom. 10.15, The Little Show: a radio cabaret.

Reg., 8.30, "The Peaslake Crash." 9.20, The Theatre Orchestra and Freda Townson (contralto)

**Abroad.**  
Königsberg, 9, Don Cossacks choir.

**WEDNESDAY, SEPTEMBER 29th.**  
Nat., 6.20, The Rt. Hon. W. S. Morrison talking on grassland improvement. 7.20, Harpsicord recital: Yella Pessl. 8, Star Gazing: Huntley Wright. 10, The Company of Heaven: a programme for Michaelmas.

Reg., 8, Brahms Prom. 9.40, The Military Band and B.B.C. Singers.  
**Abroad.**  
Radio Paris, 8.30, Messenger's operetta "Beatrice."

**THURSDAY, SEPTEMBER 30th.**  
Nat., 7.25, "The Peaslake Crash." 8.15, Promenade concert. 9.30, The Prime Minister.

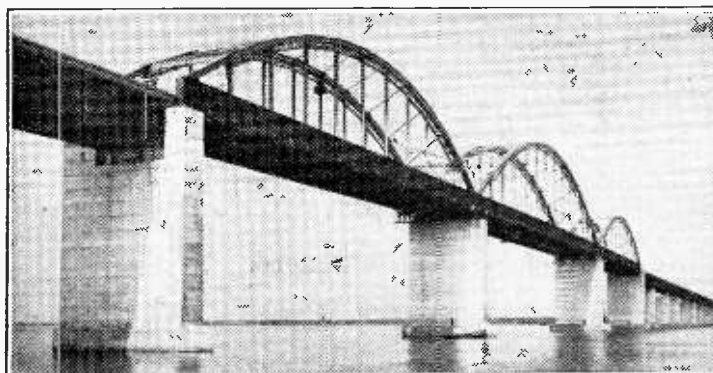
Reg., 8, Peter Yorke and his orchestra. 8.25, Jimmy O'Dea in "Blarney": a revue from Northern Ireland. 10, Recital: Maggie Teyte.

**Abroad.**  
Radio Paris, 8.30, Debussy's opera "Pelléas et Mélisande," from the Salle Gaveau.

## EUROPE'S LONGEST BRIDGE

THE outstanding event of this week's Scandinavian programmes is the broadcast on Sunday of the inauguration ceremony of the Storstrom

of which weighs twenty thousand tons. The ceremony will be attended by the Diplomatic Corps, the Danish Cabinet, Dr. Burgin (British Minister of Transport), the



H.M. KING CHRISTIAN X will open the Storstrom Bridge, Denmark, on Sunday, when the inauguration ceremony will be broadcast throughout Scandinavia. The three middle spans of the bridge are shown in this photograph.

Bridge, which will be performed by H.M. King Christian X of Denmark, whose birthday this will be. The bridge, which runs from Sealand to the Isle of Falster, is the longest in Europe, measuring about two miles. It carries a rail track, roadway and footpath, the superstructure

German Minister of Finance, and many other high officials of Europe.

Running commentaries will be broadcast at 11.25 a.m. in Danish from all Scandinavian stations, and it is probable that an English commentary will be given at the same hour. THE AUDITOR.

# "Scale" Distortion

By "CATHODE RAY"

**R**EGULAR readers of this page, if any, who observed the title of a certain article in the July 9th issue by Dr. Foster—"The Evolution of the Phon: a Successor to the Decibel Notation for Sound"—may have passed it over as too highbrow for mid-summer. If so, it is unfortunate, for it would be a good deal easier to explain what I want to explain if I could assume a knowledge of that article.

Having acquired a set giving level amplification from 30 to 10,000 cycles or thereabouts, and enough power for working always well within the 5 per cent. harmonic limit, one can tend to become rather cocky about its distortionlessness. A little gentle debunking may be necessary, and now follows.

For the moment the obviously rather vulnerable loud speaker will be left out of account, and attention concentrated on the amplifier. Assuming that its straight-line characteristic curve is fully justified, that it is situated so close to a transmitter that no reduction in top frequencies is imposed by the requirements of selectivity, and that harmonic distortion at all working volumes is negligible, most owners would have little hesitation in claiming it to be practically distortionless. But there is still one condition, and an awkward one, that must be fulfilled if this description is to be well earned. The programme must be reproduced at the original volume. When a military or dance band, a symphony orchestra, or a cathedral organ are playing with all their might, the original intensity of sound must be reproduced in the home listening room. When the announcer speaks, the amplification must be cut down until his voice assumes its original gentle tones—not those so often heard bellowing across suburban gardens.

## Why the Volume Control Distorts

You may be saying, "This 'Cathode Ray' fellow is really getting a trifle unreasonable, making out that unless a thing is life-size it is distorted. One might as well insist on a passport photo being printed life-size." Now, that is just where the mistake comes in. There is no inherent reason why a portrait two inches high should not correctly represent to scale a six-foot man. Photographic reduction or enlargement does not necessarily distort. But a volume control, which appears to perform the corresponding service for sound, does. It is as if in the process of photographically reducing a man's body 10 times the head were to diminish 30 times and the feet 100 times. The result would unquestionably be disowned by the

man concerned. Yet that is not an unfair illustration of what happens to the sound "picture" when its volume is altered.

To understand why, it is necessary to distinguish between loudness and intensity (or volume) of sound. It is because most people use these terms interchangeably that they overlook this "scale distortion," and are mystified because a high-quality reproducer sounds good with music and bad with speech, or vice versa. If two persons take it in turns to stand in the same position near a loud speaker, both are subjected to sound of the same intensity, but they may get quite different impressions of loudness, especially if one of them is stone deaf. Moreover, the same person may get different impressions of the loudness of this programme, depending on whether or not a pneumatic drill is at the same moment engaged in breaking up the ground close to where he stands.

## Phons and Decibels

Having grasped this important distinction between intensity and loudness, you should have no difficulty in understanding curves of equal loudness (shown in Fig. 1 of Dr. Foster's article and repeated here for convenience). Loudness, as judged by a person of average hearing, undistracted by other sounds, is measured in phons. Relative intensity is indicated in decibels (10 db. means 10 times the sound intensity, 20 db. 100 times the intensity, 30 db.

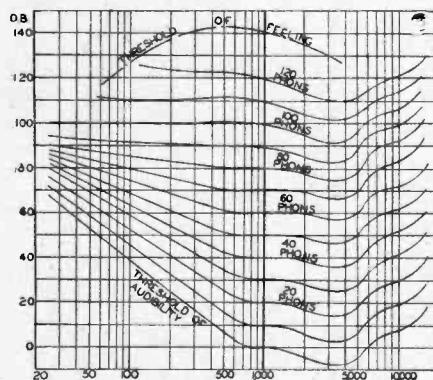


Fig. 1.—Characteristics of the human ear; relationship between loudness (in phons) and sound intensity above threshold (in decibels).

1,000 times, and so on). Zero db. does not mean no sound intensity; it means no increase above (or decrease below) a certain intensity which has been chosen to be the feeblest sound at a frequency of 1,000 c/s that is audible. From the diagram it can be seen that a sound of the same intensity at 3,500 c/s appears to be louder, while sounds above 7,000 c/s and below 1,000 c/s are not audible at all.

## HOW AMPLIFICATION DIFFERS FROM ENLARGEMENT

(In the Photographic Sense)

Referring to the same article to get some idea of the number of phons corresponding to familiar sound loudnesses, we find that 90 phons is typical of a "loud radio set." Suppose the loud radio set is giving perfect reproduction of a loud programme; possibly a Hungarian Rhapsody played on a grand piano might come at least up to 90 phons. But it is about 11.30 p.m., and we have regard for our neighbours, so we turn it down to 70 phons ("medium radio set"). The means of doing this—the volume control—not being human knows nothing about phons; only db. If the pianist happens to be playing in the upper-middle region of the keyboard, between 500 and 1,000 c/s, phons and db. amount to the same thing; the volume is reduced 20 db., let us say. But when the pianist's left hand gets busy, this reduction in volume is found to produce 30, 40 or even 50 phons reduction in loudness. While a 500-c/s note is reduced to one-hundredth the loudness, a 50-c/s note dwindles to one-hundred-thousandth. To put the thing more clearly, the mere act of turning the volume control from loud to medium (judging by upper-middle notes) is equivalent to replacing the perfect amplifier specified by the characteristic A (Fig. 2) by an amplifier having the much less satisfactory characteristic B. It makes the quality-enthusiast's discussions as to whether or not he is losing 1 db. at 30 cycles look rather funny, does it not?

## A Catch Somewhere?

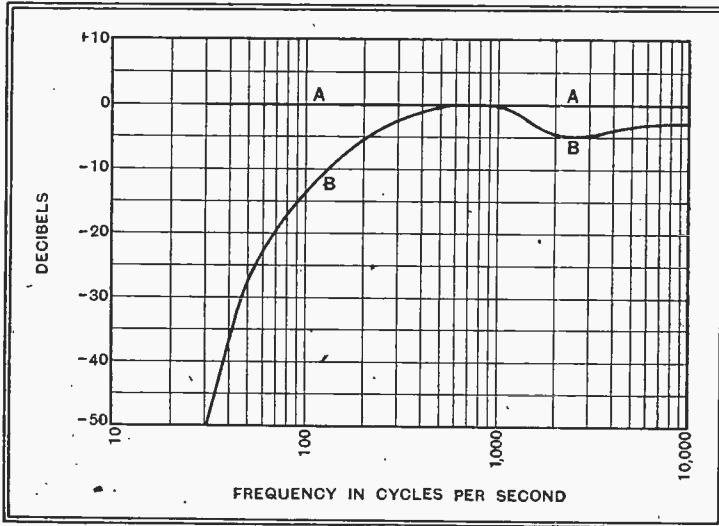
Some readers faced with this disclosure may suspect a catch somewhere. Well, the foregoing reasoning is not absolutely watertight, because it is based on data that apply to isolated tones, not the continuously changing mixture that constitutes music or speech. Whether the quality-enthusiast's position would be improved if account were taken of this complexity is a debatable point. But whatever the actual magnitude of the effect may be in practice, the existence of it can easily be settled by walking out of a studio in which a dance band is going full blast into a listening room where a perfect-as-can-be reproducer is delivering the same programme at "medium radio set" loudness. The bass simply walks away. Or go from the studio where the News

**"Scale" Distortion—**

Bulletin is being read (if you can get into it) to the same reproducer turned up to "loud radio set" and listen to the bass that wasn't noticeable in the voice itself.

Two methods of combating this type of distortion are in use. There is tone-compensated volume control, in which circuit components are used to increase the proportion of bass as the volume control is set to lower levels. And there is the much more elaborate and uncommon automatic bass boost, which provides the extra bass amplification needed when the original programme is reproduced on a

Fig. 2.—Curve A represents characteristics of a perfect amplifier; B represents the aural effect of turning down the volume control.



small scale and cuts it out when the audio output voltage rises. Both methods are founded on the assumption, that the amount of tone compensation required depends on the volume of reproduction. This is another error caused by confusing things that differ. It is like assuming that because a photograph is small it is also small scale. Whether it actually is so or not depends on whether it is a portrait of an elephant or a flea. Though small in size, it may be an enlargement of the original. The "medium radio set" volume to which in imagination we turned down the piano recital made bass boosting desirable, not because it was medium volume but because it was softer than the original. If the original had been less than medium volume, bass cutting would have been prescribed.

The automatic bass control scheme is wrong, then, in assuming that a small-scale reproduction and a small audio voltage necessarily go together.

Actually, it is well known that if the volume control is left alone during a day's broadcasting, the average volume resulting from all programmes is usually about the same, so that a given voltage output from the amplifier may sometimes represent a reduced edition of the original, sometimes an enlargement. Even patent medicine advertisers, though they strain credulity pretty severely, don't go so far as to offer the same dose as a stimulant and also as a sedative.

There are also other fallacies in this fairly complex and costly scheme. The tone-compensated volume control is a cheaper method of indulging in the same error. Even if the setting of the volume control bore some sort of consistent relation to the scale of the reproduction, the correction could at best be only approximate because the phon curves in Fig. 1 are irregular; but actually, as we have seen,

a given volume control setting may at one time represent a scale smaller than life-size and at another a larger-than-life reproduction.

Is there any way of getting over the difficulty? I know of no automatic this or that which can be fitted into the receiver to do the job. The only solution

is to make intelligent use of a fairly flexible system of tone control. That is all very well for the few individuals who are both intelligent and prepared to take the trouble. A compromise which is so simple as actually to be commercial is a "Speech-Music" switch. Except that in the "Speech" position it would cut bass as well as merely restoring what residual top frequencies the set may be blessed with, this is just our old friend the commercial tone control. You say, why not leave it as a tone control? The answer is that the general public don't know how to use a tone control. If it were marked "Speech" and "Music," there is just a chance that they might derive some benefit from it.

**STABILISING EFFECT OF AVC**

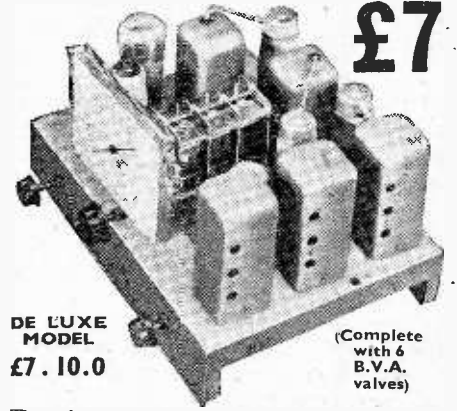
WHEN a receiver with AVC, after working satisfactorily, begins to show signs of instability except when it is tuned to a strong incoming signal it is to be assumed that stability is being brought about by the heavy negative bias applied to the RF and/or IF valves through the action of the AVC system.

This, we think, is a satisfactory answer to the question put by a reader as to why his set is unstable except when receiving strong signals, but it is rather more difficult to determine the most probable cause of instability, especially in the absence of full details about the circuit arrangement. However, in such cases one always suspects internal or external disconnections in bypass or decoupling condensers or a bad earth connection between some component and the chassis.



**BATTERY ALL-WAVE SUPERHET**

**£7**



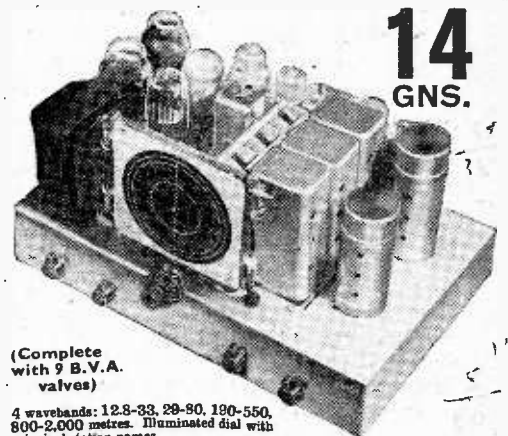
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**9 VALVE FOUR-WAVE SUPERHET DE LUXE**

**14 GNS.**



(Complete with 9 B.V.A. valves)

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# Random Radiations

By  
"DIALLIST"

## The Little Nationals

FROM to-morrow the London and North Nationals are to resume daylight transmissions at the week-ends and during school holidays. This news will be welcome to large numbers of listeners in London and in big northern cities who are now unable to hear the National programmes properly for one reason or another. In some places Droitwich is received with poor strength; in others, man-made interference spoils long-wave reception. Some of the B.B.C.'s mental processes are not too easy to follow. The Scottish National station has been radiating the National programmes all the way through the recent school holidays, though the London and North Nationals, which are synchronised with it, have been kept silent. Why? The week-end and school holiday concession is something; but it isn't enough. I cannot feel that it is right that listeners, most of whom pay the Education rate directly or indirectly, should be deprived of the National programmes from ten o'clock in the morning until five in the evening every day from Monday to Friday during the school term time just to enable Scottish schools to hear the educational broadcasts. I can't agree that the B.B.C. is called upon to educate the young any more than the Board of Education is called upon to provide grown-ups with concerts or music-hall entertainment!

## It Won't Do

THE figures for the attendance at Radiolympia in 1937 show that something is very radically wrong with the organisation. There has been no slackening of public interest in wireless; on the contrary, the increase in the number of receiving licences has been well maintained. Yet the number of people who visited the Wireless Exhibition was over 30,000 fewer this year than in 1936. That's bad enough, but the total is actually more than 26,000 smaller than for 1935—in fact, you have to go back to 1930 before you find one that is about on the same level. I don't think the reason's far to seek: the public is not going to be beguiled into Olympia nowadays in anything like such large numbers as in the past just to see in the theatre the broadcasting stars whom it has heard by way of the loud speaker. Nor can television be relied upon as a major attraction unless far better facilities for viewing are provided. Again, the man in the street won't go to the Exhibition to see the outsides of receiving sets or to listen to the "sales patter" of men on the stands who are unable to answer any but the most elementary technical questions about their wares.

## Action Needed Now

It is not too soon for those who organise the Radio Show to realise now that the 1937 Radiolympia wasn't good enough, and to begin to make the plans that will ensure success next year. Here are a few suggestions that I offer with becoming humility. Ideally, the prospective purchaser should be able to hear at work the set in which he is interested. Some years ago I seem to remember that there were numbers of sound-proof demonstration rooms in which this could be

done. Why not develop this idea to the full? If for one reason or another direct reception cannot be managed, then it should be possible to hear the audio-frequency side of the set, and not just its loud speaker, in operation. This could be done if 1-volt RMS were delivered to each demonstration room from a central receiving station, as suggested by a writer in *The Wireless World* a year ago. Next, there should be a concerted drive amongst exhibitors to stress the technical advances made and the points of real interest about their sets. This would mean the attendance of properly trained men at every stand. The off-hand, lackadaisical, cigarette-puffing ignoramus should be reformed out of existence. And why not make the television department very much larger? Why limit each maker to one television receiver in one booth? Improve the facilities for viewing, make it possible for large numbers of people to look-in, and the crowds will come right enough.

## Real Attractions

Again, I believe that the money now spent on the theatre would show a far better return were it laid out on really interesting side-shows of one kind or another. And by side-shows I do *not* mean stunts. I mean such things as films and working models showing how the cathode-ray tube, the loud speaker, and so on, perform their wonders. Or demonstrations of the ways in which the parts of a wireless set are made and put together. Why not initiate the man-in-the-street into some of the mysteries of quality in reproduction by demonstrations which allow him to hear for himself the effects of various forms of distortion? Hints and tips on short-wave reception with, possibly, practical demonstrations by experts would be popular. Let the public know that it is invited to Olympia chiefly to see and hear what wireless and television can do. Make the whole affair interesting, exciting, and attractive, and there won't be any fears of dwindling attendances in the future.

## This One Has Succeeded

If Radiolympia didn't succeed in pulling

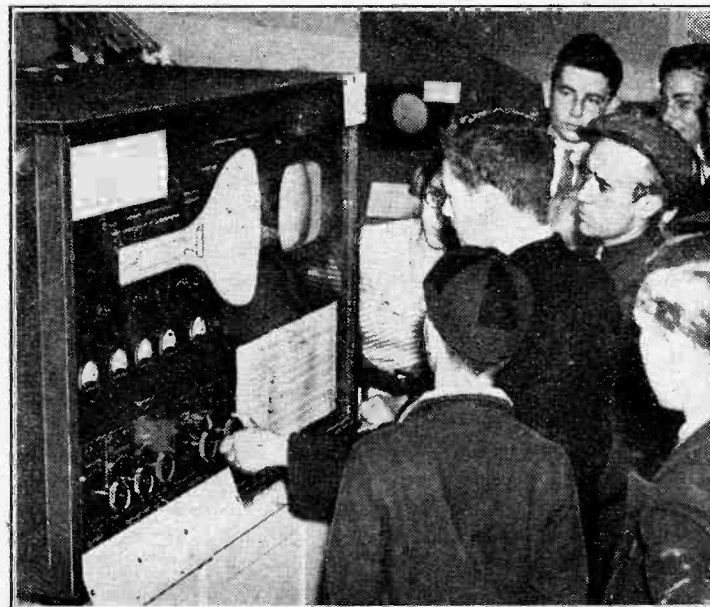
as it ought to have done, there can't be any doubt about the success of the Television Exhibition at the Science Museum, which closed on September 21st after a three months' run. During that time a quarter of a million people were admitted. They came genuinely to see television. There was no music-hall or anything of that kind to attract them, but they numbered some 90,000 more than the visitors to Radiolympia. It's true that admission was free, but against this the Television Exhibition had nothing like the publicity that was accorded to the Wireless Exhibition. The former's success is surely proof that if you've got something worth seeing and the right men to demonstrate it the public will come to see it without the need of any variety entertainments or other outside attractions.

## Spluttering Sibilants

QUITE a few people tell me that their receiving sets have begun to splutter like soda-water syphons on the sibilants and other high-frequency consonants during speech transmissions. I haven't heard that the B.B.C. is giving extra prominence to high frequencies, and I think that the trouble can probably be traced to tired or worn-out output valves, or to some other small defect on the audio-frequency side of the receivers. Certainly there are few more annoying things to listen to than a set which either possesses inherently or has developed this horrible hissing and spluttering. For my sins I had to spend a recent evening close to the loud speaker of a friend's set which made every S sound like the rapid drawing of a piece of sandpaper across the surface of a slate. A gruesome experience!

## A Grim Experience

A HEART cry comes to me from a correspondent, who has all my sympathy, since I have suffered myself in much the same way. "Little did I think," writes he, "that I should ever develop a hatred of wireless, even a temporary one; but I have done so now." His sad tale is that he found himself not long ago in a household of chain-listening addicts. The first person down to breakfast switched on the large wireless set with an output of many watts; the last to go to bed switched it off. Between breakfast time and midnight it was rarely silent at all.



## THE TELEVISION IMAGE EXPLAINED

A working model at the Science Museum, South Kensington, which demonstrates the functions of a cathode-ray tube in a television set.



To make matters worse for one unused to such a spate of wireless, there were no fewer than two extension loud speakers permanently at work.

**Queer Cases**

People who live constantly in a welter of noise from the loud speaker without listening to anything that is coming through are by no means rare. I have myself had to play billiards, to the accompaniment of an interminable list of *Irish* soccer results from Athlone. The owner of the set (and of the table) gave every sign of enjoying it, though in reply to a subsequent casual question whether he was interested in Association football he told me that he wasn't, and didn't know the name of a single team! My correspondent deduces from his experiences that, just as continuous noise is a misery to most people, even a few moments' peace and quiet are equally objectionable to those who have contracted chain-listening mania. He found that the members of this household were completely impervious to the most devastating forms of distortion.

**HTB's Have "Normal Temperatures"**

I WONDER if you've ever had occasion to notice the big effect that temperature can have on the performances of dry high-tension batteries? I've tested several thousand under laboratory conditions, and the tests have produced a good many queer happenings. One of these occurred during one of our rather patchy summers with one of the first batches on which I tried my then prentice hand. It concerned four large-capacity batteries which were undergoing an intermittent test of four hours a day under an initial load of 20 milliamps. These were particularly good batteries. Their original nominal voltage was 90, and after 20 days (80 hours) it had fallen to 78.4. The voltage was taken, I should mention, only at the end of each four-hour run. On the twenty-first day there was no fall. On the twenty-second the average voltage was up to 79.3; on the twenty-third to 79.7; on the twenty-fourth to 80.0; on the twenty-sixth to 80.5.

**Puzzling**

As I didn't know then as much as I now do of the ways of dry batteries, I was sorely puzzled. By all the rules the voltage should fall, yet here it was laughing at a load of 20 milliamps, and gaily rising. It didn't rise any further, but it kept stationary at 80.0 until the thirty-eighth day—152 working hours. For the next seven days the fall was comparatively small; then it became rapid: 75.6, 75.3, 74.8, 73.5 . . . For some time I couldn't make out this curious behaviour, and then I tumbled to it. The rise in voltage and its maintenance at a high figure had coincided with a spell of hot days and nights; the fall occurred as soon as one of those bitter periods that go to make so many English summers came along.

**The Explanation**

Investigations showed that when the temperature was high the depolarisers of certain makes of battery at any rate, and probably of all, became much more active than usual. Internal resistance was reduced; during the rest period the batteries picked up much more completely than they do in the ordinary way; and when the circuit was completed through the loading resistance the depolariser was fully able to keep pace

with the hydrogen bubbles that normally accumulate round the carbon rod. After that I realised the importance of keeping as nearly as possible a constant temperature in the lab., and made most of my tests in winter time when this can be done by artificial heating. There was an interesting sequel. An American battery company sent me a large packing case full of their wares, with a request for tests to be made at living-room temperature. My results didn't at all agree with those of their own labs.; in every instance my service hours were less than theirs. After some correspondence we found the reason. I had made my tests at as nearly as possible 60 deg. Fahr., which is just below our average living-room temperature. They had done theirs at 70 deg. —Americans keep their rooms much hotter than we do. The moral of all this is that if you want good performance from dry high-tension batteries you should keep them reasonably warm. You needn't bother about the evaporation of internal moisture, of which such a point is made in old textbooks, for cells are sealed nowadays. But don't try putting them into the oven!

**Body Resistance**

A GOOD many readers have been making the experiments that I suggested recently to find their own DC resistance by means of a battery of small voltage and a microammeter. Here are some of the results obtained by a Luton reader, to whom my best thanks for his interesting and detailed account of his doings. Using a battery showing 5 volts on the voltmeter he found that with dry hands his resistance was 250,000 ohms. After soaking his hands in hot water and leaving them still wet, the figure dropped to 25,000 ohms, just one-tenth of what it was originally. Not content with DC results alone, he went on to see what happened with AC. The supply was 240 volts, 50 cycles, and using a fixed resistance of 276,000 ohms in series with himself he obtained a current reading of 766 micro-amperes, which indicates a "personal R" of the order of 37,000 ohms. This reading was obtained with perfectly dry hands. He also endeavoured to make a measurement with a 500-volt megger but found that he could not hold on long enough. I don't wonder!

**The "Skin Effect"**

My correspondent is puzzled that his AC resistance should apparently be so much lower than his DC. He suggests as a possibility that human resistance decreases with an increase in the applied voltage. That may be so—perhaps, he may be further inspired, to make another test with the 276,000-ohm series resistance and a 240-volt DC supply. If he does so, my prophecy is that his DC figures will not be enormously different from those obtained with 5 volts. I think that the decrease in resistance noted when the source is AC is most likely due quite literally to the "skin effect," which is such a well-known feature of the passage of alternating or oscillating currents along a conductor.

In any event, almost all of those who have made the experiment suggested have found that after washing in hot water the hand-to-hand resistance drops to a figure between one-fourth and one-tenth of what it was previously. The moral is undoubtedly that the bathroom is no place for metal switches or for apparatus connected by flex leads to plug points.

Quaint IDEAS  
YOU ACCEPT WITHOUT  
QUESTION . . .

NUMBER SIX

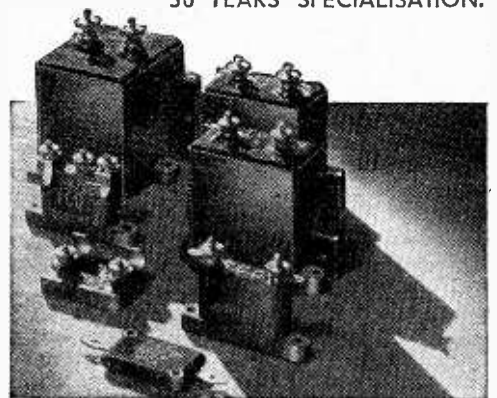


that  
**WINTERS** were  
more severe years ago

GRANDFATHER may insist that winters of his youth were harder than of today, but statistics prove him wrong. Statistics are built up to prove facts, and statistics, going back for more than 30 years, show conclusively that T.C.C. condensers have always been the choice of the communication and radio technician. And there's no change today. Throughout the radio industry all the knowledgeable folk are guided by this

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# Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

## Television Demonstrations

**Y**OUR correspondence columns have carried several complaints about the difficulty of seeing television at the Olympia Show.

There was no difficulty at the Science Museum, South Kensington, where some eight different instruments could be seen in action. It was possible to stand back and view two or more simultaneously, and compare the differences of the pictures.

When I visited the Museum there were probably not more than one hundred people at one time in this section; the demonstrations were free of charge, as were the accompanying exhibition and explanatory lecture. Why did thousands of Londoners pay 1s. 6d. at Olympia and wait hours for a glimpse of one instrument?

Edinburgh. ALEX. STEUART.

**I** READ with surprise in your issue of September 10th the letter of Mr. V. R. Cornell, in which he complains that none of the television receivers on the stands at Radiolympia were working.

Imagine the congestion in the aisles if they had been working! And surely to get tickets at 8 p.m. for the 9 o'clock show was not so bad when one considers the fact that thousands of provincial visitors were unable to see any television at all as they found "House Full" notices at the booking office?

The fault of the whole unfortunate affair lies, I suggest, with the B.B.C. in giving only three hours' transmission a day. I deliberately use the word "transmission," rather than "programme." Those viewers who, like myself, had to endure the transmissions will well understand why!

As regards the theatre at Olympia, I heartily concur with *The Wireless World* in demanding its abolition. At almost every session in the television booths the sound was completely blotted out at times by the bagpipes from the theatre.

Finally, regarding Mr. O. S. Puckle's complaint that he was given a ticket to view an unspecified receiver, I would point out, in fairness to the R.M.A., that this was done on the last day only, and on other days the public were given a free choice in the matter.

Dagenham. S. GOULD.

## Synchronising Film and Disc

**I**N response to Mr. D. W. Aldous' letter on synchronising, I would like to draw the attention of those interested to the issue of "Funktechnischer Monatshefte" for November, 1936. A relatively simple system of electrical synchronisation is described therein and well illustrated. For those who may be unable to read this article, I will venture on a brief description of the system.

Two AC synchronous motors, such as the V.G., are used. The camera is driven by one of these through suitable gearing and has in front of the lens a solenoid-operated mask.

The other motor is fitted with a heavy turntable flywheel, surmounted by the turntable proper, a light aluminium disc. This carries the record and is connected to

the lower turntable by a magnetically released clutch.

In making a film, the lower turntable is started revolving first (the clutch being out); then the recording head is lowered on to the stationary record and a start mark made.

The camera motor is then started by hand, and as soon as it is up to speed the clutch is let in and the lens mask lowered by closing an electric circuit common to both solenoids. Film and disc will now remain in synchronism (the first exposed frame on the film corresponding to the start mark on the record), with only four wires between camera and recorder.

In reproducing, the camera motor is coupled to the projector to keep it running synchronously. On the gate of the projector is a switch connected to the clutch release solenoid and closed momentarily by a notch cut in the aforementioned first frame of film.

The lower turntable is started first as before and the pick-up placed on the start mark. The projector is then switched on, and as the notched frame passes the switch the clutch is let in and the record starts in step with the film, and keeps so throughout the reel. (A mechanical coupler could be used for reproduction just as well.) If a second reproducing turntable is available it will be seen that with a succession of notches quite a long film can be provided with synchronised sound, each notch as it passes the switch operating a simple relay system that automatically switches from one turntable to the other.

It is interesting to note that if a magnetic clutch is provided on the camera as well it is theoretically possible to take many separate shots on one record, since both camera and recorder may be stopped and started almost instantaneously. Also if two such cameras are available it should be possible to switch from one viewpoint to another during a long scene, while keeping the sound continuous.

The clutch mechanism which forms the basis of this system consists of a conical clutch about three inches in diameter and half an inch deep, one half of which is turned directly in the underside of the aluminium turntable itself. The other movable half is connected by two rigid rods through the lower turntable to a grooved collar sliding on the main spindle. One end of a rod, pivoted in the middle, engages in the groove, and a spring at the other end causes the collar to rise and press the two halves of the clutch together.

A magnetically released arm, however, catches the end of this rod, keeping the pull of the spring off and hence the clutch out until the moment for release.

The clutch is reset in the out position by hand.

Tunbridge Wells.

D. ROE.

## Landline Distortion

**A** CORRESPONDENT in your issue of September 3rd comments on the poor quality of B.B.C. transmissions whenever these are taken over the landline system; he refers particularly to programmes relayed from the provinces and heard in London via the London station.

I have no knowledge of London con-

ditions, but I can say that here, where the alternative programmes have to be taken either from Droitwich or the local transmitter, the quality of transmission is always very inferior and sometimes disgracefully bad.

Anyone who doubts these statements should listen via any receiver which has the slightest claim to high fidelity to the German transmissions, and he will be a doubter no longer.

As examples of the disgraceful quality, the transmission from Folkestone, 9.5 p.m., via the local station on September 5th was completely devoid of the whole bass register, while on September 3rd the talk relayed from Nottingham was so muffled, heard via Droitwich, that practically all the intelligibility was lost.

Although the B.B.C. professes to have high quality at heart, every recent move it has made has been a set-back in this direction. As an example, they scrapped the overhead landline system which had a response up to 10,000 cycles in favour of the underground cables, which, according to their own statement, cut off at approximately 6,000 cycles. On the other hand, the German transmitters and some French ones, I am told, have cables flat to 12,000 cycles.

The B.B.C. persistently refuses to transmit audio-frequency tones for test purposes, although here again these can be heard frequently from German stations. In addition, the request for high-quality transmissions via the ultra-short wave station at Broadcasting House has evoked no response.

Recently the London National transmitter has been closed down during the day time and London listeners have to take Droitwich, which again results in a loss of fidelity, since the programme has to travel over some 100 or more miles of cable, to say nothing of the additional cut-off of the higher frequencies in both transmitter and receiver tuning circuits at 200 kc/s compared with 1,149 kc/s.

Manufacturers during the last few years have greatly improved the response and quality of reproduction of receivers by means of negative feedback and variable selectivity, etc., while during the same time B.B.C. transmission quality has deteriorated considerably, and to-day the modern receiver is much better than the transmissions. When will the B.B.C. wake up to these facts?

C. C. V. HODGSON

(Service Dept., Thomson and Brown Bros., Ltd.).

Newcastle-on-Tyne.

## "Direct Current" or "Zero Frequency"?

**F**ROM time to time and in various places I have protested, without noticeable result, against the widespread use of the term "DC current," which, presumably, stands for "Direct current current"—whatever that may be. Outside the language of love and childhood the consecutive repetition of words, for emphasis or any other purpose, is considered crude. But the main trouble is that often current is called where there is no current, and it is not always even direct. What precisely does "DC voltage" mean? And must alternating current always be indirect? If you get it when you

are in your bath it comes with a directness that "DC" cannot beat.

The fact is that "DC" no longer means "Direct current," if it ever did. Then why should everybody go on using it when its use is manifestly absurd, inconsistent, and inaccurate? The same question may be applied to many generally accepted things, such as lbs. avoirdupois and half-crowns; but if exponents of the most modern and—shall we say?—enlightened branches of applied science do not set an example in rationality, can the costermonger be expected to sell by the kilogramme?

My protests, as already mentioned, have gone unheeded. That may be for lack of constructive suggestion. If so, can anybody do better than the following?

What one is trying to express by the term "DC" is the description of a quantity (it may be current or it may be voltage or something else) which can be regarded as a particular case of *alternating*—namely, *zero frequency*. If the alternations get slower and slower until the thing sticks at some level, large or small, positive or negative, the result is what one means. To describe it as "steady" or "unvarying" or "continuous" is not only rather clumsy, but may not be quite true. It may be necessary to tell people to vary the "unvarying" current. And AC can reasonably be described as continuous. Moreover—and this is very important in these days of broadcasting, television, sound films, and one knows not what future developments—the expression "zero frequency" is free to apply not only to electrical quantities, but magnetic, sound, light, or anything else. We have "AF" and "RF," the latter sometimes falling into the subdivisions "IF," "VF," or "UHF." To these I would suggest adding "MF," meaning "mains frequency," if I did not so dislike the term "mains." But "ZF," certainly! All the absurdities and inconsistencies of "DC" disappear. Is it quite too late to do something about it?

M. G. SCROGGIE.

Bromley, Kent.

## Club News

### Golders Green and Hendon Radio Scientific Society

Headquarters: 60, Pattison Road, Hampstead, London, N.W.2.

Hon. Sec.: Mr. A. G. Griffiths, "Hornbeams," Priory Drive, Stammore, Middlesex.

The five-metre competition held by this Society on September 12th last was notable in demonstrating that DF on the ultra-short waves does not necessarily demand open country and unscreened receiving positions, for of the six groups that took part two actually succeeded in locating the transmitter.

The successful competitors were Mr. G. J. E. Hubbard and Mr. E. Gardiner.

### Radio Society of Northern Ireland

Headquarters: Y.M.C.A., Radio Club, Wellington Place, Belfast.

Meetings: The first Wednesday of each month.

Hon. Sec.: Mr. C. Taylor, 2, York Crescent, Shore Road, Belfast.

At the recent annual meeting of the Society, after the election of officers for the year 1937-8, the Leonard, Stevenson and Robinson trophies were presented. It was reported that over two hundred amateurs from all over the world had entered for the Leonard Trophy Contest, the Gold Medal for the highest scorer outside Ireland going to Mr. K. Karkauskas, of Kaunas, Lithuania, the Silver Medal being awarded to Mr. J. P. Jessup, of New Jersey, U.S.A. Mr. E. A. Donovan, of Dublin, won the actual Trophy, the runners-up being Mr. F. A. Robb, of Belfast, and Mr. A. R. Irwin, of Ballygowan. The Stevenson and Robinson

Trophies were awarded to Mr. J. Cowan and Mr. S. H. Pattison respectively.

It was decided to communicate with the I.R.T.S. in Dublin with a view to having an early joint meeting of the two Societies.

### Wirral Amateur Transmitting and Short-Wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.

Meetings: Last Wednesday evening in each month at 7.30 p.m.

Hon. Sec.: Mr. J. R. Williamson, 49, Neville Road, Bromborough, Birkenhead.

As a result of the club securing new headquarters, it is expected that arrangements will be made for meetings to be held more frequently. At the next meeting on September 29th a junk sale will be held.

### Exeter and District Wireless Society

Headquarters: Y.W.C.A., 3, Dix's Field, Southernhay, Exeter.

Meetings: Mondays at 8 p.m.

Hon. Sec.: Mr. W. J. Ching, 9, Sivel Place, Heavitree, Exeter.

The programme of meetings for the autumn session is now available for those who are interested. The annual subscription is 5s. and the entrance fee is 6d. These figures are reduced to 2s. 6d. and 1s. respectively in the case of juniors under seventeen. At the next meeting on September 27th a design for the Society's amplifier will be selected.

### Southend and District Radio and Scientific Society

Hon. Sec.: Mr. F. S. Adams, "Chippenham," 27, Eastern Avenue, Southend-on-Sea.

A total of thirty-six members and their friends took part in the recently held DF contest. Three parties succeeded in finding the hidden wireless transmitter within the prescribed time, the winners, Messrs. L. Pugh and J. Leggett, tracking down the transmitter in the record time of 1 hr. 6 min.

A night DF contest will be heard on October 9th and will commence at 12 midnight. The Hon. Sec. will be pleased to send copies of the rules to any members of other societies who are interested. Visiting teams will be cordially welcomed. Reports on the transmissions, which will be on 155.8 metres, are invited.

### Thames Valley Amateur Radio and Television Society

Headquarters: The Albany Hotel, Twickenham.

Meetings: Wednesday evenings at 8.15 p.m.

Hon. Sec.: Mr. J. N. Roe, 19a, The Barons, St. Margaret's-on-Thames.

The Autumn Programme is now available. The annual subscription is 3s. 6d. At the next meeting, on October 20, a lecture on the manufacture of thermionic valves will be given by Mr. W. S. J. Nixon, of the G.E.C.

### Edgware Short-Wave Society

Will all readers who are interested in the formation of a short-wave society in the Edgware district kindly get into touch with Mr. G. Yale, of 40, Raeburn Road, Edgware?

## The Radio Industry

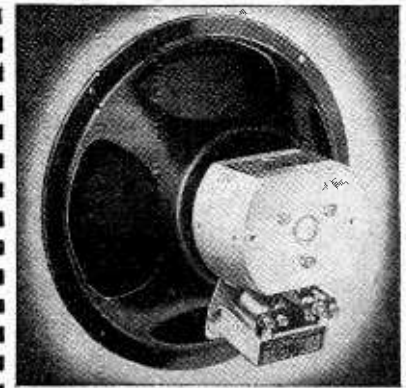
THE Mullard Wireless Service Company, of 225, Tottenham Court Road, W.1, have now issued leaflets describing a cathode ray oscillograph, a service signal generator and a bridge for the measurement of resistance, capacity and inductance.

We have received from the Supreme Instruments Corporation, of Greenwood, Mississippi, U.S.A., a copy of the firm's new catalogue of test equipment.

A leaflet just issued by Thompson, Diamond and Butcher, of 34, Farringdon Road, E.C.1, describes the "National Band" Convertograms. As its name implies, the Convertogram comprised a gramophone turntable and the necessary accessories for converting a radio set for record reproduction.

An extremely well-prepared and informative catalogue, issued by A. C. Cossor, Ltd., of Cossor House, Highbury Grove, N.5, describes all current Cossor receivers.

# NOTABLE FEATURES of the New ROLA F742-PM



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# Recent Inventions

**Brief descriptions of the more interesting radio devices and Improvements issued as patents will be included in this section.**

## TWO-WAY SIGNALLING

A COMBINED transmitting and receiving set, working on centimetre waves, is arranged so that outgoing signals are transmitted on one frequency and incoming signals received on another frequency, the difference between the two forming the intermediate frequency used for superheterodyne reception at both ends of the link.

The incoming signals at each station are fed from the aerial to a transmission line where they are combined, through a Lecher-wire coupling, with the local oscillations—normally used for transmission—and are rectified by a diode valve. The latter is coupled to the superhet receiver, so far as the resulting beat frequency is concerned, by a circuit which blocks out the local waves used for transmission.

*Telefunken Ges Fur Drahtlose Telegraphie m.b.h. Convention date (Germany) January 28th, 1936. No. 466014.*

## AERIALS

THE aerial arrangement shown in the drawing is suitable for receiving short waves, of the order of 10 metres or less, as well as those used for normal broadcasting. If separate sets are available both types of programme can be received simultaneously, or if only one receiver is used it can be switched over

from the short to the medium- and long-wave programmes as desired.

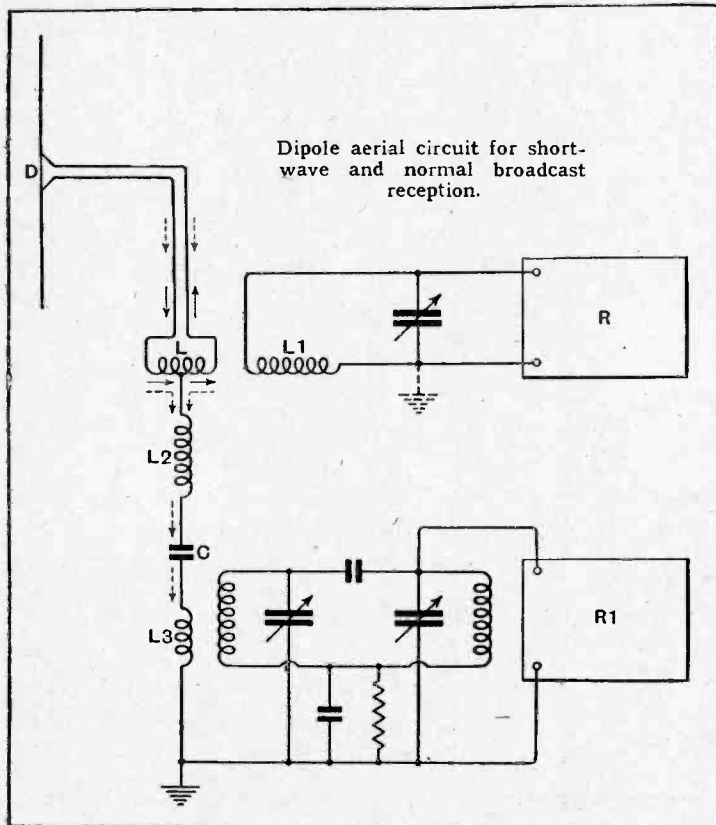
Short-wave signals received on the half-wave dipole D flow, as shown by the full-line arrows, in series through the coil L<sub>1</sub> which is coupled to the input L<sub>1</sub> of the short-wave receiver R. For medium- and long-wave reception the dipole D is earthed through a coil L<sub>2</sub> (which serves to choke back the short waves), a condenser C, and coil L<sub>3</sub>, which is coupled to an ordinary broadcast receiver R<sub>1</sub>. The signal currents in this case take the path shown by the dotted-line arrows, flowing in parallel through the two-wire down-lead from the dipole.

*The General Electric Co., Ltd., and D. C. Espley. Application date, November 14th, 1935. No. 466020.*

## LOUD SPEAKERS

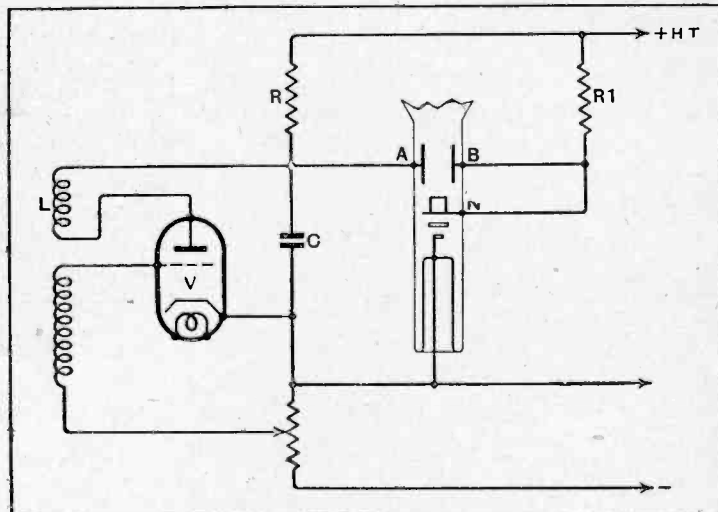
A MOVING-COIL speaker is fitted with two diaphragms. One is large and relatively flaccid, and reproduces the lower frequencies; whilst the other is light and rigid and feeds the high notes into a horn with flared side-walls and substantially flat top and bottom walls. The directional effect of the horn is an additional factor in accentuating the top notes relatively to the bass.

*E. K. Cole, Ltd., and A. E. Falkus. Application date November 21st, 1935. No. 465830.*



## TIME-BASE CIRCUITS

THE circuit shown is designed to prevent distortion of the picture due either to inequality in the scanning voltages applied to the deflector plates A, B of the cathode-ray tube, or to differences of potential between the deflector plates and the anode N.



Time base circuit for CR tube with electrostatic deflecting plates.

The output of the oscillator valve V is connected through a feed-back coil L and resistance R to the positive terminal of the HT supply, a direct connection being taken to the deflector plate A from a point between L and R. The second deflector plate B is connected directly to the anode N of the CR tube, and through a resistance R<sub>1</sub> to the positive source of supply.

The resistances R and R<sub>1</sub> are so chosen that under normal conditions the mean voltage on the plate A is equal to the fixed voltage of the plate B and anode N. The saw-toothed oscillations are, of course, generated by periodically discharging the condenser C through the back-coupled valve V.

*Baird Television, Ltd., and L. R. Merdler. Application date, November 16th, 1935. No. 465892.*

## MECHANICAL SCANNING

IN high-definition work there is a tendency for the rapidly moving mirrors to "curve" each of the scanning lines slightly, instead of keeping them straight. Also the lines appear to diverge instead of remaining perfectly parallel. The latter defect, in particular, is a serious one and can only be corrected by a very exact and troublesome adjustment of all the mirror faces relatively to the drum.

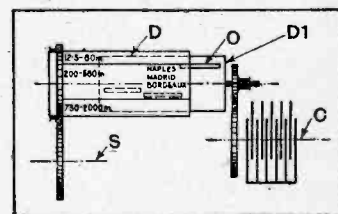
To overcome the trouble at its source, the usual square aperture which defines the shape of the

beam of light is replaced by a vertical slot, of the same width and of any desired length. The image of this slot is then moved across a transverse slot by the line-scanning mirror, and the brightly illuminated small square, formed by the intersection of the two slots, is projected on to the frame scanning-mirror. The latitude of movement allowed by the two transverse slots eliminates both curvature and any lack of parallelism.

*E. Traub. Application date February 26th, 1936. No. 465642.*

## TUNING INDICATORS

A COMBINED wavelength and station-name indicator consists of two concentric drums D and D<sub>1</sub>, one rotating inside the



Drum-type tuning scale described in Patent No. 465442.

other. The outer drum is controlled from the shaft S of the wave-change switch, and carries a tabular list of stations operating on the short, medium and long waves.

The inner drum is controlled from the tuning-condenser shaft C, and is provided with a series of apertures, such as O, which expose the name of the station to which the receiver is tuned. The two drums are shown slightly displaced, in an axial direction, for the sake of clearness, but in practice they fit exactly one within the other, and an illuminating lamp is placed along the axis of the inner drum.

*Minerva-Radio W. Wohleber. Convention dates (Austria) June 27th and July 16th, 1935. No. 465442.*

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