The Wireless World AND RADIO REVIEW

(19th Year of Publication)

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A Word to New Readers.

A WORD of welcome to our new readers and our thanks to old readers who, to judge from information from our publisher, must have responded wholeheartedly to the suggestion which we made that they should introduce *The Wireless World* to their friends with the New Readers' Number of last week. The reception which this issue has received has exceeded all expectations and shows clearly that *The Wireless World* has an obligation to carry out to meet the needs of an ever-increasing public.

We want to feel that, following on the publication of the New Readers' Number, every additional reader of the paper added to our circle has the same confidence in the value of the journal that we feel sure is felt by all our former supporters.

The policy of *The Wireless World* is distinctive. It sets out to keep the reader informed on everything that matters in connection with wireless in a sane and unbiased manner. If readers look for sensationalism of an artificial character in *The Wireless World* they will be disappointed; if sensational events take place or new discoveries are made *The Wireless World* can be counted upon, as in the past, to give the news at the earliest possible moment, but sensations will not be raised in the journal simply as journalistic stunts. *The Wireless World* has built up its reputation on the sane presentation of facts, and has no intention of sacrificing that reputation in the future. Through the columns of *The Wireless World* it has always been our endeavour to give the utmost service possible to the reader and to put readers' interests before all other considerations. We like to feel that we are in personal touch with our supporters, and welcome letters at any time from readers who have suggestions to make which may enable us to meet their special requirements by the choice of articles to include.

We would take this opportunity of stressing to the new reader the importance of taking rather more than a superficial interest in understanding how wireless works. There is fascination, we know, in owning and operating a receiver; there is an added interest when the receiver is self-assembled; but the utmost satisfaction comes from an understanding of the inner working of the set and ability to appreciate the purpose of every component and the part it plays in the receiver as a whole. The articles which new readers will find in *The Wireless World* will be largely concerned with providing this information; the sets for home construction which we describe will be distinctive and original, whilst the general features will continue to make the journal a complete wireless newspaper.

In This Issue

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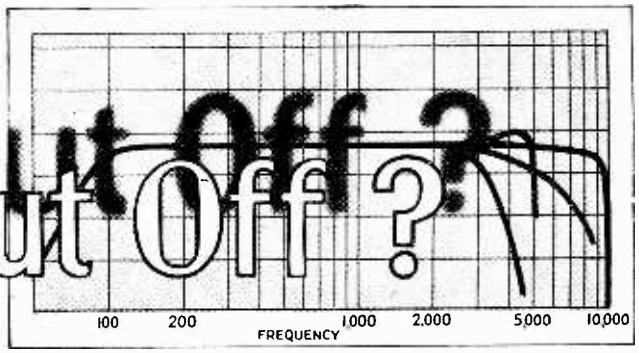
Our Show Competition.

IN this issue we include descriptions of the receivers, accessories, and components which were elected by our readers to first place in the various classes into which we divided the exhibits at the recent Olympia Radio Show in connection with the competition conducted by *The Wireless World*.

Adjusting Response in the Upper Register to Eliminate Heterodyne Whistles.

Where to Cut Off?



EVERY user of a wireless receiver capable of receiving foreign stations is familiar with that irritating form of interference—the heterodyne whistle. During the winter months, when the signal strength of foreign stations shows a marked increase, and the greater part of our normal listening time is after sunset, the problem of heterodyne interference assumes greater importance. The trouble has been still further aggravated by recent difficulties in controlling the wavelengths allocated to European broadcasting stations and by the marked increase in the numbers of high-powered transmitters using powers of the order of 20 kilowatts or more.

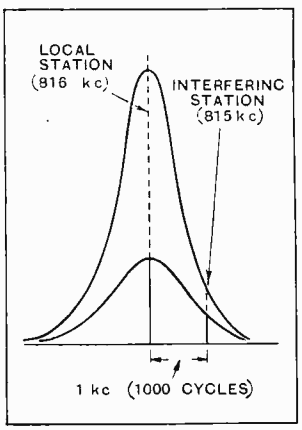


Fig. 1.—Heterodyne interference is reduced by the employment of selective circuits.

The pitch of a heterodyne whistle depends on the relative frequencies of the carrier waves emitted by the interfering stations. It is, in fact, exactly equal to the difference between the two frequencies. Thus, two stations working on 368.1 metres (815 kilocycles) and 367.6 metres (816 kilocycles) would be capable of producing heterodyne whistle of 1 kilocycle, or 1,000 cycles—a note having a pitch about two octaves above middle C on the piano. Clearly, this is a case where it is convenient to think of stations in terms of kilocycles rather than wavelengths. A fixed relationship exists between the frequency in kilocycles of the alternating currents in the aerial of a transmitter and the length of the ether waves they produce. To find the kilocycles equivalent to any given wavelength, divide 300,000 by the wavelength.

Band-pass an Improvement.

Turning our attention once again to the two stations in our example, which are *capable* of producing a beat note of 1,000 cycles, let us now consider the conditions under which the note will actually be heard in the loud speaker. In general, the strength of the beat note produced will depend on the relative strengths of the two interfering signals by the time they reach grid of the detector valve. This, in turn, will depend on two factors —the relative field strengths of the two transmitters at the place where the receiver is situated, and the treatment to which the two signals are subjected in passing through tuning circuits of the set. If one station happens to be the local and the other an obscure relay station in Central Europe, the interference, if any, will not be very serious; but, nevertheless, it will be materially reduced by the employment of a more selective tuning circuit. This point is made clearer by the diagram in Fig. 1, which shows that a more selective circuit increases the strength of the local station relative to that of the interfering station.

In the modern band-pass tuning circuit the same effect may be obtained by reducing the peak separation to something less than the customary 9 or 10 kilocycles. With inductive or capacitative coupling this can be conveniently effected by making the coupling elements variable, as in Fig. 2; in the case of inductive coupling the amateur may like to experiment with a miniature variometer, or, alternatively, a tapped coupling coil. The idea is attractive in principle, but in practice it will be found that, in order to produce any noticeable reduction

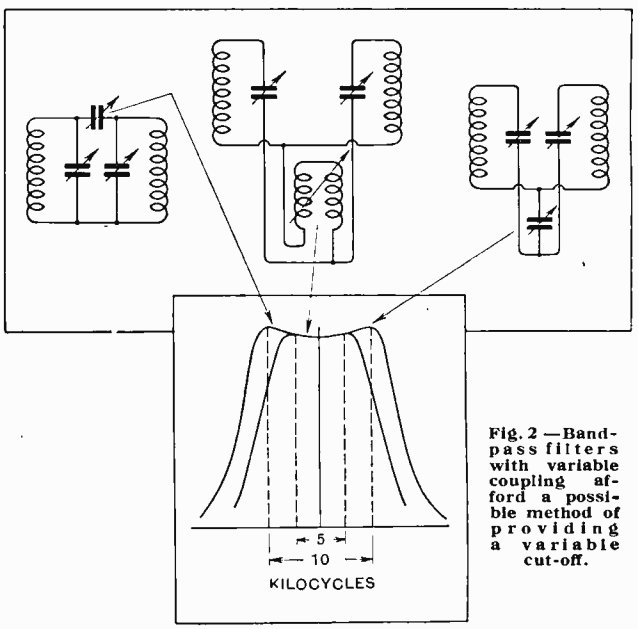


Fig. 2.—Band-pass filters with variable coupling afford a possible method of providing a variable cut-off.

Where to Cut Off?—

of heterodyne whistle, the band width will have to be narrowed so considerably that the lower side-band frequencies will become affected.

The same effect can be produced equally well on the L.F. side by the well-known expedient of connecting a resistance and condenser across the anode load of one of the valves. This method works well when applied to the correction of high-note response in pentode valves, as in Fig. 3. The type of correction curve given by this circuit is shown at (2) in Fig. 4. It will be seen that the correction is progressive, and starts well down in the middle register, which is desirable when applied to the rising characteristics of a pentode valve used in conjunction with a moving-iron loud speaker. When applied to the elimination of heterodyne whistle, however, it will be found that the middle register will suffer considerably before interference in the region of 3,000 to 6,000 cycles is reduced to a sufficiently low level.

Recent improvements in the high-frequency response of receivers and loud speakers have accentuated interference troubles due to heterodyne whistles. For the full enjoyment of programmes subjected to this interference restriction of the upper register is essential. The article discusses the cut-off frequency which will give the best compromise with quality and the circuits available for achieving the desired result.

A Low-pass Filter.

A two-stage filter circuit provides the only practical solution of the problem. The type of filter required is similar to that used in the smoothing of rectified H.T. current, and is known as a "low-pass" filter. It consists of a number of inductances in series with by-pass condensers connected between the junction of each inductance element and earth. By a suitable choice of values, the cut-off can be adjusted to any desired frequency, and the sharpness of the cut-off can be increased by multiplying the number of stages in the filter. Experience shows that for the present purpose two stages will give satisfactory results.

The next step is to decide at what frequency to cut-off. From the point of view of quality it is desirable to maintain response up to as high a frequency as possible, while the wide divergence in the pitch of heterodyne whistles calls for a low cut-off in order that the filter may be able to deal with the majority of cases of interference to be met with at different parts of the tuning scale. Since it is impossible to cope with every particular case we must allow the question of quality to pull the most weight in effecting a compromise, and decide to abandon reception of those stations which are heterodyned at a frequency below the cut-off which it is finally decided to adopt.

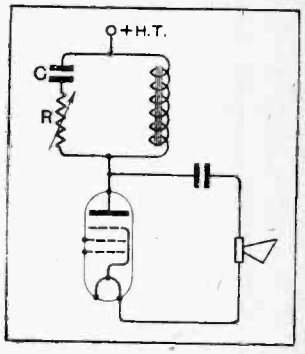


Fig. 3.—The simplest form of tone correction in the upper register consists of a condenser and resistance in parallel with the output choke.

Fortunately, the greater part of the interference occupies the region above 3,500 cycles (shown shaded in Fig. 4), and does not interfere with the fundamental frequencies used in speech and music. Some of this will be automatically eliminated by the loud speaker, since, with one or two notable exceptions, the range of response seldom exceeds 6,000 cycles. It is for this

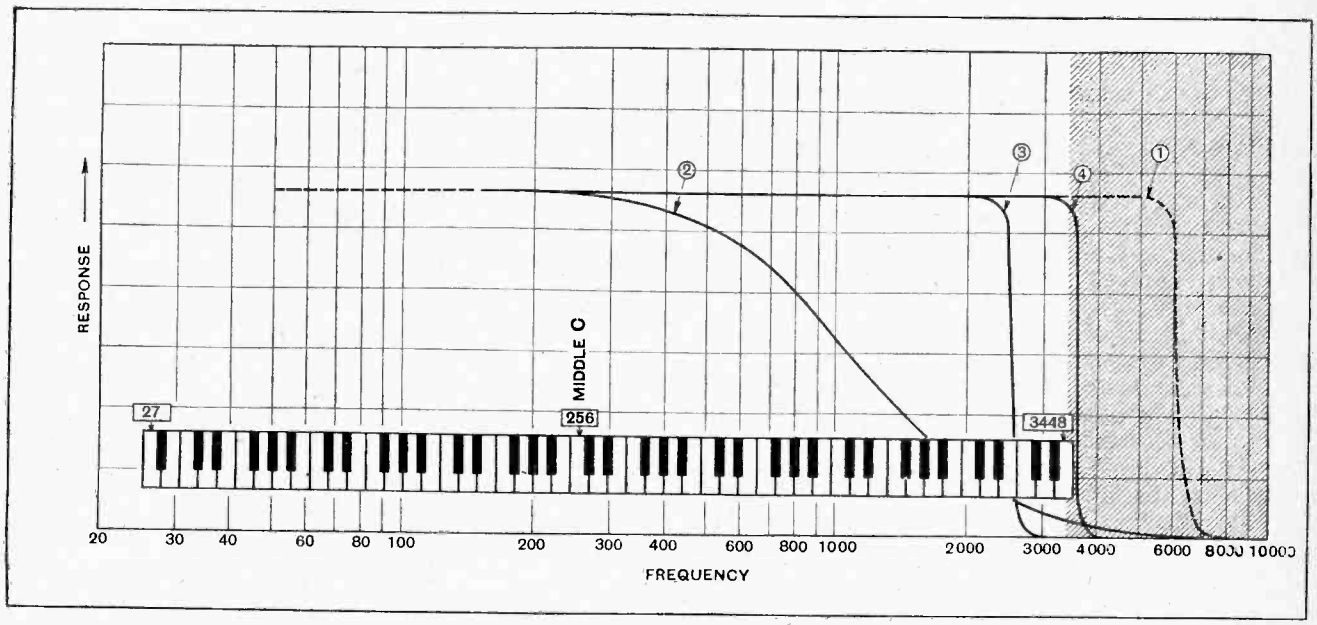


Fig. 4.—Diagrammatic presentation of the cut-off problem. (1) The majority of loud speakers, including moving coils, provide a natural cut-off at 6,000 cycles. (2) The simple correction circuit of Fig. 3 cuts deeply into the middle register before the high note response is sufficiently reduced. (3) 2,500 cycles represent the lowest permissible cut-off frequency. (4) The best compromise with quality is provided by a cut-off at 3,500 cycles.

Where to Cut Off?—

reason that the heterodyne beat between stations separated by the official 9 kilocycles is seldom heard in the loud speaker. The troublesome region between 3,500 and 6,000 cycles can be best dealt with by fixing the cut-off at 3,500 cycles. A survey of musical scores suggests that the lowest possible limit for the cut-off

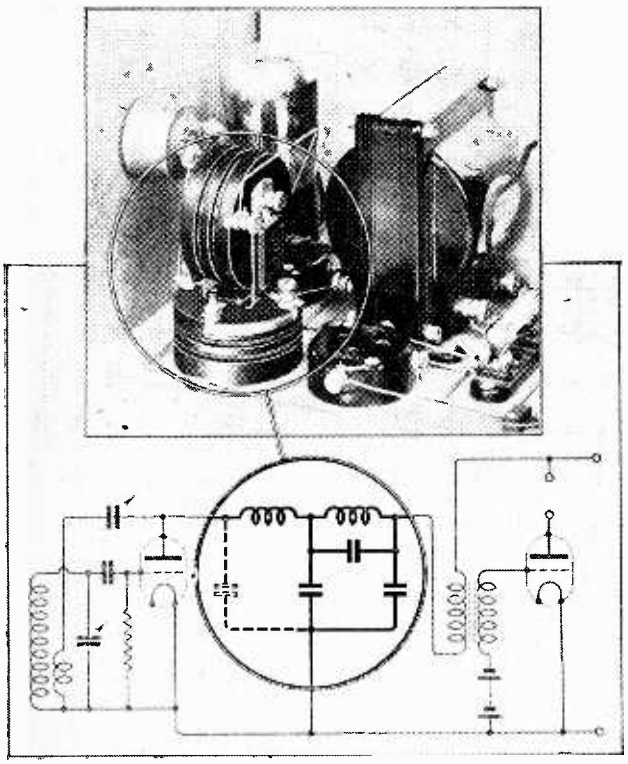


Fig. 5.—Filter circuit made by Messrs. Postlethwaite Bros., and designed to follow the detector valve.

would be about 2,500 cycles, since notes up to this frequency are in common use. A cut-off as low as this, however, would begin to affect the articulation of speech, and occasionally the top notes of scale passages in music would be decapitated. The answer to the question in the title of this article can, therefore, be given fairly definitely as *3,500 cycles*.

Considerable latitude is permissible in the method of applying the filter. For instance, it may be connected immediately following the detector valve in the set in the position normally occupied by the H.F. choke. A special filter designed for this position is made by Messrs. Postlethwaite Bros., Kinver, Staffs, and is illustrated in Fig. 5. The circuit diagram shows that the first capacity in the filter is the normal anode by-pass condenser (shown dotted). The constants of the circuit has been adjusted on the assumption that a 0.0003 mfd. differential reaction condenser will be used. The unit is suitable for transformer and resistance coupling, and can also be adapted for ordinary leaky grid or power-grid detection by substituting different values for the by-pass condensers, which are easily detachable. The cut-off is in the region of 3,500 cycles, and in no way affects the quality of speech, while the higher frequencies of music are very little reduced. Nevertheless, the majority of the more troublesome heterodynes on the medium wave-band are completely cut out by the filter. It has been found that the filter is more effective when the second section is tuned, so that the unit really functions as a combined "low-pass" and "band-stop" filter.

In the Philips type 2181 permanent magnet moving-coil loud speaker a two-stage filter is incorporated between the secondary of the output transformer and the low-resistance winding of the loud speaker. The cut-off is at approximately 4,000 cycles, and a switch is incorporated, so that the filter may be disconnected when receiving stations not subjected to heterodyne interference. Under these conditions the full-frequency range

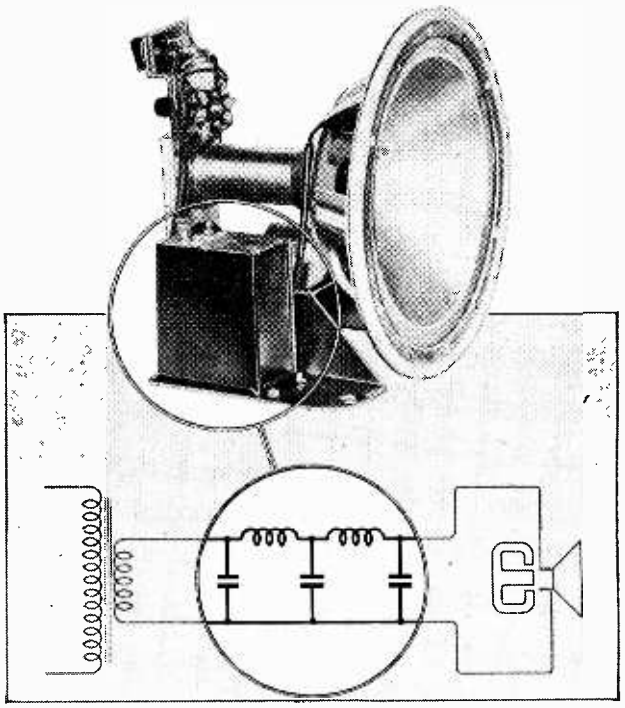


Fig. 6.—The filter circuit in the Philips type 2181 loud speaker may be switched out of circuit when not required.

of the loud speaker may be used, with a consequent improvement in brilliance and the reproduction of transients.

"THE CHRONICLE" WIRELESS ANNUAL.

THE Manchester Radio Exhibition owes its inception mainly to the energies of our contemporary, the *Manchester Evening Chronicle*, which played a prominent part in inaugurating the earlier Exhibitions, and is now acting in conjunction with the Radio Manufacturers' Association.

The publication of the very useful *Chronicle Wireless Annual* usually coincides with the opening of this Exhibition, and the Ninth Edition of this little book fully retains the standard reached by its predecessors, and contains full descriptions of sets recommended, and many valuable hints to amateur constructors and users of receivers. An excellent innovation is the chart of "wiring" diagrams, in which the actual wiring is not shown, but, instead, the various points to be connected are indicated by the same letter.

This Wireless Annual is published by Allied Newspapers, Ltd., Withy Grove, Manchester, for the modest price of 1s.

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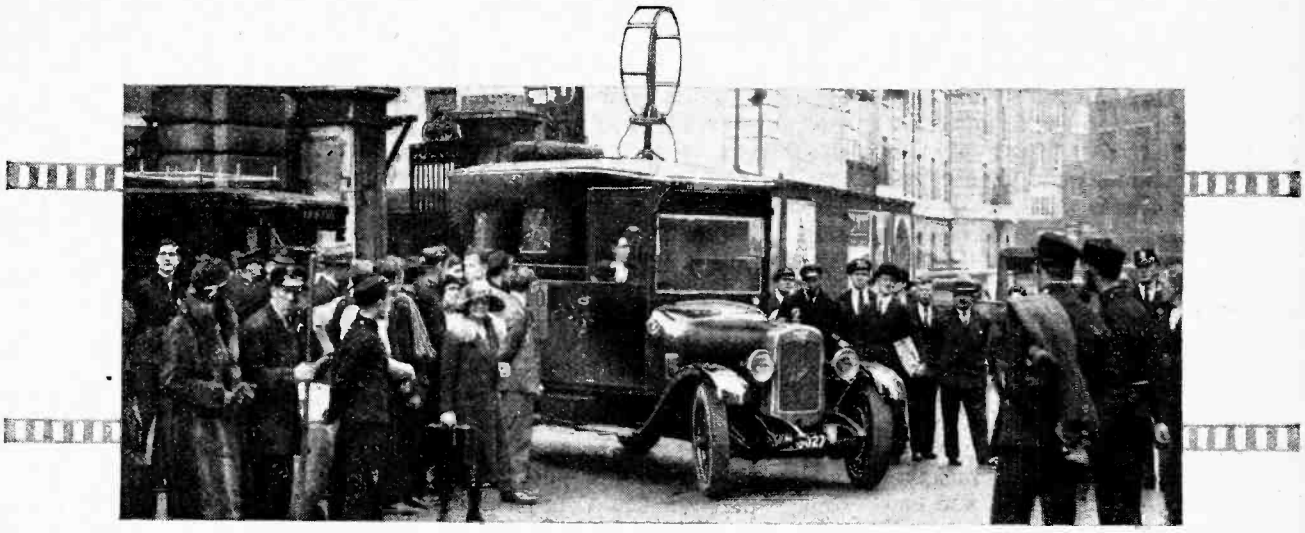


PREVENTION v. DETECTION.

How Licence Anomalies Could be Overcome.

By J. GODCHAUX ABRAHAMS.

WHEN on October 1 last the Post Office authorities started a vigorous campaign towards trying to scare the radio pirates into buying licences, the step taken did not come as a surprise to the majority of registered listeners. According to official statistics, at the end of 1930 only 3,391,042 licences had been issued for the year in Great Britain and Northern Ireland, and this figure appeared to be out of all proportion to the sales of receivers, components, valves, etc., when statistics were taken into consideration.

If the figures were to be believed the London area was responsible for fewer than 600,000 licences in a population of over seven million souls. Apparently the authorities, looking around for further sources of income, awakened to the fact that in this large community there lurked some 400,000 or more owners of receivers who had not gone to the expense of paying the annual tax. Was it possible to estimate the number of radio pirates in the rest of Great Britain? A difficult matter, as obviously it was not correct to take the London area as a basis for the proportion of non-registered to licensed listeners throughout the kingdom.

We must admit, *a priori*, for many reasons that the majority of pirates must be found in the more populated areas. Taking, however, the figures put forward by the Post Office, we could assume that almost similar conditions were likely to obtain in such congested agglomerations as Birmingham, Manchester, Liverpool, and so on. In these circumstances it was reasonable to presume that from three-quarters to one million licences might be roped in. The figures were interesting, inasmuch as the extra income derived would be a substantial one, and would not only counteract any suggestion put forward in certain quarters to increase the cost of the tax, but would also amply compensate the British Broadcasting Corporation for the sacrifice it had willingly offered to make in cutting down by £200,000 its share of the revenue derived from the sale of such licences.

* * *

FROM the outset, the Post Office authorities missed an excellent opportunity of securing valuable data when the terms of the original wireless licence were drafted. It is true that on the advent of broadcasting in the United Kingdom it was assumed that the bulk of the applicants for such permits were endowed with little more than an ordinary, and very primitive, crystal set, and for years, apparently, the B.B.C. seems to have devoted its energies to providing adequate reception by this class of receiver. Progress, however, has been rapid, and since that date most crystals have been replaced by the more effective valve. How many crystal sets are there in existence to-day? *Such information was, and still is, most valuable, yet no step has been taken at any time to secure it.* From the start, as in other countries, the applicant for a licence should have been asked to state the class of wireless set used. Such information might also have influenced greatly the choice of sites for the home high-power transmitters.

* * *

IN respect to radio pirates, I am convinced that during the first few years their number was a limited one; their rate of increase was slow so long as an outside aerial was needed. But with the advent of more sensitive valves and more efficient circuits, with the use of indoor aerials, and in particular with the wireless receiver obtainable in portable or transportable form, *nous avons changé tout cela.* From that moment we can assume without any great risk of contradiction that the

Prevention v. Detection.—

number of radio pirates increased by leaps and bounds. Maybe, through ignorance, some purchasers of wireless apparatus which did not need outside aerials were led to think that its acquisition was on a par with that of a gramophone, and that consequently no licence was needed; but, on the other hand, *every facility was given to the public to evade the payment of the tax.*

Over four years ago I advocated a measure which was an easy one to adopt—namely, that a broadcast licence should be issued by the dealer at the time of purchase, exception to be made in cases where the buyer was able to produce proof that he had effected registration and had paid the tax for the current year. If you buy a motor car you cannot take it out of the garage or showroom without a licence, and I doubt whether anybody would attempt to do so. Why should not this rule apply to radio sets? The dealer would be furnished with a book of licensing forms, and after issue would remit the money and counterfoils, duly filled in, to the nearest post office. In Canada, I understand, the procedure has already been adopted with success, and the issue of the licence carried a *ten per cent. commission to the dealer.*

As regards home constructors, the matter would not offer any greater difficulty. A licence would be shown to the person from whom purchases are made. It is perfectly true that some unscrupulous people, by obvious methods, could still evade payment of the tax for a more or less limited period, but in any case they would be in the minority, and the great increase in the number of radio pirates would be checked at the source.

* * *

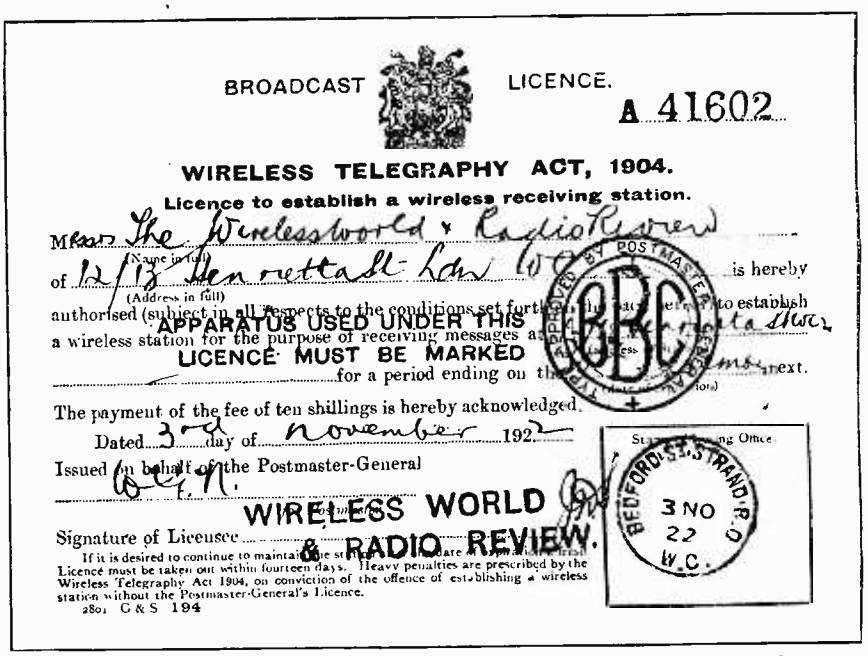
SUFFICIENT use is not made in Great Britain of the official broadcast licence; it has a definite value abroad, apart from the permit it grants to the holder to install a wireless receiver. In Germany, for instance, registered listeners, in many instances, are classed as a separate section of the community, and enjoy certain privileges denied to other members of the general public. Many theatres in both Germany and Austria make substantial reductions in the prices of seats if such a licence is produced at the booking office. In the case of radio exhibitions in most foreign countries, licence holders are also favoured, and on these occasions the railway companies agree to concessions on fares. Shops, also, in most cities grant liberal rebates to this class of customer.

It is a pity that wireless licences do not fall due on specified dates instead of being taken out on any day (barring Sundays) of the year. Possibly the reason for not adopting the former method was to avoid congestion at the post offices, but to all intents and purposes a similar practice could have been adopted as for the application or renewal of car and driving licences. Forms, also, should be obtainable everywhere, from post offices, stores, and wireless dealers alike, and such forms should be the means of providing information useful both to the authorities and B.B.C. As a matter of fact, in Denmark this channel was used for obtaining an expression of opinion from listeners in respect to the programmes broadcast. No general consensus of likes and dislikes on the part of the public can be gathered in any other way.

* * *

THE manager of a theatre or cinema may judge the success of his presentations by a scrutiny of the box-office receipts; a newspaper, to a certain degree, can gauge the popularity of new features adopted in its columns by its circulation figures. The B.B.C. can in no instance tell whether, as a public service, any particular style of programme has met with general approval, or even with the approval of the majority of its supporters. Information such as could be obtained from application and renewal forms would prove of valuable help in the compilation of popular programmes.

The suggestion I have put forward should, I think, be considered with an open mind. The whole matter dealing with the suppression of radio pirates is wrapped up in the licence question; *prevention is better than detection or cure,* and I feel that if due precautions are taken there would be no need to resort to post office "radio sleuths," "ghost" vans, and "penny gaff" tricks such as we have recently witnessed, which are surely little more than an insult to our credulity.



BROADCAST LICENCE. A 41602

WIRELESS TELEGRAPHY ACT, 1904.

Licence to establish a wireless receiving station.

Messrs. The Wirelessworld & Radio Review (Name in full)

of 12/13 Henrietta St. London W.C. (Address in full) is hereby authorised (subject in all respects to the conditions set forth in the Schedule hereto) to establish a wireless station for the purpose of receiving messages at the address specified in the Schedule hereto for a period ending on the 31st next.

APPARATUS USED UNDER THIS LICENCE MUST BE MARKED

APPROVED BY POSTMASTER-GENERAL BBC

The payment of the fee of ten shillings is hereby acknowledged.

Dated 3rd day of November 1931

Issued on behalf of the Postmaster-General

WIRELESS WORLD & RADIO REVIEW.

Signature of Licensee

If it is desired to continue to maintain the station the above Licence must be taken out within fourteen days. Heavy penalties are prescribed by the Wireless Telegraphy Act 1904, on conviction of the offence of establishing a wireless station without the Postmaster-General's Licence.

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BEDFORD ST. STRAND. W.C. 3 NO 22

Nine years ago radio traders were required to submit their products to a Post Office test before the necessary B.B.C. mark could be affixed. Our contributor's proposals, if carried out, would involve no more inconvenience and would, incidentally, provide dealers with a small commission revenue.

B 12

America Favours the Highly Developed Superheterodyne.

By A. DINSDALE.

THE eighth annual Radio-Electrical World's Fair which was held in New York from September 21st to 26th was remarkable in several respects. First and foremost there is the inclusion of the word "Electrical" in its title. Last year the non-radio exhibits of household electrical equipment were sparsely dotted about on a balcony; if you weren't interested there was no need to climb up there to see them. This year these exhibits were mixed up indiscriminately with purely radio exhibits on the main floor.

Why?

Well, it's a long story. Briefly summed up, American radio dealers have found that, for one reason and another, it is no longer profitable to deal exclusively in radio sets. Or perhaps it would be nearer the truth to say that the enormous profits of former years have, like the Arabs, folded their tents and faded away. Hence, the dealers have turned to such side-lines as moving picture cameras, home talkie equipment, gramophones (electric), sports goods, vacuum cleaners, electric washing machines, and electric refrigerators. Particularly the latter.

For some reason which remains a mystery, a luxury such as an electric refrigerator, costing several hundred dollars, has sold in quantities approaching boom proportions during the past year. Anybody who can sell an article priced at several hundred dollars (such, for instance, as the radio set of a few years ago) is assured of a handsome profit at the expenditure of no more effort than it takes to sell a present-day cheap and (to the dealer) unprofitable radio set.

The next unusual feature has to do with the business aspect of the show. Only 122 radio manufacturers exhibited their products, as against 176 last year. The total attendance for the week this year was 252,573, as against a total of 246,395 last year. And the total business done during the week this year amounted to $6,483,421, as against $5,700,000 last year. These latter figures are all the more remarkable when it is remembered that prices are lower this year. It is estimated that three million radio sets will be sold in the United States during the next twelve months.

No Outstanding Developments.

These figures would seem to indicate that the show was a huge success, that it must have proved very interesting, and that the American 1932 radio set must be possessed of many unusual features. Personally, and quite frankly, I came away from the show a sadly disillusioned man, still wondering what it was all about, and how on earth I could possibly write for *The Wireless World* the intelligent report of the new set features which is expected of me!

First, I reviewed the show from the technical man's point of view. Nothing *very* outstanding. Next, from the potential set purchaser's point of view. A few points there, perhaps. Then, from the point of view of the proletariat which wants a show. Eureka! They got a show, all right. That's the answer to the popularity puzzle. Now to explain it.

The inclusion of domestic electrical equipment brought the womenfolk along in increased numbers, and "side-shows" were so numerous and so well staged that, for

New York Radio Show.—

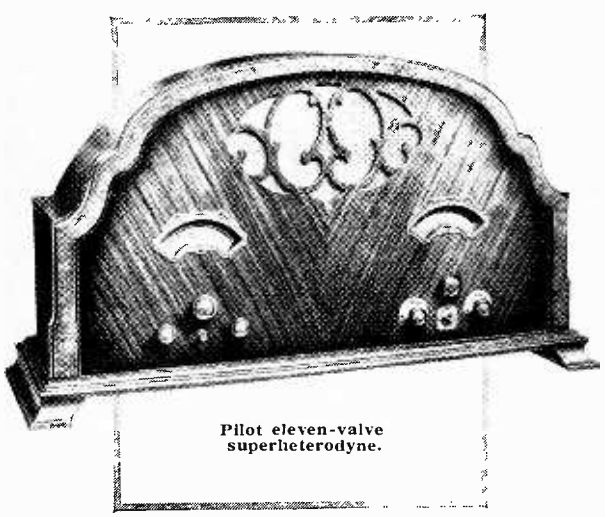
the first time, they held the centre of the stage, while the purely radio exhibits, figuratively speaking, were lined up against the backdrop.

During the week a television set-building contest for Boy Scouts attracted considerable attention, while radio service men were catered for by the promotion of a "trouble shooting" contest. The chassis of a dozen well-known makes of radio sets, previously put out of commission with a multitude of faults, were lined up on a bench, and each competitor had to diagnose what was wrong with each one. The sets were not repaired, but left for the next competitor. This idea might be used to advantage by those who aspire to improve the calibre of our own service men. (No offence meant, but there *have* been some complaints in the past, haven't there?)

The "Stunts."

In the Radio Corporation of America's booth great interest centred on a complete record-making outfit, which visitors were invited to use, free, to make records of their own voices to take home and play on their own gramophones.

Another popular side-show was the exhibit of historic radio equipment, which this year included models of apparatus used by Michael Faraday. As usual, the American Radio Relay League ran an always crowded stand from which they offered to send messages to any part of the world, free, on short wave. Last year I thought I'd be a smart reporter and send the Editor of *The Wireless World* a message outlining briefly the highlights of the show. He never got it. This year there were no highlights. (No offence to amateurs; I used to be one myself.)



Pilot eleven-valve superheterodyne.

Separate tuning controls are fitted for short-wave reception.

The National Broadcasting Company had an exhibit which had as much significance as showmanship. It consisted of a long panel some six feet high, studded with dials and switches. By donning headphones, visitors could listen in to short-wave broadcasting from all parts of the world. Immediately over the panel there was a large map of the world, studded with little lights. As you tuned from station to station the lights lit up, one by one, indicating the station and country to which you were listening.

The regular international broadcasts which have been

Atwater Kent Compact model.
It is a superheterodyne with variable-mu valves and pentode, tone adjustment, and automatic volume control.

relayed so frequently by the National Broadcasting Company and the Columbian Broadcasting System during the past year have stimulated very considerably the interest of the American listening public in short-wave broadcasts from foreign lands. So great is this interest, in fact, that one of the few radio set features of this year's show was the introduction by several manufacturers of all-wave sets, tuning from 15 to 550 metres. It seems probable that, before long, American listeners will create a demand for these sets so that, when they tire of domestic broadcasting, they can tune in some foreign station and hear its programme without waiting for one of the chain stations to transmit a rebroadcast.

Provision for Short-wave Reception.

However, there is a danger of disappointment here. The signal, as rebroadcast, sounds pretty good nowadays, and is rapidly improving, but the listening public knows nothing of the complicated receiving equipment which picks up the actual short-wave signal. The comparatively steady signal passed on to the broadcasting stations to-day is the result of multiple aerials covering acres of ground, automatic volume controls to counteract fading, etc. However, it is a new feature which promises to stimulate business, and may develop more successfully than appears likely at present.

The ever-popular "crystal studios" were again in evidence this year. There were two of them, shared by the N.B.C. and C.B.S. They were much larger and better built than heretofore, the windows were larger and better arranged, and there was more room left for

New York Radio Show.—

the public to congregate and watch their pet radio artists "do their stuff."

Unquestionably the biggest draw of all was television. It was well advertised in the newspapers, and drew enormous crowds. There seems little doubt that television saved the radio show, from the attendance point of view.

The system exhibited was that of U.A. Sanabria, of Chicago. At the opposite end of the basement to the crystal studios he had his transmitting equipment on a raised platform, and thousands of people posed before the transmitter during the week. A few yards away, in a small theatre built in a corner of the basement, images were shown on a screen measuring about four feet square. Between three and four hundred people at a time saw these images, and each showing had to be curtailed to about ten minutes in order to cope with the mob.

Most spectacular of all, however, were Sanabria's demonstrations on a ten-foot screen which was hung high over the main auditorium of Madison Square Garden. This screen was of plate glass, frosted on one side, and weighed 350 lb. The images were projected on to it from behind. Twice a day, for fifteen minutes, at 4 p.m. and 10 p.m., all the lights were extinguished while as many as 50,000 people gathered in the aisles to watch the images of the artists in the basement, and hear them over the public address system. As I stood there in the darkness among the crowd, holding firmly on to my wallet, I wondered how many gadgets disappeared from the stands during those shows.

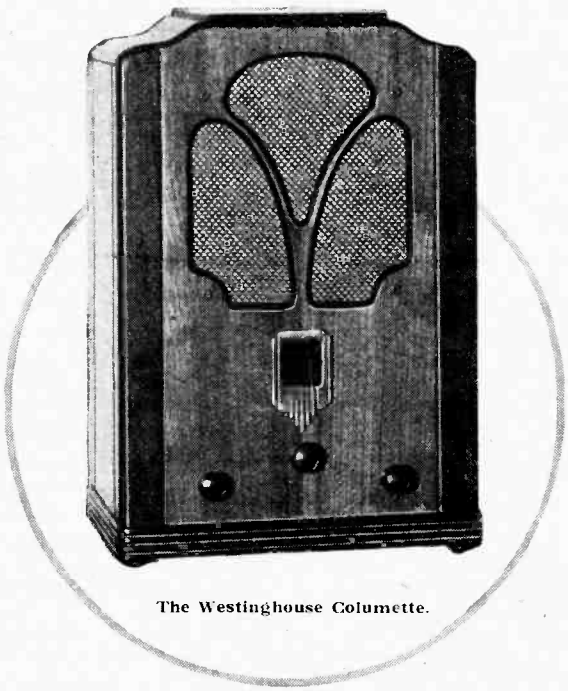
Sanabria uses a triple spiral disc, 15 holes per spiral, and transmits only 15 frames per second. The spirals are so arranged that succeeding light spots half overlap their predecessors. With these refinements the net result is an image which is almost devoid of both "strip effect" and flicker. In my opinion the illumination of the screen is about half that of a cinema screen, and the image detail can bear comparison with similar close-up shots on the screen at the average cinematograph theatre.

The secret of the light source which permits such brilliant long-range projection is that it is a crater type neon lamp fitted with a heater element, like an indirectly heated valve cathode. Thus, the discharge takes places in hot gas instead of having to heat up cold gas. This is said to make the lamp much more responsive to minor current fluctuations, thus making possible more detail in the image. Also, the hot gas breaks down, it is said, at from 15 to 25 volts instead of the usual 160 volts for cold neon.

Before leaving the subject of television, David Sarnoff, President of the R.C.A., announced when opening the show that he definitely expected television to take its place in the American home in the autumn of 1932. From this and other utterances it is expected that the secrets of the R.C.A.-Victor laboratories will be revealed at next year's Radio Show in the form of a cathode ray receiver which will project an image on to a screen measuring six by eight inches, and it is said that that image will be as good as a newspaper reproduction.

The demonstrations, however, have little bearing on the solution of the problems standing in the way of the production of radio-operated home television equipment.

During Radio Show week the American radio industry received the most welcome piece of news it has heard for some time. The long-drawn-out litigation between the R.C.A. and the De Forest Co. over valve patent rights has at last been ended by an amicable settlement under the terms of which R.C.A. will pay the De Forest Co. a million dollars, and cross-licensing agreements will be entered into. This settlement will affect some twenty independent valve manufacturers, and quash their triple damage anti-trust law infringement suits which they had brought against the R.C.A., and which totalled $50,000,000. These firms will also join the patent pool, and the radio industry is expected to benefit greatly by the resultant stabilisation.



The Westinghouse Columette.

This receiver makes use of variable-mu valves, thus eliminating the need for a "local-distance" switch. It is an eight-valve superheterodyne.

To come at last to the difficult problem of analysing the features of the radio sets. The vast majority of 1932 sets are superheterodynes; tuned radio-frequency circuits have almost entirely disappeared. Such superhet. defects as radiation, image, oscillator drift, etc., have been overcome in the better sets. Automatic volume control is obtainable in some models, and visual tuning is much in evidence. This feature is desirable in the modern sharply tuned superhet. Two forms are almost equally popular. In one form, a narrow vertical neon tube placed immediately over the tuning scale lights up only when the set is correctly tuned. In some cases arrangements are such that the call letters of the station tuned in are silhouetted by the light. In the other form of visual tuning, a small meter is fitted above the tuning scale, and the user is instructed to tune for maximum needle deflection.

The pentode valve has found wide use in the output stage of the 1932 set, due to cost savings, but unfortunately the noticeable distortion, due to odd harmonics, rules out this type of valve for the better-class sets.

New York Radio Show.—

Variable-mu valves are also widely used. Twin speakers, improved automatic gramophone record changers which take the new long-playing records are also new features. These long-playing records, which have just appeared, run for fifteen minutes, at one-third of normal record speed. Originally designed to provide, on a single record, the recorded broadcast programmes which are widely used by some American broadcast stations, and which, to fit American conditions, must fit into fifteen-minute units of broadcast time, these records are now being made available to the public, not only for general convenience, but also for home talkie purposes.

Greater interest has been taken by manufacturers this year in battery-operated sets. Improvements in valves and accessories have made it possible now to produce a battery-operated set which, in conjunction with a permanent-magnet-type dpnamic speaker, compares favourably with a power-operated receiver. The significance of the move lies in the fact that in the vast agricultural areas of the United States electric current supply is still missing, and it is estimated that there are eight and a half million homes in these areas.

As regards cabinets, the tendency this year is to smaller sizes and plainer designs in the cases of those outfits which set out to be just radio sets. On the other hand, there is a large increase in period furniture and grandfather clocks. The lady of the house has grown tired of a bulky piece of furniture which merely served as a radio set; now she wants it to serve a dual purpose. So we now have elaborate bookcases, "secretaries" (American for writing desk), and all manner of furniture of a more or less utilitarian character. As to prices, the de luxe sets of years gone by have been modernised, and their prices have been cut almost in half. The ordinary common or garden radio set, in a common or garden walnut cabinet, averages about $60—£12 to you, in the days when a pound was a pound.

One problem of radio shows has been solved very admirably this year. I refer to the tons of paper in the form of pamphlets which one used to cart home in large paper bags thoughtfully provided by certain manufacturers. This time such literature was conspicuous by its almost total absence. I never could understand what useful purpose, if any, was served by those innumerable pamphlets anyway. They never gave you any technical information, nor did they, in most cases, quote prices. Perhaps you were supposed to go and see your local dealer about it.

EUROPE'S WAVELENGTH TANGLE.

U.I.R. Unties a Few Knots.

By a Correspondent in Rome.

BEYOND a slight rearrangement of a few wavelengths to meet desperate cases of interference, the only result of the disappointing meeting in Rome of the Union Internationale de Radiodiffusion is the proposal that a special committee of European delegates should be formed at the coming Madrid Conference to discuss the whole interference question and rearrange the European ether. It is probable that at the same time the constitution of the Union will undergo reorganisation.

The autumn session, which was held at Rome from October 19th to 24th was generally felt to have one primary aim, namely, the solution of the wavelength problem, which looms larger every year. According to the Prague plan, signed in 1929, any complete rearrangement of wavelength could only be effected at an official Conference to which the European Posts and Telegraphs administrations would send delegates. To hasten matters the Union recently proposed such a meeting to the various administrations, but these voted against such a reunion by a majority of one, the opposition being based on the fact that the coming World Wireless Convention at Madrid in 1932 involved too much preparatory work to allow time for such a meeting. It was also contended that possibly more waves would be allotted to broadcasting at the Madrid Convention, and therefore it might be necessary to rearrange the whole broadcast wavelength plan within a year's time.

On the other hand, the Union, having the interests of listeners at heart, did not want to leave things as they were; consequently certain smaller-wave changes have been suggested, and it is understood that the administrations concerned will agree to their being put into practice for the winter. So far as British listeners are concerned the two most important changes will be the separation of 11 kc. between Stuttgart and London Regional instead of 9 kc. as at present, and a separation of 10 kc. between Langenberg and Northern Regional. To compensate for these changes certain stations situated geographically far apart will have their frequency separation decreased.

M. Raymond Braillard, President of the Technical Committee of the International Broadcasting Union.

Although the next meeting of the Union will not take place until May or June, with a venue in Switzerland, the Technical Committee, presided over by M. Braillard, will be immediately summoned should the necessity arise. It is understood that the slight wavelength changes will include the following:—Heilsberg from 276.5 to 274.2 metres; Turin, 274.2 to 276.5 metres; Hilversum 298.8 to 296.1 metres; London Regional from 356.3 to 355.8 metres; Stuttgart, from 360.1 to 360.6 metres; Northern Regional from 479.2 to 480 metres; and Vienna, from 516.4 to 517.2 metres.

The most optimistic will hardly expect these changes to make any appreciable difference to the interference nuisance, but it is reassuring to note that the Union is still doing its utmost for the benefit of European listeners.

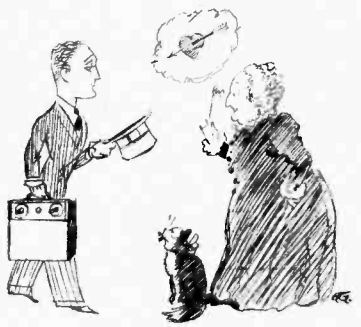
Unbiased.

Give Us More Volts!

By FREE GRID.

I WONDER why so many portable set makers insist on supplying their sets with H.T. batteries of utterly inadequate milliampere hour capacity? The old argument that if a set is to be portable at all it must be light and compact simply won't wash nowadays, for even the most compact suitcase-type "portable" has such bulk and weight that nobody but a fool would attempt to set out for a picnic with it unless equipped with a car, or some sort of conveyance. For hikers and other cranks there is always the form of instrument designed for headphones only, and requiring very few volts and milliamperes of H.T. supply.

Since, therefore, good portables are not really portable, there can be no objection to making them slightly less so, thus enabling economically sized H.T. batteries to be used. Even the largest instruments—the "transportables"—which are not intended to be carried farther than from room to room, err in the matter. I have heard it argued that poor old Aunt Agatha's heart must be considered when these instruments are being designed, but in any case the weight of the present-day instrument is quite sufficient to finish her off, so why worry about a



Aunt Agatha's heart must be considered.

a few extra pounds? So come, manufacturers, give us not only more milliampere hours, and thus lessen the drain on our pockets, but give us more volts also, so that we can use a bigger output valve and thus get better quality; it will pay you in the long run, because we shall surely be tempted to use output valves of a type only suitable for a heavy-duty battery eliminator!

Five Arguments Answered.

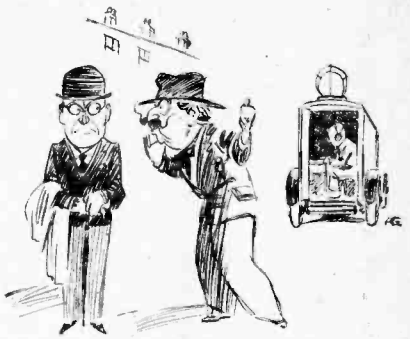
I FAIL to understand why manufacturers of battery-driven sets are still insisting on confusing the ordinary non-technical set owner by equipping their sets with more than one H.T.+ terminal, and, furthermore, fitting them with a perfectly unnecessary S.G.+ terminal. By means of suitable voltage-dropping resistances built into the set one H.T.+ terminal can, of course, easily take care of all valves, and a semi-fixed or semi-variable—whichever you like to call it—potentiometer connected between H.T.+ and H.T.− could take care of the S.G. voltage.

The five arguments which every manufacturer will marshal against this proposal are as follows: (a) the extra components will mean that a higher price must be charged for the set; (b) changed values of anode resistances will be necessary every time a new type valve is tried; (c) it will be necessary to alter the setting of the potentiometer whenever a new type of S.G. valve is tried; (d) the S.G. feed potentiometer will impose a *large* extra drain on the S.G. battery when the set is working; and (e) the S.G. feed potentiometer will run down the H.T. battery when the set is switched off unless the additional complication of a switch is provided.

Here are the respective answers to these flimsy excuses: (a) the increased cost will be negligible to the manufacturer; (b) modern valves can tolerate quite large variations in the volts "on the plate," and in any case, valves of the various classes are rapidly becoming more or less standardised in the matter of H.T. voltage and current; (c) this is so, but simple scale markings on the semi-fixed potentiometer already advised would enable the merest novice to do this himself; (d) and (e) rubbish! If British manufacturers honestly cannot arrange to connect the low potential end of this device in such a position that the ordinary L.T. switch—without any additional switch contacts—can perform this office, then they are beyond all hope, and I retract all that I have said, and advise them to go in for making something simple, such as clothes-pegs.

Setting a Van-trap.

A POST OFFICE official, in the course of an interview with the radio representative of one of our most plutocratic morning journals, made public the fact—rather unwisely, I thought—that the apparatus in the "mystery van" works on the absorption principle; that is to say, it relies upon the fact that the pirate sets act in the manner of absorption wavemeters.



Unfolded a hideous plot.

I hope that no reader of *The Wireless World* with a perverted sense of humour will attempt to emulate the example of a quondam friend of mine, who is preparing a neat trap for the wretched Post Office Inspector whom he expects to call upon him very soon.

At one time he held a licence, but becoming weary of the fare which the B.B.C. provided, he let it lapse and actually sold his set. A few days ago, however, he borrowed a wavemeter from me and he has since unfolded a hideous plot. He has put up a lofty aerial and has coupled it up to a tuned circuit consisting of a low-loss coil and tuning condenser,

Unbiased.—and with the help of my wavemeter he has tuned the circuit to the wavelength of the London Regional. The result is that the van cannot fail to discover him, more especially as his house is in a rather isolated position.

Awaiting the Call.

He is now looking forward maliciously to the inspector's call, which will give him the opportunity to state that he possesses no apparatus capable of receiving radio signals—a statement which will, of course, be technically true, because no rectifier or other apparatus will be attached to the aerial and its associated tuned circuit.

It seemed to me that there must be a legal loophole, so I hastened for advice to a well-known barrister friend, but he rather startled me with the opinion that there is no need to limit oneself to an absorption circuit, and that the Post Office authorities would have no legal leg to stand upon even if they found a complete all-mains receiver, provided that they failed to discover a pair of 'phones or a loud speaker to turn the electrical output into an intelligible form. It would appear from this that any pirate who observes the approach of an inspector can defeat the ends of justice simply by heaving his loud speaker over the wall into his neighbour's garden.

MULLARD P.M.202 POWER VALVE.

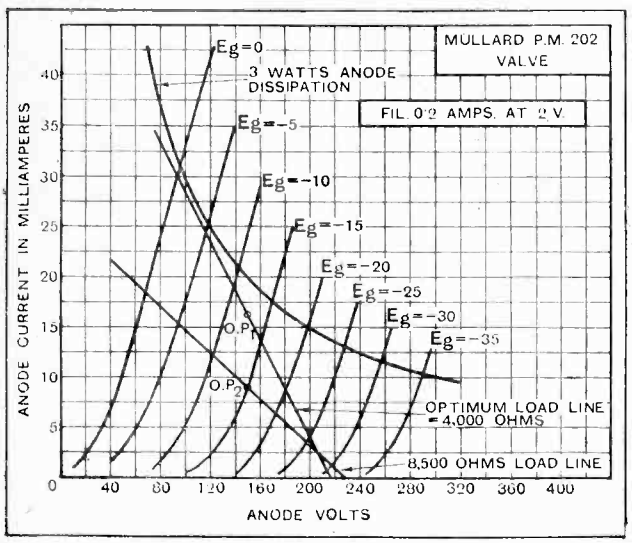
A 2-volt Battery-operated Super-power Output Valve.

IT is now generally recognised that to obtain an adequate acoustic output from a good loud speaker of the moving-reed type an A.C. input of between 300 and 400 milliwatts is desirable. While this condition is not difficult of attainment in an economical manner using the 6-volt type of power valve, there have been obvious difficulties in the way of repeating this condition in a like manner with valves requiring but two volts on the filament. In the case of the Mullard P.M.202 power-output valve the filament consumption has been reduced to 0.2 amp., and it operates with 150 volts on the anode, and when given the optimum grid bias draws 16 mA. from the H.T. battery. The undistorted A.C. power output is 350 milliwatts.

Its characteristics as given by the makers are:

A.C. resistance 2,000 ohms.
Amplification factor 7.
Mutual conductance 3.5 mA/v.
measured at Ea (anode volts) = 100; Eg (grid volts) = 0.

The low L.T. current required is of special interest to the owners of portable sets, and, although the anode current errs on the heavy side for dry-cell H.T. batteries of the smaller kind, a distinct saving in this direction can be achieved by slightly increasing the grid bias. The optimum grid bias is about $-12\frac{1}{2}$ volts, but by increasing this to -15 volts the undistorted power output is not reduced very appreciably. Actually, the drop is from 350 to 325 milliwatts only. But the anode current is brought down to the quite reasonable figure of 9 mA.



Anode volts-anode current curves for the P.M.202 valve. The maximum watts dissipation curve and the optimum loads under various conditions are shown.

When biased to the optimum value the most favourable loud speaker impedance is of the order of 4,000 ohms, but by increasing the negative bias to -15 volts the optimum loud speaker impedance becomes approximately twice this figure. This is of little consequence, so far as the moving-iron type of loud speaker is concerned, since the impedance of the average specimen is about 5,000 ohms at mean speech frequency, and the only effect produced is that the correct matching takes place slightly higher up the audible scale.

In cases where the H.T. is derived from a mains unit the optimum grid bias is recommended, since there will be no point in conserving H.T. current.

Two specimens of the P.M.202 were tested, and their characteristics measured under the most favourable operating conditions, viz., 150 volts on the anode and $-12\frac{1}{2}$ volts grid bias. The following values were obtained:

P.M.202.	A.C. Resistance (ohms).	Amplification factor.	Mutual Conductance.
Specimen 1	2,700	6.7	2.5 mA/volt.
Specimen 2	3,100	6.7	2.16 "

Where mains are available, or if there is no particular need to conserve H.T. current, but owing to one circumstance or another the use of 2-volt valves is imperative, moving-coil reproduction could be achieved by employing two valves in parallel in the output stage. It is doubtful if a single valve would prove entirely satisfactory, although reasonably good results would not be absolutely unobtainable with a single P.M.202, provided the moving-coil speaker is above the average in sensitivity.

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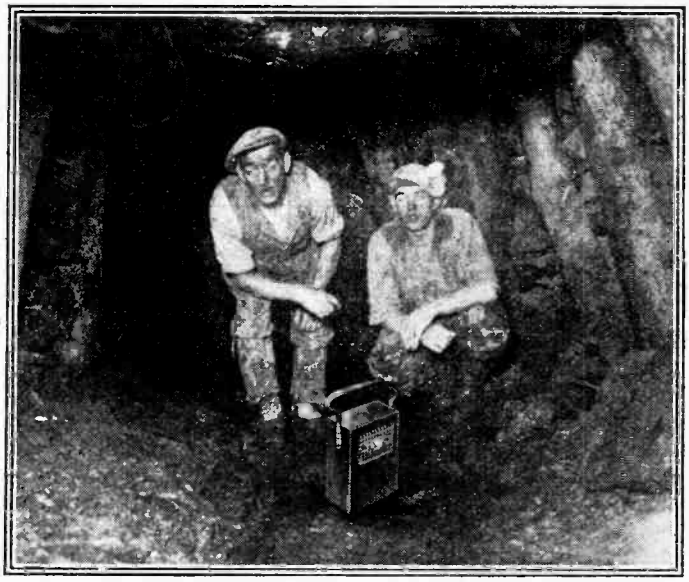
PHOTO CELLS and their APPLICATIONS

No. 2 Detection of Dangerous Gases



By R. C. WALKER, B.Sc.

THE wide application of the photo-cell in industry is well exemplified in the detection of poisonous and dangerous gases. A modification of the standard circuit, as already described in an earlier instalment, arranged to incorporate two photo-cells is very conveniently adapted for use as a detector of impurities in air or other gases, and is particularly suitable for use in certain places, such as coal mines, where gas estimation is highly important. The circuit shown in Fig. 1 forms the basis of the Pritchard gas detector.

Before proceeding farther, the action of the circuit should be made clear. In principle it is the same as that of the standard circuit, viz., control of the grid potential of the thermionic valve, in the anode circuit of which is the alarm relay. The two photo-cells, which should be of the vacuum type and of similar characteristics, are arranged with a separate adjustable diaphragm over the cathode of each, so that accurate control of the amount of light reaching the cathode can in each case be secured. A common source is used for illuminating both cells so that slight variations in the light output, due to voltage change or ageing of the lamp, affect the cells equally and thus do not vitiate the results.

Referring to Fig. 1, it is clear that if the amount of light on cell A is greater than that on Cell B, the valve grid will be positively charged and the current in the anode circuit will be unaffected. If, however, the reverse conditions obtain, viz., that the light on cell B is greater than that on cell A, then the grid will be negatively charged and the anode current will cease, so releasing the relay.

THE photo-cell, or the electric eye, as it has been aptly called, is rapidly becoming of extreme importance in industry. Not only has it rendered talking films possible, but it is also finding a place in guiding aeroplanes, counting moving objects, checking winners at race meetings, and, among a multiplicity of other uses, it can detect automatically the presence of poisonous gases, as described in the accompanying article.

In order, then, to adapt the arrangement for gas detection, a chemical indicator which is continuously subjected to the action of the gas mixture under observation is arranged in front of the cell A, and should be contained in a transparent thin-walled vessel and placed in the direct path of the light falling on to the cathode of the cell A. A schematic diagram showing some of the essential component apparatus used is illustrated in Fig. 2.

The chemical indicator is of such a nature that the presence of the impurity to be detected will bring about a change in its optical transparency. Quantitative estimation of impurities can be made by calibrating the apparatus, this being done by setting the respective diaphragms and treating the indicator with a known amount of the impurity it is desired to detect. In some cases, of course, it may be difficult to use the exact arrangement detailed above, inasmuch as the indicator itself may be incapable of transmitting light, in which case it may be necessary to arrange the photo-cell and light source so that radiation from the latter may reach the cell after having been reflected from the indicator.

The apparatus outlined above can be operated, of course, from supply mains, but in order to render the equipment accurate in reproduction of results, batteries should be used, and the whole equipment can then be readily produced in the form of a self-contained portable unit. It has been

Photo-cells and Their Applications.—

found that the weight of such a unit capable of continuous operation for as long as twelve hours is as low as 10 to 15 lbs. The gas under observation is drawn through the chemical indicator solution by means of a small pump, which can be driven by a motor or operated by hand. The intake should extend to the bottom of the vessel containing the reagent, and horizontal baffles should be fitted to break up any large bubbles rising to the surface of the liquid which might otherwise momentarily upset the equilibrium of the apparatus by passing directly through the light beam. This is, however, not essential, as the passage of gas through the solution is easily controlled by varying the speed of the suction pump.

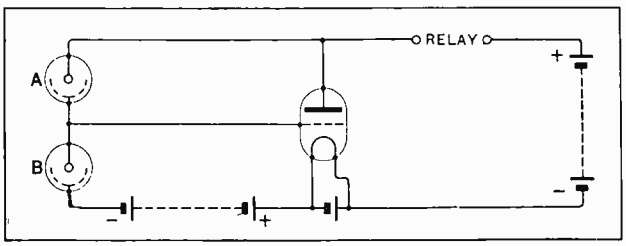


Fig. 1.—The circuit arrangement comprising two photo-cells and a thermionic valve. The relay is actuated when the grid of the valve is made negative, due to more light falling on cell B than on cell A.

The nature of the indicator will depend on the impurity it is desired to detect, it being desirable, as a general rule, that the reagent should only be affected by the impurity under observation, and not by the presence of other gases inadvertently mixed with it. Probably the most important impurity in air which is likely to be inhaled by human beings is carbon monoxide.

Detecting Poison Gas in Warfare.

Carbon monoxide most frequently occurs as a product of incomplete combustion, and is particularly toxic in its action on the human body. It unites very readily with the hæmoglobin of the blood, forming a relatively stable compound, thereby reducing the ability of the blood to convey oxygen from the lungs to the tissues. A mixture of considerably less than 1 per cent. in air rapidly causes insensibility and if breathed for any length of time there are quite likely to be fatal results.

A suitable chemical indicator can be prepared by the addition of 5 per cent. solution of caustic soda to a 2 per cent. solution of silver nitrate, and then adding ammonium hydrate until the black precipitate at first produced dissolves. When filtered, the resultant solution is reduced by carbon monoxide.

An alternative is a weak solution of potassium permanganate, and silver nitrate when acidified with weak nitric acid is discoloured by the passage of air containing carbon monoxide. The most delicate indicator is probably a solution of palladium chloride in water slightly acidified with hydrochloric acid. A precipitate is formed in this solution by 0.05 per cent. carbon monoxide in air. The reaction is unfortunately not characteristic, ammonia, acetylene, and hydrogen sulphide producing the same results.

Chlorine can be detected in air by the use of a 2 per cent. silver nitrate solution, 0.01 per cent. in air producing a precipitate. In like manner almost any gas, with the exception of those chemically inert, can be detected as an impurity and quantitatively estimated. It is a fortunate fact that the more injurious the gas the more chemically active it is, and, in consequence, more easily detected by the apparatus outlined above. The apparatus is extremely simple and easy to handle, involving nothing more than switching on the current and filling the containing vessel with the required reagent.

It may not be out of place to mention a few instances in which the apparatus could be successfully employed. Its utility as a detector of poison gas in warfare is not to be overlooked. It is a significant fact that while during the last war the poison gas used, usually chlorine or mustard gas, gave at least some warning of its approach by its acrid smell, chemical warfare research is now directed to gases which are odourless as well as more deadly, and a suitable detector becomes essential if adequate warning is to be given of their presence.

The Photo-cell in Coalmines.

Again, coal gas, commonly used as a household illuminant, may contain anything up to 12 per cent. carbon monoxide. Danger is always present from

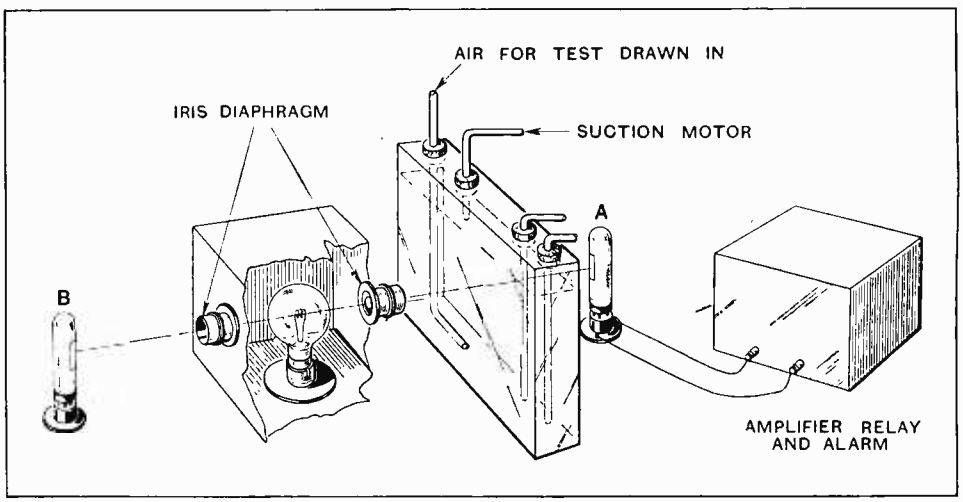


Fig. 2.—Schematic diagram of the apparatus used for the detection of noxious gases. The photo-cells A and B are connected as shown in Fig. 1.

Photo Cells and Their Applications.—

leaky pipes caused by electrolytic or chemical corrosion. The fact that several serious explosions have recently occurred in underground mains is sufficient indication that an efficient detector could successfully be employed with a view to preventing such disasters.

The increasing use of the internal combustion engine, the exhaust gases of which contain 3-7 per cent. carbon monoxide, is not without significance. The many thousands of motor cars in continual use in our large cities supply a steady stream of carbon monoxide to the atmosphere. Although, obviously, the large dilution which occurs through admixture with the air is sufficient to prevent this supply from becoming acutely toxic, there is a considerable body of opinion that the absorption of small quantities of the gas in the human body is cumulative and that a chronic form of poisoning is possible, frequently remaining unrecognised as such.

Whatever may be the value of these opinions, the danger is obvious, and records of the prevalence of such impurities in industrial areas would be useful in the interest of the health of the community. There are also the demands of the coal mining industry, where every year more attention is given to automatic detection of noxious gases, particularly carbon monoxide and methane. Explosive gaseous mixtures frequently collect in the holds of cargo boats, especially those carrying coal and sugar; in the case of the latter commodity, carbon monoxide is frequently evolved in consequence of the too close packing of the cargo.

These instances could be elaborated almost indefinitely, but it will be evident that the scope of this method of detection is very wide. Variations of the form of the instrument are numerous, and means may be provided for the automatic recharging of the reagent tank a few minutes after each detection. The relay would normally operate a buzzer or bell, but could easily be arranged to switch on a fan or control some emergency device for reducing or dispersing the gas containing the impurity when the latter reached the danger limit.

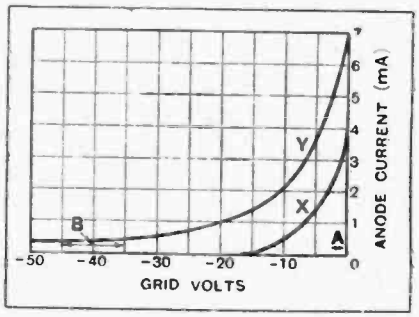
VARIABLE-MU AND SILENT BACKGROUND.

THE more one becomes acquainted with the variable-mu valve the more one realises how valuable a contribution it is to radio, ranking in importance perhaps with such developments as power-grid detection. Mere inspection of the characteristic curve suggests many advantages, but it is not until a set containing these valves is handled that their true merit is apparent.

When the valve was first introduced it was felt that the property of linear H.F. amplification of large signals without appreciable rectification would outweigh other advantages, but the new type of volume control by grid bias which it renders possible is sufficiently attractive to put these other advantages, although in themselves important, into second place.

When an outside aerial is used the signal developed on the first valve of the receiver may have a value of some 5 to 6 volts if there is a high-power transmitter a few miles away, and even at twenty miles there may be more than one volt (peak). The modern screen-grid valve will handle only a fraction of a volt satisfactorily, and to cope with inputs of the large amplitude already referred to, a volume control which cuts down the aerial volts has to be pressed into service. Unless specially designed, such a control may upset ganging, and furthermore, weakened signals will still receive the full amplification of the valve with unnecessary valve noise accounting sometimes for an irritating background.

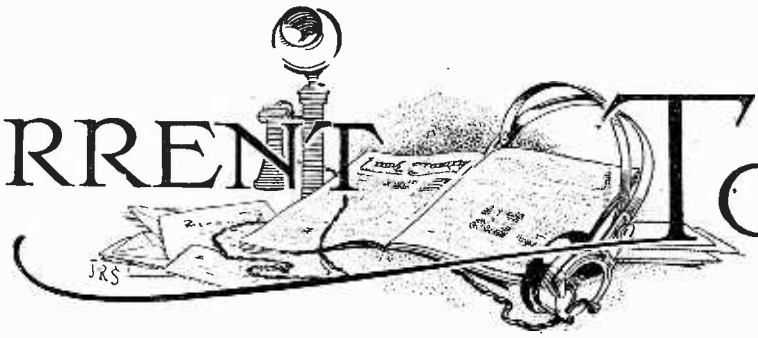
The dual type of volume control with two members ganged on one spindle goes a long way towards solving the problem by reducing aerial volts at the same time as decreasing screening grid volts (and hence valve magnification), but it may be difficult to arrange for distortionless control, since one member may require a different rate of rotation from the other. The variable-mu valve, a typical characteristic of which is shown at Y in the diagram, provides the ideal single control of signal strength, for when a weak signal is tuned in the volume control would naturally be turned to maximum, and the small input shown as A would be impressed on the steep part of the curve to be amplified as with any ordinary S.G. valve. When the local station is tuned, the loud speaker output would be badly distorted owing to overloading, and the listener naturally would turn the volume control towards minimum, so bringing the bias point to, say, B where a signal of 10 volts total swing can be accommodated on the linear "tailing" curve. By increasing the bias not only has the largest signal that is likely to be encountered in almost any locality been accepted, but also the valve magnification, and with it valve noise, has been reduced together, of course, with the the H.F. stage gain.



Typical curve (Y) of a variable-mu screen-grid valve. A small signal A is amplified at the steep part of the slope while a large signal B is applied at a region of low mutual conductance. Bias control of volume would be impossible with an ordinary S.G. valve (curve X).

Thus, a distortionless single control of volume becomes available, which can reduce the local station to silence without upsetting ganging, and having the advantage that a particularly silent background is obtained; furthermore, if selective circuits are used, then, to the advantage of distant-station reception, there is no need to reduce the length of the aerial in districts where the local field strength is high. Another advantage is the excellent quality of reproduction due to the absence of "modulation rise" so often encountered with two or more ordinary S.G. stages. The list of benefits is indeed formidable. W. I. G. P.

CURRENT TOPICS



Events of the Week in Brief Review.

BRITAIN WINS LICENCE RACE.

The race between this country and Germany for the four millionth broadcast receiving licence has ended in a victory for Britain. Thanks partly to the Post Office "ghost van" campaign, the British figures went up with a rush towards the end of October, and the four million mark was reached with Germany nearly 200,000 behind.

And now for the five millionth, and thence to the ten millionth, which the more optimistic statisticians regard as the saturation point for these islands. The German saturation point, on the basis of four heads per licence, should be in the region of 15,000,000.

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"TELEVISION" AT THE VATICAN.

"The Pope seen by *Television*," was the inevitable description given by the lay Press to the interesting ceremony at the Vatican on October 25th, when His Holiness attended the opening of the Belin phototelegraphy transmitter. The apparatus is the gift of M. Edouard Belin, the well-known French experimenter, and it was appropriate that the first picture—a photograph of the Pope and his entourage—was transmitted by radio to the Belin laboratory in Paris.

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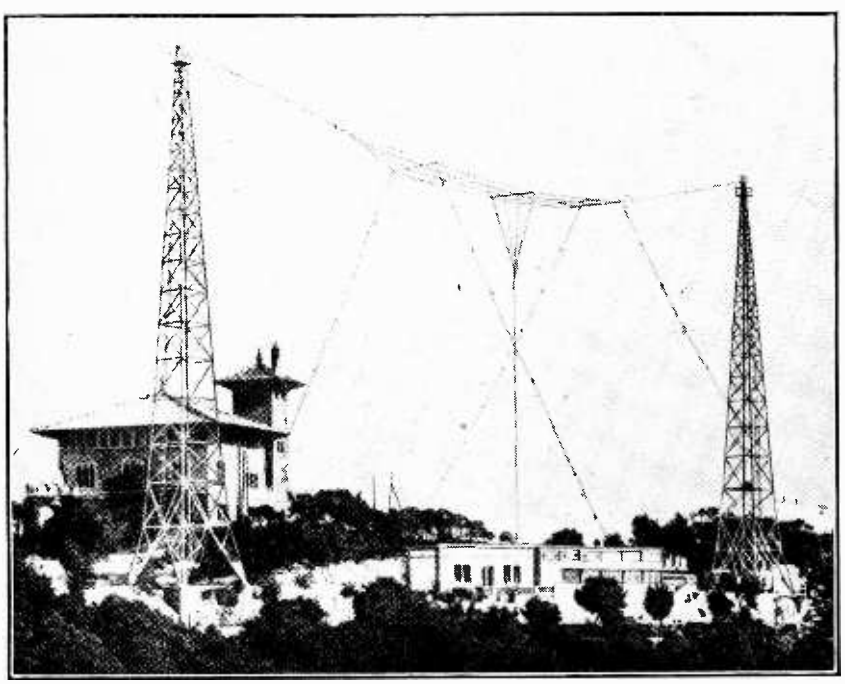
ANOTHER "BROADCASTING HOUSE."

In constructing palaces of broadcasting Britain and Germany seem to have fired the imagination of other European countries, nearly all of which seem anxious to have at least one "Broadcasting House." The Dutch Socialist listeners' league opened a "home of broadcasting" during the summer, and now the rival non-party organisation—the A.V.R.O.—is to follow suit with a building which shall be "ultra modern" in every respect. We understand that the locality has yet to be decided upon.



A POPULAR "SPANIARD." Radio-Barcelona EAJ1 is heard at its best on Sunday evenings when the B.B.C. stations are silent, its wavelength (349 metres) being uncomfortably near that of London Regional.

YUGO-SLAVIAN MYSTERY.

"Once a listener, always a listener," does not hold good in Yugo-Slavia, where the September licence figures showed a decline. The total is now 30,398.

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ALL EYES ON EDINBURGH.

Sir Gordon Nairne, one of the Governors of the B.B.C., will open Scotland's second National Radio Exhibition at the Waverley Market, Edinburgh, on Wednesday next, November 11th. The Rt. Hon. Sir Thomas B. Whitson, Lord Provost of Edinburgh, will preside. Practically the entire area of the spacious "Market" has been booked, and there will be at least 100 stands as compared with only forty last year.

Features of the Show will include a model B.B.C. studio from which programmes will be broadcast, and demonstrations by exhibitors in sound-proof rooms.

The slogan of the Exhibition is "Radio, the whole of radio, and nothing but radio!"

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R.N.D. SIGNALS.

The thirteenth annual dinner of the R.N.D. Signal Company is to be held at the Coventry Restaurant, 7, Rupert Street, Piccadilly, London, on Saturday, November 21st. Full particulars may be obtained from the hon. sec., Mr. T. N. Riley, St. Vincent, The Avenue, Radlett.

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LURING TOURISTS BY RADIO.

To encourage tourists to visit this country, the Travel Association of Great Britain and Ireland has arranged to broadcast talks on the attractions of the British Isles from 300 U.S. and Canadian stations during the winter months. Several European stations are also being enlisted for the good work, one of them being Radio-Lyons.

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RADIO TREK ACROSS AFRICA.

Many wireless enthusiasts might covet the task of Flight-Lieut. R. F. Durrant, A.F.C., the aviation wireless specialist at the Air Ministry, who set out by air for Cape Town on Monday last, November 2nd, to organise a wireless network on the all-red route from England to the Cape. Working in co-operation with Imperial Airways and the Marconi Field and Air Section, Lieut. Durrant is breaking his journey at various points en route to discuss the

wireless problems involved with the Government officials in Egypt, Sudan, Tanganyika, Rhodesia, and South Africa.

During his five-thousand-mile tour he will be in continuous touch with a chain of radio stations made up as follows: Heliopolis, Wadi Hafa, Khartoum, Juba, Malakal, Port Bell, Nairobi, Moshi, Dodoma, Mbeya, Mpika, Broken Hill, Salisbury, Bulawayo, Johannesburg, Victoria West, and Cape Town.

Mr. Durrant was the wireless operator on the airship R 34 when she accomplished the first flight westwards across the Atlantic and the first double crossing in July, 1919.

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I.W.T. IN THE NORTH.

North Country enthusiasm for radio has led to the formation of a Yorkshire section of the Institute of Wireless Technology. The headquarters will be in Sheffield, and branches probably will be opened in other Northern centres in the near future.

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200 kW. FROM LUXEMBOURG?

Luxembourg—the publicity broadcasting station of Europe—is to have a power of 200 kW., according to the announcement made on October 18th, when the foundation stone was laid in the presence of Prince Félix of Luxembourg. The promoters are not disguising their intention of bringing the whole of Europe, if possible, into the service area.

The buildings are to be finished on January 15th; tests will begin three months later, and, according to the plans, Europe will probably resound with the inaugural programme on July 15th, 1932.

One consoling point: it is stated that the wavelength will be outside the ordinary broadcast band.

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A "FADING COMPENSATOR."

Mr. K. E. Ylander, of Ostersund, Sweden, claims to have invented a device which completely eliminates fading. The apparatus, which he describes as a "fading compensator," is of simple construction and can be attached to any receiver.

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ANTI-STATIC CONGRESS IN PARIS.

All radio and electrically minded Paris was present at the National Anti-Static Congress held at the French Colonial Exhibition on October 17th and 18th, when all forms of interference with radio reception were analysed and discussed. One of the most practical suggestions, which may be adopted by the Union of Electrical Syndicates, was that all electrical apparatus should bear a mark indicating that it has been tested and approved as a non-radiator of objectionable waves.

No definite action can at present be taken on the findings of the Conference.

BUSIER AND BUSIER. This view of the three new bays (on right) which have just been added to the Croydon factory of Radio Instruments Limited, tells its own story. Accommodation is provided for a further 250 employees, most of whom are busy on R.I. transformer construction.

DID YOU MISS IT?

Owing to the extraordinarily big demand for the New Readers' Number of *The Wireless World*, published last week, it seems likely that some readers may be unable to obtain copies. To meet the anticipated demand for the Foreign Stations Tuning Chart, however, a limited number of additional copies of the chart have been printed, and are obtainable post free at 3½d. from the Publishers, Dorset House, Tudor Street, London, E.C.4.

CLUB NEWS.

All communications should be addressed to the Hon. Secretary, Mr. E. A. C. Jones (2BOC), 46, Lady Margaret Road, Kentish Town, N.W.5.

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A Formidable L.F. Tester.

Mr. P. W. S. Valentine, A.M.I.E.E., was well equipped to demonstrate "Good Reproduction in L.F. Amplifiers" at the opening winter meeting of the South Croydon and District Radio Society, for his apparatus consisted of a two-stage all-mains L.F. amplifier with provision for gramophone pick-up and fitted with innumerable measuring instruments and switching devices. By changing valves and transformers in rapid succession Mr. Valentine proceeded to show how many types of reproduction are generally considered "perfect" until compared with something better!

Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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Field Day Hints.

Wireless field days have always been a strong feature in the programmes of the Golders Green and Hendon Radio Scientific Society, and therefore special interest attaches to the following points which were emphasised at a discussion at the opening meeting of the autumn session: (1) Suitable loading coils should be provided for the frame aerial in order to take check bearings on a long-wave station. (2) It is an advantage to use a telephone output transformer with an earthed shield between the primary and secondary. (3) The set should move with the frame aerial. (4) Batteries and accumulators should be on top of the set.

The Society intends carrying out research work in band-pass filters. Some useful measuring apparatus has been constructed by Messrs. Maurice Child, A. J. Bremner, B.Sc., and J. C. Emerson, B.Sc., which will be available for members' use next month.

Hon. Secretary: Mr. W. A. Hudson, 22, The Parade, N.W.11.

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Problem Solving in Public.

Query night with Slade Studio (Birmingham) is always an exciting affair, and last week's event was no exception. Three of the expert members were chosen to reply to the deluge of questions on all phases of wireless, and the success can be gauged from the fact that a number of members admitted that their problems had been solved. The popularity of these meetings is enhanced by the fact that new members are given a chance to have their difficulties investigated and overcome.

Full particulars regarding the Society's activities may be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

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Loud Speaker Rivalry.

Representative American and British pick-ups coupled to a 1.75-watt all-electric two-stage amplifier were used at the demonstration before advanced members of the Bec Radio Society by Messrs. C. H. Roddis and J. C. G. Gilbert on October 13th. Two loud speakers were employed—one American and one British—and the latter, manufactured by Baker's Selhurst Radio, was, in the unanimous opinion of the members, superior to its Transatlantic rival.

Hon. Secretary: Mr. A. L. Odell, 9, Westway, Grand Drive, Raynes Park, S.W.20.

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Catering for Everybody.

By running concurrently three courses of radio study, the Kentish Town and District Radio Society is enabling new members to "find their level" and so build up, by easy and logical stages, a knowledge of radio principles. The opening lecture for the more advanced students on the "Decibel" was received with great enthusiasm by the short-wave and broadcast members alike, the former being anxious to see the "R" signal scale superseded by the more scientific unit. The transmitting group is showing great interest in the question of modulation, which is to receive thorough practical attention during the next few weeks. Cinematograph films on the subject of chemical effects of an electric current have proved instructive to beginners.

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Comparing Loud Speakers.

"Loud Speakers, Ancient and Modern," was the description of a demonstration given at the first meeting of the winter session of the Southall Radio Society. The output of the Society's amplifier, fed from a portable gramophone, was switched from one speaker to another, thus enabling aural comparisons to be quickly made. The range of speakers included almost every type from the very early tin-horn type to the latest moving-coil instrument.

The Society meets every Tuesday at the Red Lion Hotel. Hon. Secretary: Mr. H. C. Rayner, 114, North Road, Southall.

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A Set-testing Switchboard.

Instantaneous "change-overs" from one set to another were demonstrated with the aid of a large switchboard at the new radio showrooms of Messrs. Metal Agencies, Ltd., on the occasion of a recent visit by members of the Bristol and District Radio and Television Society. After the demonstration the directors of the company entertained the Society at supper.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrew's Park, Bristol.

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Southend Society's Technical Section.

The formation of a Technical Section of the Southend-on-Sea and District Radio Society was officially sanctioned at the meeting on October 9th—the first of the winter session. An early announcement is to be made.

The Hon. Treasurer of the fund for the provision of wireless in the New Hospital reported that cash in hand totalled £343. The wiring has already been done under the supervision of the Society, and plans are in hand for the design of the three receivers required.

Hon. Secretary: Mr. F. J. Waller, 49, Fermoy Road, Thorpe Bay, Essex.

WIRELESS ENCYCLOPEDIA

No. 5

Brief Definitions with Expanded Explanations.

BAND-PASS FILTER. ***A network or system in A.C. circuits designed to pass freely currents whose frequencies fall within a definite band of values, whilst rejecting currents whose frequencies do not fall within this band. The simplest band-pass filter consists of two tuned circuits loosely coupled together.***

WHEN a condenser is connected across an inductance coil to form a tuned circuit, the combination gives maximum response to one particular frequency, which is the resonant frequency of the circuit. The type of resonance for such a circuit is shown by the broken line curve A in Fig. 1. As the frequency is varied above

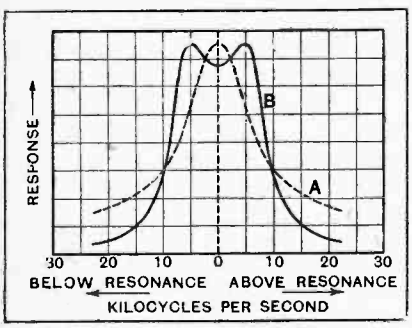


Fig. 1.—A = Resonance curve for a single tuned circuit. B = Resonance curve for a band-pass filter.

or below the resonant value, the response falls off to an extent depending on the "efficiency" of the circuit. The result of this, in so far as the reception of modulated waves is concerned, is to weaken the higher-note frequencies; the higher the efficiency and selectivity of the tuned circuit the greater is the resulting high-note loss.

Selectivity and Quality.

Simple band-pass filters are used to enable high selectivity to be obtained without undue attenuation of the highest-note frequencies, and the simplest type is a two-circuit filter which depends for its action on the property by virtue of which two identically similar tuned circuits loosely coupled together give maximum response to two separate frequencies, one on either side of the carrier frequency to which each circuit is tuned. The type of resonance curve obtainable is indicated by the full-line curve B of Fig. 1, and it will be noted that this resonance curve has two peaks.

There are several ways of coupling the two tuned portions of the filter, examples being given in Fig. 2. At (*a*) the coupling is obtained simply by the mutual inductance M between the coils, giving the simplest possible form of inductive coupling. At (*b*) the coils are totally screened from each other, but a moderately large-capacity C_0 forms a reactive path which is common to both tuned circuits, and provides a practical form of capacity coupling.

The Coupling Device.

For a receiver to give the best results, all note frequencies up to at least 5,000 cycles per second should be reproduced at full strength. Consequently, in designing a band-pass filter for tuning purposes, the aim should be to make the separation between the peaks about 10 kilocycles, so that each peak occurs at about 5 kc. off the central or carried frequency. Now, the peak separation in cycles is determined chiefly by the degree of coupling between the circuits, being approximately equal to the coefficient of coupling multiplied by the carrier frequency. (Actually, the H.F. resistance also plays a small part.) The coefficient of coupling is the ratio of the reactance which is common to both circuits to the total reactance of the same kind in one of the tuned circuits.

With the inductive coupling (*a*) the peak separation increases as the circuit is tuned to higher frequencies or lower wavelengths, whereas with the capacity coupling (*b*) the reverse effect occurs. These shortcomings of the simple filters have led to the development of a type of filter in which both inductive and capacity coupling are employed, a successful arrangement being shown in Fig. 2 (c). Here the coupling condenser C_0 is retained, as in (*b*), but to obtain the desired effect the mutual inductance must operate in the correct "sense" relative to the capacity coupling. This is achieved by the auxiliary link circuit shown, being connected so as to give a positive reactance compared with that of C_0; but as inductive and capacitative reactances are normally opposite in sign, it follows that the link circuit must be so connected as to give the effect of a "negative" inductance. With such a circuit it is possible to keep the peak separation nearly constant over the whole tuning range.

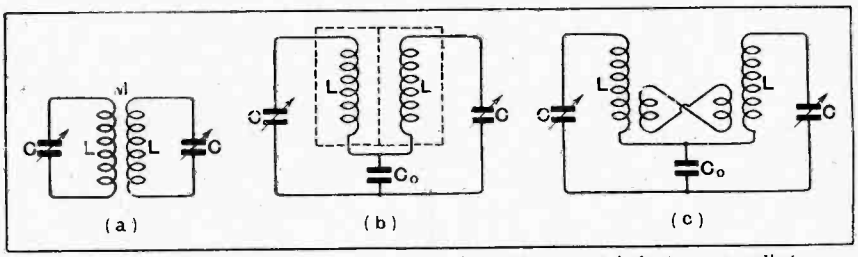


Fig. 2.—Simple types of band-pass filter, (a) with mutual inductance coupling, (b) with capacity coupling and (c) with mixed coupling.

The salient feature of band-pass tuning is that it enables the selectivity of two tuned circuits to be obtained without the serious high-note loss inherent in ordinary cascade tuning.

OLYMPIA SHOW COMPETITION.

The Winning Apparatus Described.

THE result of *The Wireless World* Olympia Show Ballot was announced in our issue of last week, when it was also stated that this week we should be describing the various sets, accessories, and components which the votes cast by our readers had elected to the position of first in the classes into which apparatus was divided for the competition.

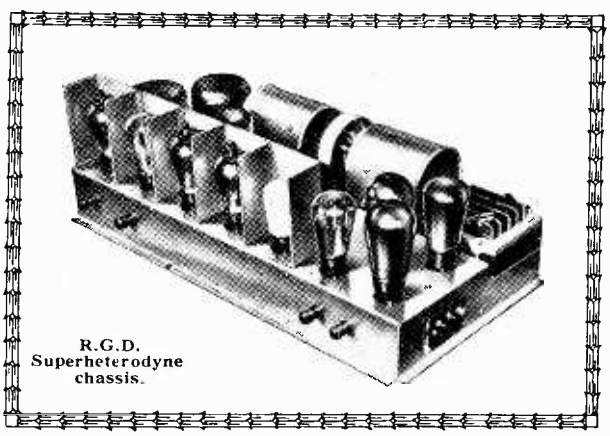
In the pages which follow we accordingly illustrate and describe these items, putting first the receiver which, in addition to gaining first place amongst receivers employing four or more valves, was also voted the outstanding single exhibit of the Show.

Class I.—RECEIVERS EMPLOYING FOUR OR MORE VALVES AND OUTSTANDING SINGLE EXHIBIT.

R.G.D. SUPERHETERODYNE: TYPE 901.

AS the revival of the superheterodyne was unquestionably the outstanding feature of this year's Radio Exhibition, it was generally anticipated that a receiver of this class would almost certainly be voted into first place in the "Receivers employing four or more valves" class. It must be gratifying to those responsible for the R.G.D. Superheterodyne that their instrument not only headed the poll in this category, but was also considered by readers to be the outstanding single exhibit at the Show.

As no fewer than nine valves (including the rectifier) and a total of ten tuned circuits are included in the receiver, it will be clear that it is of most ambitious design. Whatever one's views may be in the controversy between the conflicting claims of straight-set and superheterodyne, there can be little doubt that the latter scores heavily when extreme long range and high selectivity are needed. With regard to the actual number of tuned circuits in the R.G.D. receiver, it should, perhaps, be made clear that in arriving at the total the long-wave oscillator circuit, which is tuned by a separate condenser, is counted as an extra circuit.



R.G.D. Superheterodyne chassis.

The circuit specification of this most elaborate set includes a band-pass input filter, first detector, oscillator, two intermediate-frequency amplifiers, a second detector, an L.F. amplifier, and, finally, a pair of push-pull output valves. Anode current supply is rectified by a full-wave valve.

Although the circuit details of "straight" sets tend to become stereotyped, the designer of a superheterodyne still has wide scope for originality, and the R.G.D. set is full of interesting features. Opinions differ as to the desirability of a stage of signal frequency H.F. amplification preceding the first detector, and many of the most successful superheterodynes, among which is the instrument under discussion, do not include it. But there can hardly be any doubt as to the value of an input band-pass filter in preventing second-channel interference; here it goes almost without saying that a filter is fitted.

Ordinary capacity coupling by means of a large common condenser is hardly admissible, and we find that the high-potential ends of the component filter circuits are linked by means of a very small variable condenser. This has the important advantage that provision for band-width control is easily arranged. Whatever the academic advantages of the conventional 9- or 10-kilocycle peak separation may be, it is an undoubted advantage, in the present chaotic state of the ether, to have a ready means of controlling selectivity, even if the higher notes are somewhat attenuated and the coupling condenser of the R.G.D. set is mounted in an accessible position. This extra control should be regarded as one that does not need continuous adjustment, and, indeed, it may be permanently fixed at a value determined by local receiving conditions and the kind of reception that is desired.

In every superheterodyne receiver the frequency changer is probably the most interesting part of the circuit; in essentials, this is shown in the diagram on next page. Following the band-pass input filter, already discussed, comes the first detector, a screen-grid valve operating on the anode-bend principle, and biased by means of a resistance in its cathode lead. It should be added, however, that the voltage developed across this resistance is not entirely due to the anode current, as a screen-grid potentiometer (not shown) is returned to earth through the bias resistance, and consequently negative grid voltage is mainly due to the flow of steady current in the potentiometer circuit.

R.G.D. Superheterodyne Type 901 (continued).

Medium- and long-wave oscillator circuits are tuned by separate condensers linked to the main control spindle. Although at first sight this plan may appear to be extravagant, it is probably economical in the long run as it must simplify the operation of making initial adjustments at the factory and at the same time ensure good performance over both wavebands.

Special means are taken to ensure the necessary tuning conditions in the oscillator circuits which, as completely ganged tuning is employed, must be maintained at a constant frequency difference with respect to the tuned input circuits. As all the tuning condensers are of the same type, it becomes necessary artificially to alter the law of those in the oscillator circuit. This is actually done by inserting in series with each of the variable elements what is known as the "padding" condenser. This, as well as the variable condenser, is shunted by a trimmer (not shown in the diagram). Energy from the oscillator circuit is fed into the detector grid circuit through a small pick-up coil inserted in the cathode lead of this valve.

There is nothing particularly unconventional in the intermediate amplifier, where two screen grid valves are used. All couplings are in the form of band-pass filters, with tuned primary and secondary windings and plain inductive coupling. Of course, adjustments of tuning and band width are made permanently in the factory, and these do not directly concern the user. The frequency is 110 kilocycles, a value which seems to be highly popular and for which a very good case can be made out.

Next comes the second detector, operating on the power-grid principle, and with an elaborate filter in its anode circuit to separate H.F. and L.F. components —always somewhat of a problem in superheterodyne design.

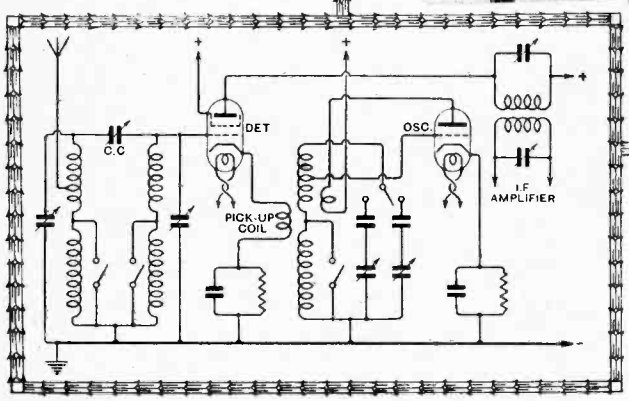
Although the use of an intermediate L.F. stage between detector and output is becoming comparatively uncommon, there are often sound reasons for adopting it, as in the present case, particularly in a radio-gramophone. Here the L.F. stage is not intended to give any great amount of magnification, and is coupled by means of a resistance. In the grid circuit of the valve there is a "fader," consisting merely of a potentiometer with earthed centre-point, which allows a radio transmission or the output from a gramophone pick-up to be faded in or out smoothly without any annoying clicks and with complete control of volume, from inaudibility to maximum.

While on the subject of volume control, it should be stated that, in addition to this post-detection adjustment, means are provided for reducing the sensitivity of the L.F. amplifier by overbiasing one of the grids.

Transformer coupling is provided between the L.F. amplifier and the push-pull output valves, with regard to which the purchaser may exercise an option. If required, a pair of P.P.5/400's, giving about 10 watts, can be fitted, but for ordinary needs P.X.4 valves, providing about half that amount, will suffice. A special moving-coil loud speaker is fitted.

With regard to construction, the set is built up on a cadmium-plated steel chassis and all H.F. and L.F. components are thoroughly screened in individual covers. Various forms of cabinet work are available, and if desired an automatic record changer can be fitted. This device allows ten records to be reproduced in the sequence in which they are placed in the carrier; any record may be omitted or repeated.

A special model R.G.D. Superheterodyne, with automatic record changer.



The inset diagram shows the first detector and oscillator circuits: the receiver is entirely mains-operated, with indirectly heated valves except in the output stage. The latest models are fitted with variable-mu valves in the I.F. stages.

Class II.—RECEIVERS EMPLOYING THREE VALVES OR LESS.

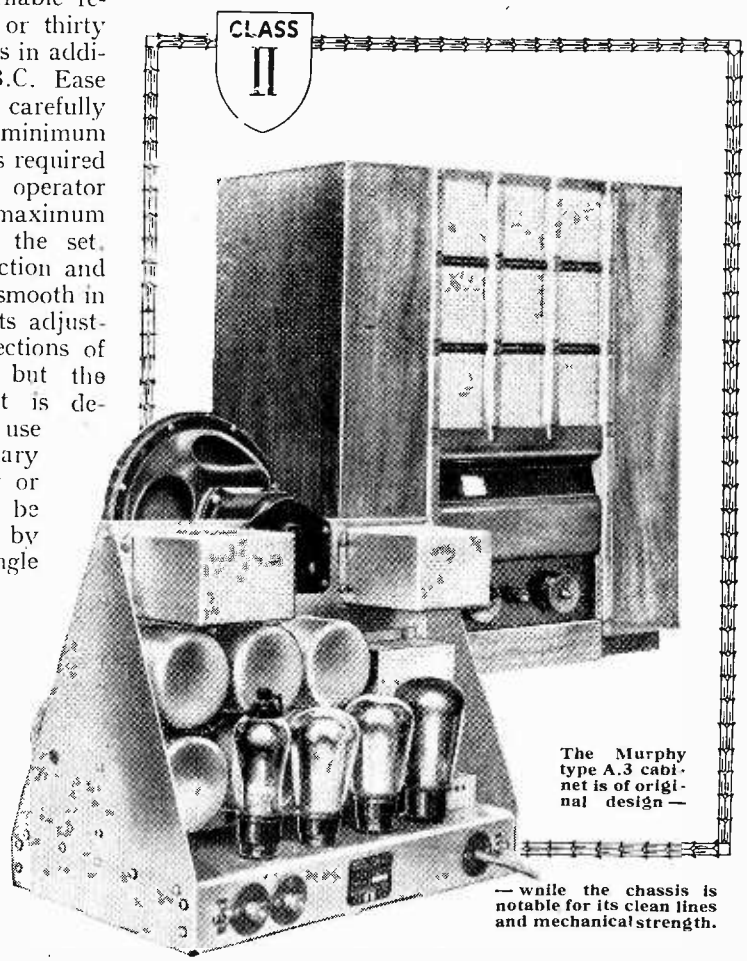
MURPHY TYPE A.3 RECEIVER.

THIS class is specially important for it includes the wide range of three-valve sets of all types which undoubtedly constitute the backbone of the wireless industry as far as complete receivers are concerned.

The Murphy type A.3 all-mains receiver is a worthy representative of its type. The circuit specification is thoroughly up to date and includes band-pass tuning, while the performance in the matter of range and selectivity gives reliable reception of twenty or thirty foreign programmes in addition to those of the B.B.C. Ease of control has been carefully studied, and the minimum of skill and effort is required on the part of the operator in extracting the maximum performance from the set. The combined reaction and volume control is smooth in action and holds its adjustment over wide sections of the tuning dial, but the range of the set is dependent on its use only to a secondary degree, for twenty or more stations can be logged merely by rotating the single tuning control with the reaction at minimum.

A moving-coil loud speaker is incorporated in the chassis, and the quality of reproduction provided is of a very high standard. The response in the upper register is maintained up to at least 4,000 cycles and gives crispness and clarity of speech without introducing too much extraneous background hiss. The maximum volume available is sufficient to fill a small café, but it can be turned down to a sufficiently low level for a small room without serious detriment to the bass—an important quality which is frequently overlooked by designers.

Complete details of the circuit have already been given in the pages of this journal.[1] It follows the usual screen-grid H.F.-detector-power pentode arrangement, but has many interesting detail refinements. The volume control, for instance, consists of two graded variable resistances coupled together on the same spindle. One of these is in parallel with the reaction coil and the other can be connected across the aerial circuit at will by means of the "Local-Distance" switch. The scheme works well in practice and gives smooth control of overall amplification from zero to the maximum available from the set. Further, manipulation of the volume control in no way affects the ganging of the tuned circuits. On the L.F. side the gain has been adjusted so that the detector overloads before the pentode, thus protecting the pentode and the loud speaker from excessive voltages and the listener from startling noises. Incidentally, it may be mentioned that a special output transformer has been designed to eliminate that prevalent form of distortion known as "pentode whistle."



The Murphy type A.3 cabinet is of original design — while the chassis is notable for its clean lines and mechanical strength.

The mechanical design of the cadmium-plated steel chassis is sound, and its clean exterior appearance is one of the first features to win approval on seeing the set for the first time. The screened tuning coils, smoothing condensers, chokes, and transformers are mounted on a vertical partition which also supports the loud speaker, while the valves are placed in an accessible position near the back of the cabinet. The back of the set is covered by a thick board of non-resonant material, in which a number of holes are pierced to prevent acoustic resonance in the cabinet and to ventilate the indirectly heated valves.

In conclusion, a word about the cabinet. It is solidly built of thick walnut, and its lines are bold and distinctive without being obtrusively modern or futuristic. The controls are mounted low down on a narrow metal panel, and the illuminated wavelength scale occupies a similar panel immediately above. Recesses at the sides enable the set to be easily lifted, and, as it works well on a short indoor aerial, this instrument may be said to fulfil all the requirements of a self-contained transportable.

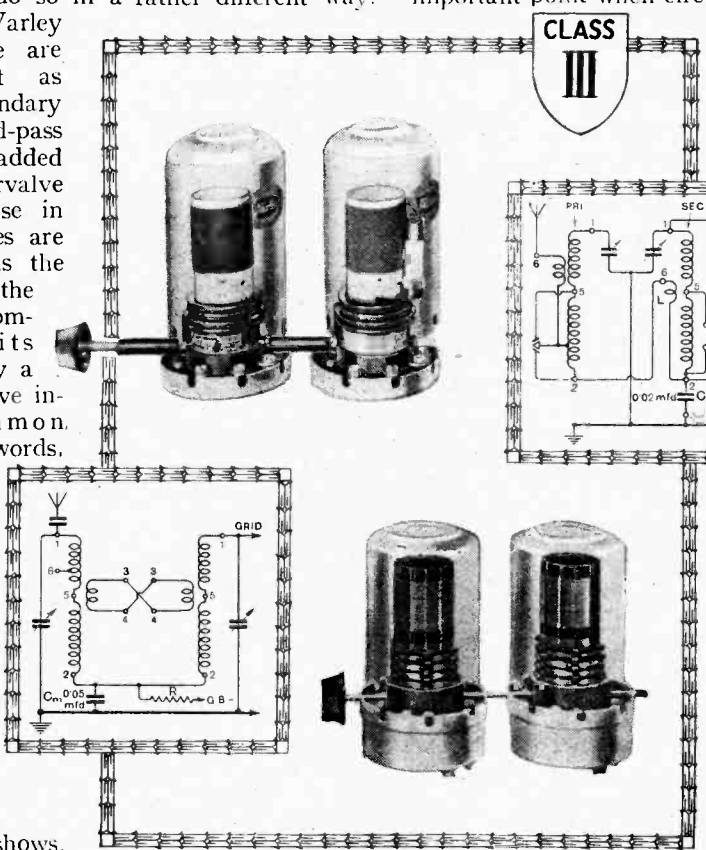
[1] "The Wireless World," July 29th, 1931, page 114.

Class III.—COMPONENT PARTS FOR HOME CONSTRUCTION.

IN forming a decision as to the most meritorious apparatus in Class 3, there seems to have been singular unanimity, as the Varley "Square-peak Canned" coils and the Colvern "Link Filter" coils have tied for first place; both of these products are put forward by their makers to perform exactly the same function, but, though similar, do so in a rather different way.

VARLEY SQUARE-PEAK CANNED COILS.

The particular Varley coils with which we are here concerned act as primary and secondary elements of a band-pass filter; it should be added that matched intervalve coupling coils for use in succeeding H.F. stages are also produced. It is the primary intention of the designers that the component filter circuits should be coupled by a combination of negative inductance and common capacity—in other words, a "mixed" filter, which is generally admitted to give greater sensitivity than simple inductance- or capacity-coupled filters, in addition to possessing the advantage of sensibly constant band-width over the whole tuning scale.



(Above) Varley Square-peak Canned Coils. A tubular coupling condenser is mounted on the coil former.
(Below) Colvern Link Filter Coils. An aluminium base, with a spring earthing clip making contact with the metal switch rod, is supplied.
The circuit diagrams show terminal numbers. In each case bias is applied through a resistance R of 1,000 ohms or more. Negative inductance coil marked L.

As the illustration shows, the medium-wave tuned winding is a single-layer coil; the paxolin former has a diameter of 1¼in. The coil is wound with double-silk-covered wire, and, as it is enclosed in a screening cover 2⅝in. in diameter, it will be appreciated that the general dimensions coincide very closely with the ideal specification for screened coils as recently published in this journal.

The wave-range switches, built into the moulded base of the coil, are of unusual and apparently highly effective design. Spring blades, operated by a cam, are fitted with gold-silver contacts; the action is such that a real rubbing action takes place, and so the switches should be entirely free from trouble. The switches of several coils can be mechanically interconnected by insulated links.

COLVERN LINK FILTER COILS.

THESE coils are for use in a mixed input filter of the type in which the component circuits are coupled by a combination of negative inductance and common capacity. The arrangement by which the inductive part of the coupling is effective is distinctively unconventional, and possesses the advantage of complete symmetry—an important point when circuits are to be tuned by ganged condensers. Corresponding matched coils for use as intervalve couplings are also available, and are of similar appearance and dimensions.

Optional junction points for the aerial are provided, connected, through a very small condenser, to the high-potential end of the primary coil, or directly, or through a somewhat larger condenser, to a tapping point on the coil (terminal No. 6); the latter is more usual.

The diameter of the Colvern coil screens amounts to 2⅝in., and the height overall is well under 5in.—no more than that of a screen-grid valve in its holder. Coil diameter amounts to 1¼in., and all windings, including the three-section long-wave coils, are of enamelled wire.

It should be noted that the link circuit coupling coils are operative on both wavebands, and, with this object in view, are divided into two sections; the first, a single-layer coil, is fairly closely coupled to the low-potential end of the medium-wave section, while a continuation is wound in a slot adjacent to the long-wave coil.

The wave-range switch blades, tipped with gold-silver contacts, are operated by a floating cam actuated by a half-round control rod which may be passed through any reasonable number of coil assemblies. The general design of the switches, which appears to be highly satisfactory and likely to stand up to any amount of hard work, is that recently adopted for all Colvern coils. Bent aluminium bases, with earthing conducts for the switch rod, are supplied for two, three, or four coils.

Class IV.—VALVES.

Mazda Pen 220 Valve.

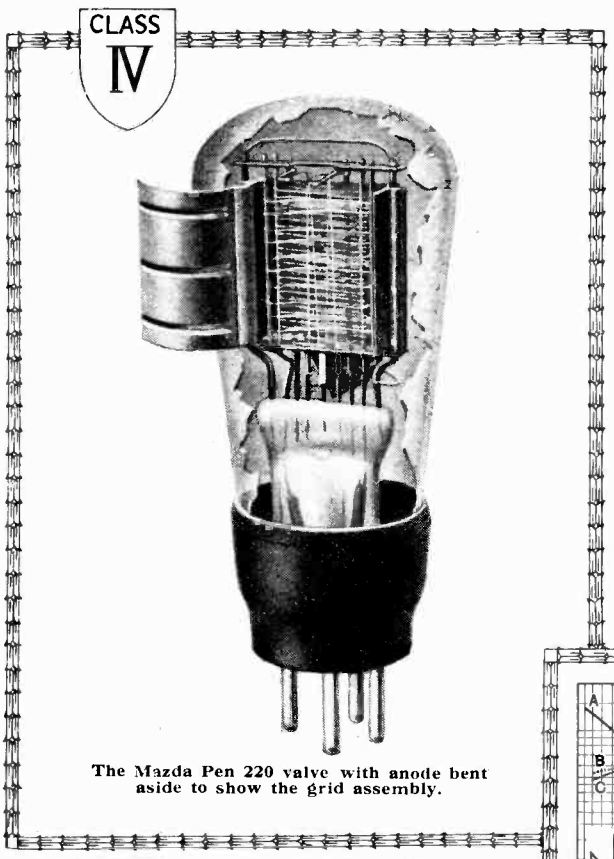
IT can fairly be said that with the advent of this highly economical battery pentode the portable receiver, in which the exigencies of space demand a small H.T. battery, obtains a new lease of life. Neither is the use of this valve confined to self-contained sets; it renders possible battery receivers such as the "Band-pass Pentode Three" and "*The Wireless World* Two," recently described in this journal. These sets are capable of delivering an undistorted output sufficient for all home needs with an anode consumption within the discharge capabilities of a small H.T. battery.

It is not surprising that so many votes were given to the valve when one considers the striking advance in efficiency that has been made. Hitherto, the highest ratio of speech output to D.C. watts dissipation in the anode in the case of the pentode has been some $33\frac{1}{3}$ per cent. In the present instance it is possible to obtain 370 milliwatts speech output for 750 D.C. milliwatts, representing an efficiency of 49 per cent. These figures are obtained when the anode voltage is 150, the screen voltage 125, the grid bias −4.5, and the anode current only 5.0 mA.

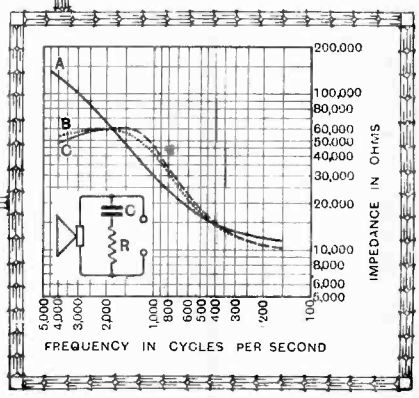
Where the anode supply is restricted to 120 volts the screen should be given 105 volts and the anode current will be 5 mA. at −3 volts negative bias. In these circumstances the undistorted output is 250 milliwatts. With a 100-volt H.T. battery the anode current is only about 3 mA. and the output still sufficient for small rooms, namely, 160 milliwatts.

As with other pentodes, it is important in order to prevent shrill reproduction that the speaker impedance should not be allowed to rise with frequency. Whether the speaker is connected directly in the anode circuit or choke filter fed, an output compensating filter is required. This should take the form of a condenser and resistance arranged in series and connected either across the speaker or the output choke. The accompanying curve A shows the pronounced rise of impedance with frequency of the Celestion speaker type Pen./M, specially designed for the Pen 220 valve. However, when a compensator of 0.002 mfd. and 60,000 ohms resistance is shunted across the windings the overall impedance of the load is modified to curve B. If the capacity member of the filter is left at the same value but the resistance reduced to 40,000 ohms, the impedance-frequency response is given by curve C. The importance of the impedance limiter is thus apparent.

With ordinary moving-iron speakers not specially wound to have such a high impedance as the instrument already referred to a tapped choke-filter output should be arranged and connection made to that tapping which brings the artificial impedance of the speaker at low frequencies to the value given in the table. It should be remembered that if, for example, the centre tap of the choke is used, the step-down ratio is 2 to 1, and the effective impedance of the speaker four times the normal value.



The Mazda Pen 220 valve with anode bent aside to show the grid assembly.



(Inset) Curves giving load impedances at different frequencies.

Anode volts.	Screen volts.	Grid bias.	Anode current (mA).	Optimum load (ohms).
100	90	−3	3.2	30,000
120	105	−3	5.0	23,000
150	125	−4.5	5.0	28,000
150*	150	−4.5	9.0	17,000

* In this case the undistorted output is more than ½ watt.

The load is considerably modified by the voltages applied to anode and screen, suggesting that where a choke is used in the output circuit a number of tappings should be provided. Due to the precision with which the electrodes are assembled, close spacing is possible, resulting in the high mutual conductance of approximately 2 mA./volt. The sensitivity of the valve measured as undistorted milliwatts output per volt (R.M.S.) squared input is 37—the highest figure known.

Class V.—LOUD SPEAKERS OF ALL TYPES.

FERRANTI TYPE M.1 LOUD SPEAKER.

FOR the third year in succession a Ferranti loud speaker has secured the largest number of votes in this section. In 1929 the A.C. mains "Electro Dynamic" model, incorporating a valve rectifier, was chosen, and last year the permanent magnet type known as the "Magno Dynamic" won the place of honour.

The type M.1 permanent magnet model which has been chosen by readers this year is a development of last year's "Magno Dynamic" model. Most of the differences between the two models are to be found in the proportions of the permanent magnet, and it is significant that the design of the diaphragm and its method of suspension have remained practically unchanged for three years. Naturally, the Ferranti research department has tried out many alternative designs with a view to possible improvement, but it has been found that any deviations from the dimensions of the original design or the material used in the cone have in each case given less satisfactory results.

Ferranti type M.1 permanent-magnet moving-coil loud speaker, showing method of mounting output transformer in the base. The dust cover has been removed for the purpose of this photograph.

The angle of the cone is 90 degrees, and it has the comparatively small diameter of 6¼in. It is constructed of thin paper treated with cellulose. The outer periphery is suspended on a sectionalised ring of very soft kid leather, and the apex is located by a flexible three-legged spider attached to the centre pole piece by a single fixing screw. The ends of the moving coil winding extend to the outer edge of the cone to which they are carefully attached with adhesive. From the terminal eyes in the periphery of the cone, flexible tinsel leads are taken to insulated terminals in the base of the unit. The movement of the diaphragm is very little restricted, and is capable of developing an amplitude of $\frac{3}{16}$in. at low frequencies.

The new field magnet is of the "curling stone" type, and is 6in. in diameter and 3½in. deep. The increase in size has permitted the use of 9 per cent. cobalt steel instead of the 35 per cent. alloy used last year, yet the total flux available is much higher, and is, in fact, of the order of 96,000 lines. The useful flux density in the gap is 8,000 lines per sq. cm. as measured by a search coil moving $\frac{3}{16}$in., or a distance equal to the movement permitted to the diaphragm. Actually the total depth of the gap is $\frac{3}{8}$in. and the length of the moving coil ¼in. In radial width the gap has been reduced from 75 to 62.5 mils., which further improves the efficiency of the magnet.

Although designed primarily for domestic use, the speaker is capable of handling far more volume than could be tolerated in the average room. Inputs up to 6 watts may be used without distortion.

The response is aurally uniform between 50 and 100 cycles, after which is rises slightly to 1,000 cycles. Between 1,000 and 5,000 cycles the new level is maintained, but there is a reduction to the 50-100-cycle level between 5,000 and 6,000 cycles. From 6,000 to 8,000 cycles, however, the output is equal to that between 50 and 100 cycles—an exceptional performance in view of the fact that the majority of moving coils give little or no response above 6,000 cycles.

Normally an output transformer is not supplied with the chassis, but holes are provided in the base for fitting one of the new OPM8 transformers if the ratios available happen to fit in with the requirements of the amplifier. For the purpose of calculating the correct ratio, the average impedance of the moving coil is taken as 20 ohms. Actually the impedance varies from 40 ohms at 100 cycles to 15 ohms between 300 and 500 cycles, then rises to 30 ohms at 2,000 cycles and approximately 80 ohms at 8,000 cycles.

It is difficult to convey in a photograph the meticulous care which has obviously been exercised in the assembly of the diaphragm and moving coil. All joints are made and allowed to set under pressure, so that there is little likelihood of deterioration, even after prolonged use. Incidentally, the pole pieces are cadmium plated to prevent atmospheric corrosion, and a dust cover is provided to keep the air gap clear.

The experience of Ferranti, Ltd., in the design of magnets for supply meters has been brought to bear on the design of the field magnet of this loud speaker, with the result that the permanence of the magnet is assured. Tests point to the fact that the magnet should last at least a lifetime.

Class VI.—ACCESSORIES.

Clarke's Atlas Combined Mains Unit Model A.C.290.

IN the section devoted to accessories the greatest number of votes has been recorded in favour of a Clarke's Atlas mains unit, the signal honour falling to the model A.C.290. It is a combined unit for use on A.C. mains and supplies three H.T. voltages, four grid bias potentials, and when not used to operate the receiver it can be employed to charge the L.T. accumulator. Its size is comparable with that of a standard capacity type 120-volt dry battery, the overall dimensions being 10½in. × 6in. × 3¾in., and as quite a number of self-contained receivers will accommodate a battery of this size, the unit can be housed in the cabinet, thus dispensing with external connections.

Of the three H.T. tappings, one is rated to give 150 volts, the actual potential being governed by the current flowing. The maximum output is 25 mA. The remaining two tappings supply variable voltages and are controlled by compression-type resistances. They are rated as 0-120 volts and 0-100 volts respectively. The first-mentioned has a series resistance, while the 0-100 volts tapping is fitted with a potentiometer arrangement and is intended obviously as the screen voltage supply for S.G. valves.

A Westinghouse rectifier of the voltage-doubling type is used, and a single high-inductance choke, with the usual array of condensers, constitutes the smoothing circuit. It would seem to be adequate for all practical purposes. The intermediate tappings are well decoupled, and each has its own by-pass condenser.

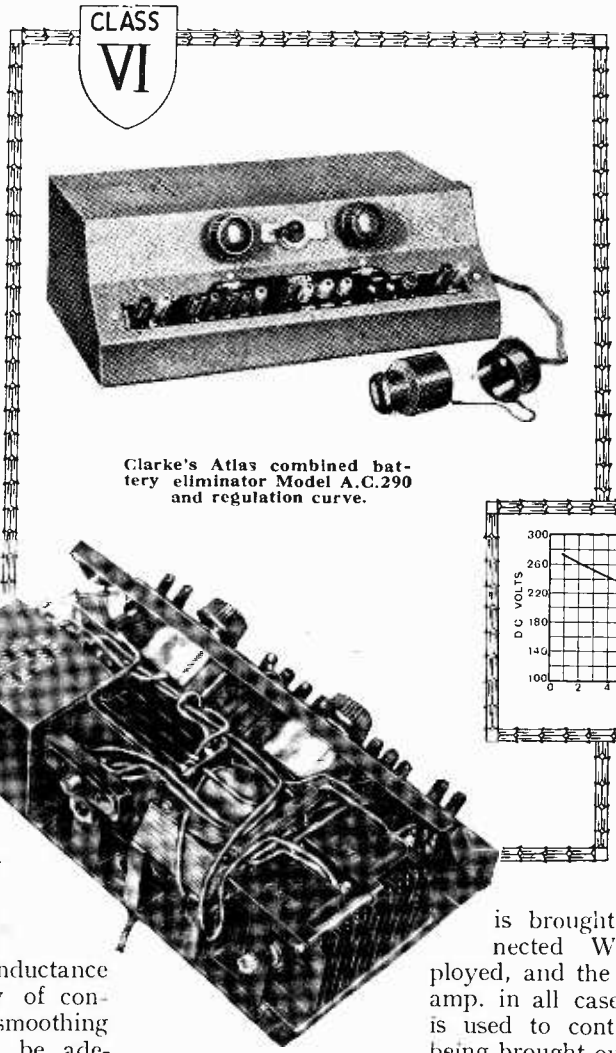
Grid bias is derived from a special winding on the mains transformer, and a separate rectifier is used. To conserve space this is incorporated in the H.T. rectifier, but electrically it is independent, and is in no way influenced by the load on the H.T. circuit.

Smoothing of the grid bias is carried out by a high value of resistance and two 6-mfd. "dry" electrolytic condensers. The output is shunted by a tapped potential divider giving 1½, 3, 9, and 16 volts respectively. Neither decoupling resistances nor by-pass condensers are fitted, but since the grid bias is derived from a separate circuit this omission is justified. There need be little real cause for concern, for in the majority of cases the stability of the receiver will not be affected.

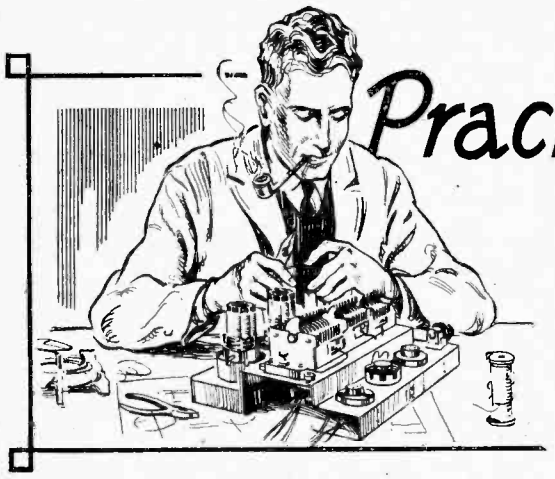
There is the possibility that with a receiver fitted with a highly efficient H.F. stage, slight instability may be noticed owing to this omission, but the usual grid decoupling embodied in the set will combat this trouble.

When not employed to operate the receiver the unit can be used as an L.T. charger for 2-, 4-, or 6-volt batteries. Four L.T. sockets are fitted, two of which connect to the accumulator, while the remaining pair join to the L.T. terminals on the set. With the switch in the "charge" position, the H.T. circuit is broken, the L.T. battery is completely disconnected from the receiver, and the charger is brought into action. A bridge-connected Westinghouse rectifier is employed, and the charging current is about 0.5 amp. in all cases. A tapped series resistance is used to control the current, the tappings being brought out to three sockets on the front panel. The selector plug must be inserted into the correct socket for the battery in use, as otherwise the rectifier may be over-run and damaged.

It will be noticed from the regulation curve that while the maximum output is 25 mA. the voltage is brought down to rather a low level, and it would seem that about 20 mA. would be the maximum load to impose on the eliminator to obtain a reasonably high operating voltage.



Clarke's Atlas combined battery eliminator Model A.C.290 and regulation curve.



Practical Hints and Tips

Simplified Aids to Better Reception.

THOSE who have not handled a wide variety of sets do not always realise the surprising extent to which the choice of speaker, and the standard of quality demanded, control the amount of undistorted output that is desirable. With a cheap speaker, suffering from resonance, and with an amplifier in which no special pains have been taken to preserve tonal purity, an output of 150 to 200 milliwatts is adequate. More than this is not even desirable, because at a higher level of sound the imperfections that pass unnoticed on quiet signals become extremely prominent.

STANDARDS OF OUTPUT POWER.

At the other extreme is the straight-line amplifier with a carefully picked speaker free, at least, from defects that force themselves upon the attention. With such a combination the greater the output of sound the greater the impression of realism created, the limit being set only when the volume becomes physically too great for comfort. Some 3,000 milliwatts is not too much to provide volume roughly equal to that given by a modern acoustic gramophone; and, since the slightest sign of overloading is instantly obvious with a first-class speaker and amplifier, a large margin of safety is demanded—output valves capable of handing out as much as 5,000 milliwatts need never be overloaded, even momentarily, in domestic use.

As a result of this interdependence of quality and volume-level, disappointment is often experienced by those who improve their sets or buy a better speaker with the idea of getting more pleasing results, but who have not realised that a very substantial increase in the power-handling capabilities of the output stage is necessary to provide the same apparent level of volume without signs of distress.

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THE phenomenon known as threshold howl generally makes itself known as a grunt or hoot which occurs just as the receiver is going into oscillation. This unpleasant noise, which partakes of the nature of low-frequency oscillation, is not only annoying, but has also a very definite limiting effect on the range of any receiver which relies largely upon reaction for its distance-getting properties. In a bad case it becomes impossible to bring reaction up to a point where the maximum sensitiveness of the set is developed.

"THRESHOLD HOWL."

The behaviour described is in most cases due to high-frequency currents which, flowing in the low-frequency circuits, are picked up on the aerial or in the tuning circuits of the set—a form, really, of stray reaction. It is particularly likely to make its appearance in a portable set where frame aerial and loud speaker are often in the closest juxtaposition, but it is not unknown in receivers of less compact design. If the loud speaker leads are very long, for example, there is greater feed-back to the aerial circuits, and therefore a greater tendency to threshold howl.

The recognition of its cause at once indicates the cure; it is only necessary to keep all high-frequency currents out of the low-frequency part of the set by inserting a proper filter into the anode circuit of the detector, reinforcing this, if it is found necessary in a bad case, by a resistance (of 100,000 ohms or so) in series with the grid of the first low-frequency valve.

The filter usually consists of a high-frequency choke connected directly to the anode of the detector; from each terminal of this choke a condenser, of capacity 0.0003 to

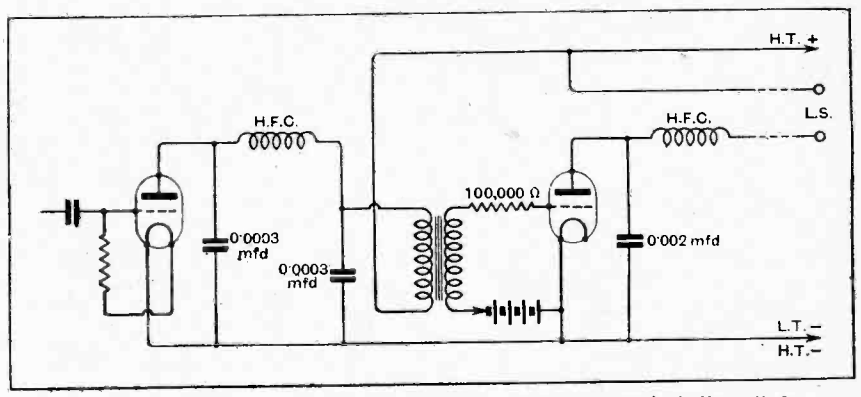

Fig. 1.—Prevention of "threshold howling"; a typical circuit including all the precautions discussed in the text.

Hints and Tips.—

0.0005 mfd., runs directly to the filament of the valve.

In the case of a set connected to its speaker by leads many feet long, it is often advisable to take still a further precaution by connecting another high-frequency choke between the negative loud speaker terminal and the lead, with a condenser of about 0.002 mfd. between this point and filament.

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DETECTOR VOLTAGE.

IN the most popular type of battery-driven set, using the H.F.-det.-output circuit, there is often some difficulty in finding the best anode voltage for the detector. If such a set is used for the reception of distant stations, it becomes necessary to choose this voltage chiefly with an eye to the smoothness of reaction, which is the dominating factor in determining its behaviour for long-range reception. For this purpose a low voltage, in the neighbourhood of 50 volts, or even less, is generally most favourable.

But when the set is tuned to the local station quite different considerations arise. There is now no longer any question of using reaction to the limit to get good strength, so that if reaction becomes "ploppy" no harm is done. Since the detector valve will usually overload before the output valve if the anode voltage on the former is too low, it will in most cases be found best to put the volts on the detector up to the highest available, thereby checking this annoying tendency to overload when strong signals are being received.

The rule then emerges; for local reception put 120 to 150 volts on the detector, but for distant reception cut the detector-voltage down until reaction becomes smooth. This moving of the wander-plug must be regarded in the same light as the "Local-Distance" switch fitted to some of the larger sets. It might be worth while, in cases where it can be done without too much trouble, actually to fit a switch for changing over the detector anode voltage from "high" to "low."

INCIPIENT MOTOR-BOATING.

ALTHOUGH a receiver may be perfectly stable when working and give first-class results, one sometimes finds that it motor-boats for half a minute or so when it is first switched on—a disquieting effect.

The circuit of Fig. 2 is the one in which this effect most commonly occurs. If the detector valve be removed from its socket it will be found that the pentode motor-boats continuously; if the detector valve be replaced, however, motor-boating continues for a short time, but soon ceases. It ceases, in fact, as soon as the detector cathode is fully heated.

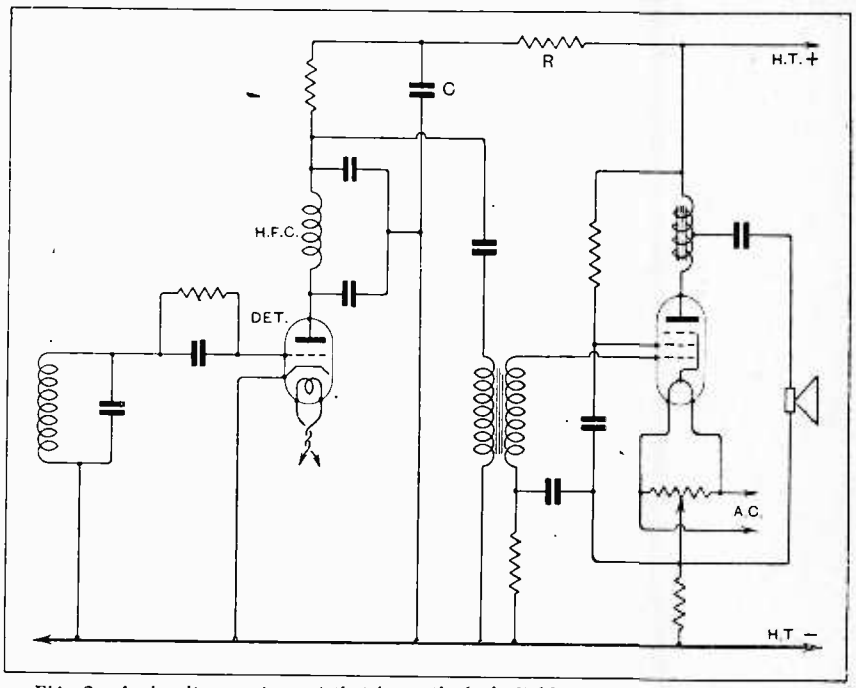

Fig. 2.—A circuit arrangement that is particularly liable to "motor-boat" on first switching-on. More effective decoupling is the surest cure for this annoying defect.

This gives us the clue to what happens. In the absence of the detector, or when its cathode is cold, the set is unstable, but only just unstable. When the valve heats up, its anode A.C. resistance damps the intervalve coupling, and alters the voltage distribution, so that the set becomes just stable, and motor-boating ceases.

The remedy, of course, is to increase the detector de-coupling by increasing the capacity of the condenser C. At least double the existing capacity should be employed, unless it is possible also to increase the value of the de-coupling resistance R.

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H.F. COUPLING CONDENSERS.

IT may be noticed that there is by no means unanimity among designers as to the best value of coupling condenser to use as a link between the anode of an H.F. valve and a succeeding tuned-grid coupling circuit. We are here referring, of course, to H.F. amplifiers coupled by the tuned-grid method.

Probably the most usual value of coupling capacity is 0.0003 mfd.; although a larger condenser would confer a slight theoretical advantage, particularly when dealing with long waves, that capacity is generally satisfactory.

But in cases where there are signs of instability on the long-wave band, due to the almost embarrassingly high H.F. amplification that is so readily obtainable, a smaller coupling capacity of about 0.0001 mfd. will often effect a cure. Its use will not reduce medium-wave amplification to any noticeable extent.

Broadcast Brevities

The recent eclipse of the moon provided an opportunity for a "running commentary" at Radio Barcelona.

By Our Special Correspondent.

Madrid Conference: Bad News?

It was disappointing enough to learn the results of the latest conference of the International Broadcasting Union; now comes the news that the Madrid Convention, on which everyone is setting such hopes, is to be postponed from March next until September. This means that the wholesale revision of the Prague Plan must be delayed until well into the winter of 1932; and as upheavals of this sort involve a good deal of tedious testing, we shall be lucky if 1933 sees European listeners out of their difficulties.

Extending the Broadcast Band.

One advantage may come from the delay if the European broadcasters can find cogent reasons for a proposal for the extension of the broadcast waveband. I understand that the administrations will be pressed to extend the band down to 150 metres and up to 545 metres. A still bolder proposal which may at least be entertained by the Madrid delegates is the raising of the ships' wavelength from 600 to 650 metres.

Good News for Britishers.

The best news from Rome, so far as British listeners are concerned, is the forthcoming increase in the kilocycle separation between London Regional and Stuttgart, and between Northern Regional and Hilversum. A difference of 2 kc. seems small, but it will probably mean a noticeable improvement.

Stuttgart's Strength.

Measurements taken by the B.B.C. engineers have shown that the signal strength of Stuttgart in the London area has recently reached a peak value after nightfall of 5 millivolts per metre, the mean value being from 1.5 to 2. It is believed that the extra separation will reduce the interfering signal by half on sets tuned to the Regional wavelength.

"Roxy's" Lunch.

A lot of fuss has been made because the B.B.C. gave a lunch to "Roxy"—that fly-by-night comet who is now off to America with a starry trail of British and Continental ideas. The truth is, of course, that Savoy Hill extended to Mr. Rothafel the same courtesy that it offers to any foreign visitor to our shores, and is not forgetful of the fact that when Sir John Reith was recently in America he was overwhelmed with hospitality, and spent part of his time explaining that he takes only three meals a day.

Dangers of the "Ring."

Many of us will be glad that the B.B.C. is at present able to resist tempting offers for a complete "tie-up" with an American amusement "ring" of the type envisioned by Mr. Rothafel, whose aim appears to be a central employment bureau for theatre, radio, and film artistes all over the world. What would be more humiliating than to have to obtain permission from America for the appearance of a British artiste at a British microphone?

What Savoy Hill Thinks.

There is a danger signal in the fact that Savoy Hill shows some sympathy with "Roxy's" ideas in so far as they might be developed in Britain. I believe that the Corporation, if it had the chance, would gladly assume the rôle of amusement dictator in this country, and that it is already hankering after an "understanding" with the theatrical and film industries.

Considering that both these industries may shortly be affected by the national spirit of economy, the situation is worth watching.

To Set the Ball Rolling.

The programmes to be given in the new studios at Broadcasting House are already coming under review. One of the first will be the Holt Marvell-George Posford operetta, "Good Night, Vienna," which has been written specially for broadcasting.

Better Empire Programmes.

It is a good sign that the B.B.C. have decided to enliven the Empire broadcasts from 5SW by including some of the London Regional items. Up till now Empire listeners have had to content themselves with the transmissions of 5XX or, alternatively, to tune in foreign short-wave stations, but as from Monday last (November 2nd) the B.B.C. are from time to time selecting Regional items for relaying overseas.

Cutting Out the Silences.

This new development is in response to requests received not only from Britishers, but from quite a number of American listeners, who evidently take a keen interest in the British programmes.

The scheme will mean the abolition of those periods of callous silence during which our cousins overseas have had to stand by while the home news bulletins were being read. Now they will at least have an anæsthetic in the form of music.

Empire Broadcasting Developments?

By the way, it is quite on the cards that the National Government will seize upon the Imperial broadcasting system as an ideal means of furthering unity of outlook throughout the Empire. At all events, it would be unwise to conclude that, because economy is in the air, the anti-luxury axe will fall on 5SW. The indications are quite different.

A Mystery.

It was a great pity, I think, that 5SW closed down at 9 p.m. on Wednesday last. Not a single election result was allowed to filter through. Why?

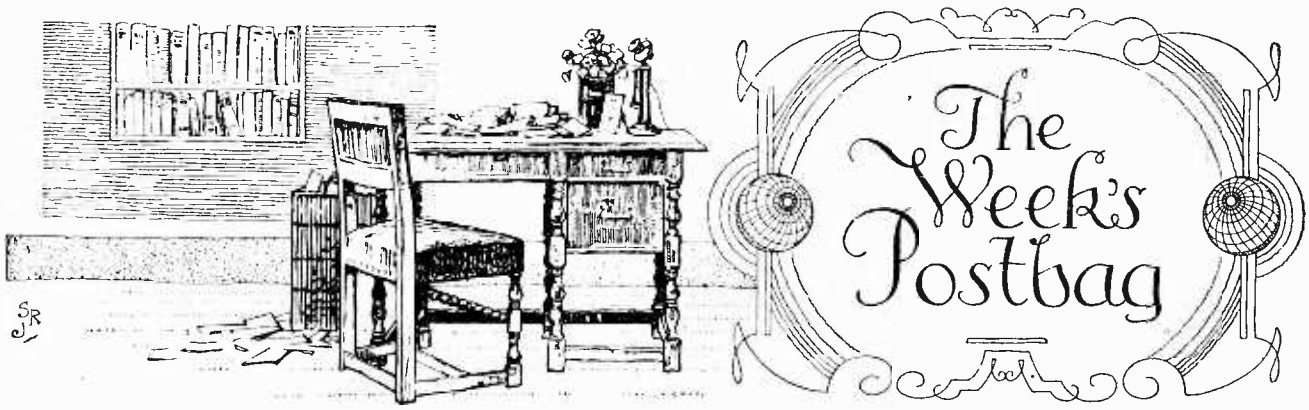
The laws of the Medes and Persians were more elastic than our modern laws of copyright.

Those Election Results.

One good point about the B.B.C. is that they can always learn a lesson. It was evident on Wednesday last during the recital of the election results that the announcements were being given by a number of individuals in turn. On previous occasions most of the burden has fallen on one individual, with the result that, as the night wore on, listeners have been tempted to fling throat pastilles at the loud speaker.

Who Were They?

Sir John Reith's voice was plainly recognisable, and I thought I detected the tones of Admiral Carpendale and the rather weary articulation of Roger Eckersley. Chief Announcer Hibberd's voice must have healed wounded hearts with its balm



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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

INTERFERENCE WITH WIRELESS RECEPTION BY TROLLEY BUSES.

Sir,—You may know that serious interference with wireless reception has been reported by listeners living along the line of route of the recently introduced trolley bus services of the London United Tramways in the Kingston area. A cure has now been found, and I think you might be interested to know of the measures taken.

When the trouble was first reported engineers of the General Post Office, in conjunction with representatives of the British Broadcasting Corporation and of the London United Tramways, undertook tests which resulted in the decision that experimental stopper coils should be manufactured and fitted to the trolley buses. On delivery, these coils were introduced between the trolley poles and the electrical gear, one in the lead to each trolley arm. Stringent tests with six trolley buses so equipped were carried out by the engineers of the authorities concerned, each test being repeated on buses without the stopper coils in order that direct results of the coils could be assessed.

The experiments proved successful. The London United Tramways have agreed, at their own expense, to fit these stopper coils to the whole of the fleet of sixty trolley buses. These coils are now on order, and, when fitted, it is thought that the interference on a normal broadcast receiving set, in so far as the London National and London Regional programmes are concerned, will be obviated.

P. W. DUNCAN.
Metropolitan District Railway Company.
London Electric Railway Company.
City and South London Railway Company.
Central London Railway Company.
London General Omnibus Company Limited.

London, S.W.1.

B.B.C. ENTERPRISE.

From Captain P. P. Eckersley, formerly Chief Engineer of the B.B.C.

Sir,—Your leader in the issue of October 14th accuses me of making an "irresponsible" suggestion because I proposed that the B.B.C. might expand its research department and study problems concerned with all phases of broadcasting.

Nearly everyone can be described as irresponsible when they are responsible only to some sectarian interest. Thus the word is unjust if applied to me. The Editor of *The Wireless World* is, quite rightly, responsible to his directors, and, therefore, works to obtain the widest circulation of his journal. Personally, I have constantly jeopardised my popularity by being "irresponsible" enough to judge everything by public service standards.

Briefly, it is contended that the B.B.C. should do research on transmission problems but leave reception alone. I once read a paper to some section of the I.E.E. (probably an informal meeting, as I find no record of my weighty pronouncements . . .) on broadcast receivers. A well-known and witty member of the Post Office asked point blank why on earth the Chief Engineer of "transmission" should concern himself with the problems of "reception." I replied as follows: ". . . . Doubtless the questioner was at one time occupied, as a technician employed by the Post Office, in studying problems concerning the telephone system. I ask him to tell me sincerely whether his difficulties would not have been enormously exaggerated had some scheme been laid down which made the Post Office responsible only for the exchanges and the wiring but allowed the subscriber to buy, make, or invent any instrument for use in his own home to connect to those wires."

Surely my questioner was answered? Surely broadcasting is concerned in two functions closely, nay, indistinguishably, allied—transmission and reception, and one *cannot* be studied without an intimate knowledge of the other.

Transmission technique determines receiver design. Was selectivity much of a problem before the Prague plan and the raising of station power all round? Would the transmission authorities have agreed to the Prague plan if they had known more about reception? Why does the B.B.C. judge studio acoustics by a loud speaker which distorts transients?—perhaps if the B.B.C. had had the funds it would have evolved a quite uncommercial but nevertheless "perfect" loud speaker.

I study *The Wireless World* because I learn by reading the excellent articles therein published that practical men are studying practical problems in a wholly factual way. This is just the sort of thing the B.B.C. might do, but it would do it by correlating both transmission and reception. I do not want it to be thought that I am trying to "score off" *The Wireless World*—far from it. I am making a constructive suggestion. I am not saying that the B.B.C. should design sets. Thus I suggest that the B.B.C. should publish invaluable technical data of benefit to those who have to design commercial sets. With cut-throat competition and, therefore, lack of contact between individual technicians, progress may easily be retarded without some central organisation devoted only to the discovery and presentation of new and useful facts.

North Acton, W.3. P. P. ECKERSLEY.

BAND PASS OR TONE CORRECTION?

From Dr. James Robinson, originator of the "Stenode" Receiver.

Sir,—The excellent article by Mr. Colebrook in your issue of September 2nd on "Band Pass or Tone Correction" has aroused considerable interest as judged by the letters on the correspondence page of your issue of September 20th.

These letters indicate that there is still a lack of understanding as to the operation of the Stenode, and, although my views on this subject already exist (see "Radio News" of February, 1931, page 682), it appears necessary to emphasise in your columns some of the important features.

Ever since Sir Oliver Lodge introduced the conception of the tuning of circuits progress has been in the direction of improving the selectivity, thereby rendering it possible to increase the number of services which could operate simultaneously. But since radio-telephony became prominent it has been considered that no further advantage would be obtained by increasing the selectivity, and, in fact, opinion has been universal that it would be incorrect procedure to do so. The reason for this was

that it was considered necessary to receive frequencies over a comparatively wide band on a receiver sufficiently flatly tuned to receive all those frequencies substantially uniformly. The apparent insuperability of this obstacle to increased selectivity led me to investigate what results would be in fact obtained by using the highest possible selectivity in a receiver, and the Stenode in its present form is the outcome of my investigations.

The general problem, as I conceived it, was that we desired to reduce interference from unwanted stations, and at the same time to receive a true reproduction of the wanted signals.

The Stenode uses selectivity of a considerably higher order than has ever been used before, and the results obtained by such high selectivity had not been appreciated before the date of my invention.

First let me give some features of the Stenode in more or less tabular form :—

(1) High selectivity of the H.F. part of the receiver is accompanied by low damping.

(2) Low damping leads to persistence of the signals.

(3) Persistence of the signals leads to a reduced percentage modulation of the wanted signals at the detector.

(4) The reduced percentage modulation of the signals facilitates straight-line-detection.

(5) Straight-line-detection enables me to get the benefit of the demodulation effect of interfering signals, which had been suggested by Beatty, and has since been developed by Butterworth and others.

(6) The high selectivity with which I started ensured the relative weakness of the interfering signal which is necessary for the demodulation effect to be operative.

(7) The persistence effects lead to distortion of the wanted signal, which is corrected, after detection, by an amplifier having a more or less straight-line-characteristic proportional to frequency.

(8) Demodulation of the unwanted signals enables the wanted and unwanted side-bands to be overlapped, since the unwanted modulation disappears.

With regard to the diminution of percentage modulation, which is produced by the high selectivity, the formula which I gave in my paper for the Radio Club of America (see "Radio News" for February, 1931, page 682) shows that the reduction of percentage modulation of incoming signals is inversely proportional to the modulating frequency when the selectivity is very high, as in the case of a quartz crystal.

This leads to the conclusion that the low frequency amplifier must be designed so that its amplification factor is directly proportional to the frequency. It is interesting to note that the formula for correction which was given by Mr. Colebrook in your issue of September 2nd leads to this same conclusion when very high selectivity is employed.

One of your correspondents, Mr. Baggs, in your issue of September 30th, suggests that as the overall response of the low frequency side of a receiver is increased the danger is introduced of a considerable loss of selectivity. One feature to which I wish to draw attention by this letter is that it is possible to counteract this effect by designing receivers with the utmost selectivity.

Another letter appears in your issue of September 30th by Mr. P. W. Willans, who draws attention to the fact that Mr. Colebrook's article describes a patent of his; further than this, Mr. Willans states that his patent foreshadows the leading feature of my Stenode; but this question is one which I can only leave to a tribunal other than the correspondence pages of *The Wireless World*.

J. ROBINSON.

London, W.1.

SUPERHETERODYNE RECEIVERS.

Sir,—We have read with interest the article which appeared in your issue of October 7th relating to a commercially produced all-wave superheterodyne, but we were certainly surprised to read the opening paragraph, which would seem to indicate that this is the first commercially built receiver of this type.

We cannot help but think that it has been overlooked that as long ago as 1930 you tested and reviewed in your issue of January 8th of that year the Igranic Neutrosonic Short-wave Receiver, which receiver we believe was the very first commercially produced superheterodyne short-wave receiver.

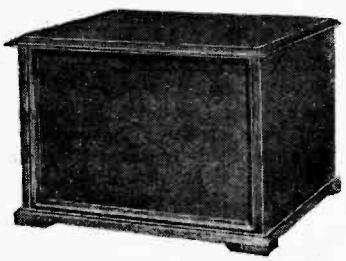
As pioneers in this field of wireless development, we have always taken great pride in the fact that we "led the field," and it is for this reason that we have ventured to draw your attention to the statement contained in the article in question.

Igranic Electric Co., Ltd.,
M. C. P. JACKSON, Radio Manager.

CABINETS FOR RECENTLY DESCRIBED SETS.

CAMCO CABINET FOR "WIRELESS WORLD THREE."

NOW that a large number of "Wireless World Three" sets have been assembled by readers and others are nearing completion, attention is being turned to the selection of a suitable cabinet.



Camco "Super" cabinet for "Wireless World Three."

A specimen cabinet has been received from the Carrington Manufacturing Co., Ltd., 24, Hatton Garden, London, E.C.1, which, at a modest price, the majority of constructors will find entirely suits their purpose. It is substantially built in oak and is fitted with baseboard and oak front panel. Baseboard and panel which are of plywood carry the "Wireless World Three" chassis and front controls, and then as a unit is slid into position from the back of the cabinet. A polished slip-in plywood back is provided.

This cabinet is known as the "Super," and, in oak, is priced at 15s. It is also available in mahogany for 17s. 6d.

"The Wireless World Three" battery model was described in the issue of September 16th.

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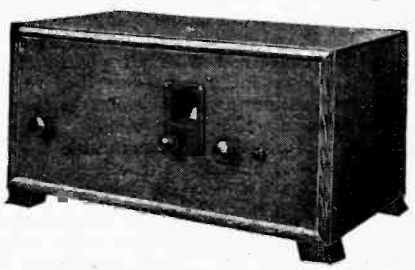
FOR THE "BAND-PASS PENTODE THREE."

THE "Band-pass Pentode Three" described in last week's issue, was constructed in such a way that it is most conveniently housed in a cabinet with a fixed front panel, through which apertures are cut to accommodate the control spindles and the condenser dial escutcheon plate. It is intended that the receiver chassis should be put in its container from the rear, and so the back cover should be removable.

A special cabinet for this set has just been introduced by the Peto Scott Co., Ltd., of 77, City Road, London, E.C.1. Constructed in medium-dark oak, and well finished in every detail, this cabinet is designed on attractively simple lines, with a half-round beading to tidy up the front by concealing the panel joints. Four feet are fitted, and the removable back is suitably slotted to clear the terminal mounts. This cabinet costs 17s. 6d. complete.



Special cabinet by Peto Scott designed for the Band-pass Pentode Three.

A pair of aluminium brackets for supporting the control components are also made by the same firm. These are suitably drilled to accommodate the fixing bushes, and are sold at 2s. 3d.

Readers' Problems.

Readers' technical enquiries are not replied to through the post, but in these pages replies to questions of general interest are dealt with week by week.

Loud Speaker Cones.

IF high notes are to be adequately reproduced by a moving-coil loud speaker, a cone having a fair amount of rigidity is necessary; the failure of a correspondent who has built one of these instruments to obtain brilliant reproduction of the upper register seems to be due almost entirely to the use of "flabby" paper for the diaphragm. It may be remembered that the use of blotting-paper cones has been suggested in this journal as a corrective of the natural tendency of a pentode to over-accentuate the higher frequencies.

Where it seems likely that "dull" reproduction is due to this cause, the obvious remedy is to make a cone of stiffer paper. A simpler way out of the difficulty is to "dope" the cone with some kind of varnish, and thus to increase its stiffness.

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Paper Condensers for Filters.

A READER has noticed that it seems usual to specify mica dielectric coupling condensers for use in straight capacity coupled or mixed band-pass filters. Having a paper condenser of the right value, he asks whether this would be equally satisfactory.

In principle there is little objection to the use of paper coupling condensers, but it is a matter of considerable importance that they should be entirely non-inductive. Provided that the manufacturers can guarantee this, all will be well, but there is a very real risk in using an old-fashioned paper condenser, which may be sufficiently inductive to impair the characteristics of the filter. Mica condensers, on the other hand, are certain to be non-inductive.

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Short Wave Advantages.

THERE are indications that many readers, whose local receiving conditions are so bad that real long-distance reception on the normal broadcast bands is unsatisfactory, are paying greater attention to the possibilities of short-wave broadcasting.

It is not permissible to give anything approaching a dogmatic answer to questions relating to the relative freedom from interference of these short wavebands, but it may be stated as a general rule that interference generated by neighbouring electrical apparatus is not so serious as when normal wavelengths are being received.

Admittedly, short wavelengths suffer from one or two forms of interference that are peculiar to themselves, but all such interference is generally of a more or less intermittent nature.

Pentode Tone Correction.

WHEN dealing with questions relating to tone correction, it is almost impossible to suggest values of components that will be applicable to all circumstances; individual tastes, as well as individual loud speakers, vary considerably, and more than one correspondent has complained that reproduction from a pentode with the conventional corrector circuit is too high-pitched.

In such cases it is logical to suggest that the usual condenser of 0.01 mfd. may be rather too small, and so an extra condenser of the same capacity may be connected parallel with it.

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Progressive Smoothing.

THERE seems to be some uncertainty as to what is implied by the expression "progressive smoothing" as applied to anode feed circuits. Briefly, this relates to the principle of providing progressively increased smoothing for the earlier valves in a chain of amplifiers.

A little consideration will show that it is only logical to do this, as any irregularities introduced into the earlier stages of a receiver will be magnified by all the succeeding stages. Although it is seldom necessary to go to extreme lengths in this matter, a number of *Wireless World* receivers include the principles of progressive smoothing to some extent.

The essence of the matter will readily be understood if the accompanying circuit diagram (Fig. 1) is considered in detail. Anode current for the output valve is smoothed only by the choke CH_1, but current for the detector, after being passed through this circuit, receives additional smoothing from the choke CH, and the associated by-pass condenser. The supply for the H.F. valve, already smoothed in these two circuits, is fed through yet another smoothing circuit, in which a resistance (R) instead of a choke is generally employed.

It is usual to interpose a resistance (not shown) in series with the detector anode feed circuit, either for the purposes of decoupling or voltage regulation.

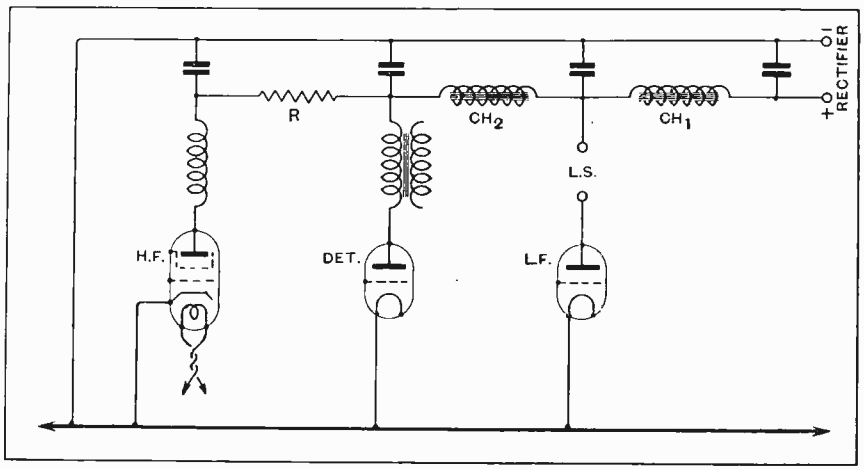

Fig. 1.—Simplified diagram showing a system of progressive smoothing, in which anode current for the input valve is smoothed more completely than that of each succeeding valve.

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Unscreened Anode Circuit.

A READER who is planning a three-valve H.F.-det.-L.F. set, with an input band-pass filter, raises the question as to whether it is permissible to omit screening for the anode circuit and components, provided that those associated with the grid circuit are completely shielded.

Now that band-pass tuning is so generally employed, this is a subject of some importance. The input filters must of necessity be well screened, and so it might at first sight appear that the anode circuit components could be "in the open," as it might be considered that there is nothing with which this circuit can interact.

Actually there is a serious risk of instability if this plan be followed. It must not be forgotten that the aerial itself obviously cannot be screened, and further, that the amount of energy in the anode circuit is much greater than that in the grid circuit; the safe rule is to follow generally accepted practice, and to screen everything, especially if high amplification is to be a feature of the set

Coupling Condenser Values.

QUERIES have arisen with regard to the capacity values specified for use in two-circuit aerial tuners of the type in which the component circuits are linked by means of a very small variable condenser. In some cases a condenser of 0.0001 mfd. is suggested, while in others a capacity of no more than a quarter of that value is recommended; the reason for these apparent inconsistencies may not be generally obvious.

In this matter one's choice of a coupling capacity must be determined with regard to the actual circuit arrangement employed. If the two circuits are directly coupled by joining the condenser between their high-potential ends, a very small capacity will be sufficient, and there is little point in using a condenser of more than some 25 mmfds. maximum; anything larger is likely to have an excessively high minimum capacity.

An alternative arrangement, necessitating the use of a larger condenser, is often met with, particularly when an existing set has been converted by adding an extra tuned aerial circuit. In this case, instead of coupling the aerial circuit directly to the high-potential end of the secondary circuit, it is convenient to join it through the necessary condenser to the primary of the original aerial-grid transformer, or to a tapping point on the coil—which amounts to very much the same thing. With this method of indirect coupling, a larger condenser will be needed, and it is unlikely that the amateur will go far wrong in using as large a value as 0.0001 mfd. But here again it is important that the coupling condenser should have a low minimum value.

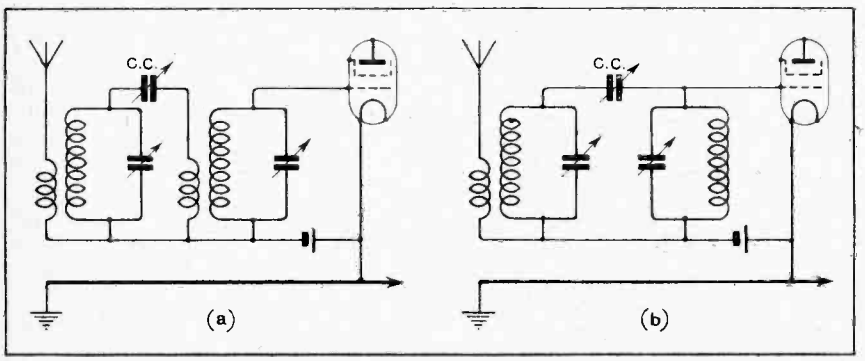

Fig. 2.—Selective aerial tuners: the first arrangement (a) requires a coupling condenser of larger capacity than does the second (b).

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Recording Telegraphic Signals.

IN a recent paragraph in this journal it was suggested that telegraphic signals could be recorded on a dictaphone, the record being afterwards reproduced at low speed, in order that the signals could be descried aurally by an inexpert operator. This paragraph seems to have intrigued several readers who are interested in morse reception, and the query has been raised as to whether a "home gramophone recorder" of the type available commercially might be used instead of a dictaphone.

Provided that a record turntable with a sufficient range of speeds can be devised there is no objection to this plan, except the very practical one of the small diameter of the discs which are of insufficient size to enable a long message to be recorded. To overcome this objection, the only solution seems to lie in the use of two separate recorders, with a change-over switch arranged to transfer the receiver output from one to the other.

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Coupling and Decoupling.

READERS who are constructing resistance-coupled amplifiers seem generally to assume that decoupling resistance in the anode circuits may safely be of a considerably lower value than in a transformer-coupled amplifier.

As resistance coupling gives considerably less amplification per stage, this is right enough so far as it goes, but it must not be forgotten that the overall amplification of the resistance amplifier may be quite as great as that of the transformer-coupled instrument, due to the fact that as a rule an extra stage is added to compensate for this deficiency.

As a further argument in favour of providing decoupling devices of normal values, it should be made clear that when resistance coupling is employed anode current is always relatively low, and so it is possible to use quite a large decoupling resistance without making an undue sacrifice in voltage.

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Reducing Hum.

A READER who is not quite satisfied with the background of his A.C. receiver states that all the usual "cures" for excessive hum have been tried without complete success. He asks whether, admitting the possibility that the centre tapping of one of the filament-heated windings of the L.F. transformer might be slightly "off centre" in the electrical sense, there would be any harm done by fitting adjustable potentiometers. By doing this, of course, it is possible to locate an artificial centre point by trial. The querist is uncertain as to whether this alteration could possibly do any damage to the valves.

This addition to the original design cannot possibly do any harm by over-running the valves, etc., but there is the possibility that it may impair quality and, indeed, the general performance, by upsetting the automatic grid bias scheme that is almost always included in a mains receiver.

To avoid all risk of this, the rule is to use potentiometers of low resistance value (not more than 40 or 50 ohms). High resistance potentiometers are undesirable on every count.

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House-lighting Battery.

WHEN a private house-lighting installation, which supplies current from an accumulator battery, is available, there is a strong temptation to operate one's receiver from this source. This is particularly true if the voltage is as high as 100 volts, and where current is delivered at this pressure it is usual to supplement the mains voltage with a dry battery of 50 or 60 volts.

At first sight it is by no means obvious whether the usual extensive decoupling that is almost invariably included in mains-operated receivers should form part of the receiver to be fed in this way. It is generally assumed that the internal resistance of the battery is likely to be negligible and, as it is joined to the receiver by relatively short leads, spurious coupling through them is not usually anticipated.

In actual practice, experience shows that it is unwise to omit decoupling entirely, although this may be considerably less extensive than in an ordinary mains-operated set. This applies more particularly to the L.F. circuit; as the anodes of the H.F. valves will be fed through a fairly elaborate network of wire, the normal precautions against instability should be taken.

FOREIGN BROADCAST GUIDE.

WILNO
(Poland).

Geographical position: 54° 40′ N., 25° 30′ E.

Approximate air line from London: 1,088 miles.

Wavelength: 244.1m. Frequency: 1,229 kc. Power: 21 kW.

Time: Central European.

Standard Daily Transmissions.

20.30 G.M.T., main evening entertainment when broadcasting from own studio. Relays Poznan, Cracow, Warsaw and sometimes Katowice.

Man and woman announcers. Call: *Uwaga! Polskie Radjo Wilno.*

Interval Signal: Cuckoo call.

Closes down as other Polish stations (*vide* Warsaw) with the Dombrovski anthem.

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INTERFERENCE TROUBLES.

A LETTER in the Correspondence columns of our issue of last week, which dealt with interference with wireless reception, raises once again this subject, which is an ever-growing source of annoyance to listeners.

Unfortunately there is no authority in this country in a position to insist that electrical machinery causing interference with wireless reception shall be modified so as to eliminate the trouble, and, consequently, all that can be done, as the law stands to-day, is for those troubled to take what steps they can to induce the owners of the interfering apparatus to effect a remedy voluntarily.

The letter published referred to the interference which has been caused by the new trolley bus services, and stated that experiments had been carried out which had resulted in a decision to fit stopper coils to the whole fleet of sixty trolley buses owned by the London United Tramways. It was stated that, when fitted, it was thought that the interference on a normal broadcast receiving set, in so far as the London National and London Regional programmes were concerned, would be obviated.

In spite of the obvious doubt expressed in this wording as to whether the remedy is to be an effective one on any but the strongest signals, we learn that it is proposed to extend at once the services of the trolley buses in various directions.

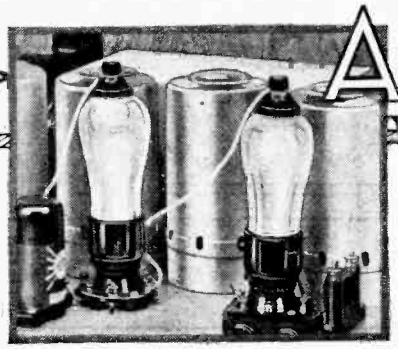
It would seem that at least it was desirable that before any authority to extend these services was granted it would be advisable to wait and see to what extent the interference caused could be remedied.

There are many other directions in which the use of electrical apparatus is causing widespread interference with radio reception. It is not as if these causes of interference were due to obsolete electrical apparatus alone and therefore dying a natural death. The Post Office automatic telephone is a case in point. All but the most insensitive sets respond to the impulses set up by the dialling system at quite considerable distances from the location of a receiver, and in an area where telephones are numerous, reception can be practically spoilt through this source of trouble. The Post Office is the authority most nearly empowered to take action against owners of apparatus causing interference, but what chance have they of effecting a remedy in this way if their own apparatus recently installed is itself setting so bad an example?

Is it not time that level-headed people representing the interests affected, which would include the radio industry, the listener, the Post Office, the B.B.C., and suppliers of electrical apparatus, should get together in conference and come to some agreement on this most important question which affects progress in broadcasting so vitally? A conference of these interests could recommend legislation to overcome the menace of avoidable interference which is rapidly becoming so serious, and which will be more difficult to eliminate the longer it is allowed to remain unchecked.

In This Issue

The Advantages of the Variable-mu Valve



Simplified Circuit Design and Elimination of Background Noise.

By W. T. COCKING and W. I. G. PAGE, B.Sc.

WHEN the screen-grid valve was first introduced, the neutralised circuit was practically universal for high-frequency amplification. The superiority of the screen-grid valve, however, very soon led to the abandonment of the triode for H.F. amplification purposes, and this notwithstanding the fact that the amplification obtainable with the early screen-grid valves was little greater than that given by a well-designed neutralised stage. The passing of the triode as an H.F. amplifier was chiefly due to the greater simplicity of general circuit arrangement which the screed-grid valve made possible.

It now appears extremely probable that the screen-grid valve will, in its turn, be superseded by the new variable-mu tetrode,[1] a modified form of screen-grid valve which has recently become available. Again, this is because of the greater simplification of circuits which it allows, for, from the point of view of amplification, some of the new valves are inferior to many of the ordinary screen-grid types. Quality of reproduction and freedom from hum and motor-boating, however, are of greater importance than pure amplification, and it is in these respects that the new valve offers such advantages over all other types.

THE importance of the variable-mu valve cannot be over-estimated. It is likely to supersede the screen-grid valve and bring about a modification of H.F. amplifier design with improved performance. This article clearly sets out the merits of the new valve and gives practical data for the design of a receiver with two variable-mu stages, the first constructional example of which—The Variable-mu Three—will follow in next week's "Wireless World."

It is well known that the neutralised triode H.F. amplifier is superior to the ordinary screen-grid as regards the quality of reproduction. This, of course, is due to the comparative straightness of triode valve characteristics as compared with screen-grid curves. With the latter only a minute portion of the characteristic is straight, with the result that with most of the screen-grid valves available, if the input signal be greater than a few tenths of a volt, rectification occurs.

Now, this unwanted rectification affects the modulation in a curious way, for it causes the modulation depth to be increased; the result is that serious distortion may occur at the detector. It is for this reason that hitherto all forms of volume control which operate by altering the valve working voltages have introduced distortion, unless special precautions in the way of ganged controls to reduce aerial input simultaneously have been used.

The variable-mu tetrode, when used under normal conditions, is quite free from these defects. Not only is it as good as a triode in its power of amplifying without distortion, but it is superior to a triode in that it is possible to control the volume by a variation in the grid bias without introducing distortion. This result is obtained by a special construction of the valve, which is really a screen-grid valve with the grid arranged to give a characteristic not unlike a combination of those of an ordinary screen-grid valve and a low-resistance triode.

Volume Control.

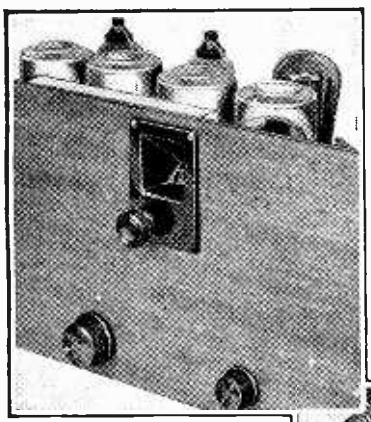
Volume control by the variation of grid bias is alone an important advance, for it means that the valve will never run into grid current, with its attendant damping of the tuned input circuit, and so the selectivity is always maintained at its maximum. This type of control is simple, since it can be carried out by a single potentiometer, and this means a simplification of the receiver and a reduction in the number of components required. Furthermore, distinct possibilities are opened out for the remote control of volume, for which no really satisfactory method has hitherto been available. It is hoped to deal with this in detail at a later date.

Automatic Volume Control.

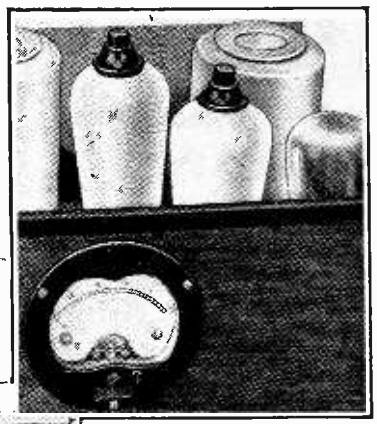
Automatic signal-level control has not found favour so far in this country. In all probability this is largely due to the small range of bias control possible with the screen-grid valves at present on the market and to the poor quality of reproduction which would result from a large increase in bias due to a local transmission. The circuit arrangement advocated consists of an anode-bend detector valve used in conjunction with the detector in the set so connected that an increase in anode current due to a signal biases back the screen-grid valve or valves. The variable-mu valve

[1] "The Variable-mu Valve, by R. O. Carter, *The Wireless World*, September 9th and 16th, 1931.

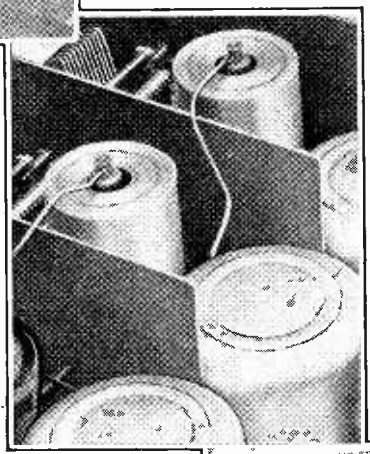
Advantages of the Variable-mu Valve.—is an ideal H.F. amplifier for this type of control, and provides an enormously increased range, no distortion being introduced with loud signals. Resistance values can be so arranged that the signal itself, according to its amplitude, picks out the correct bias point for linear amplification. Automatic control has the advantage that ear-splitting overloading when tuning through the local station is avoided, and as nearly all stations are heard at the same strength the optimum grid swing for each valve of the receiver can be maintained.

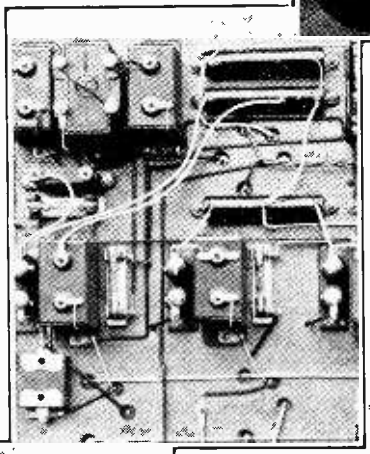


A new distortionless control of volume.



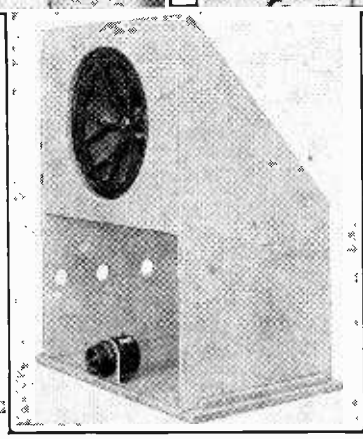
Automatic volume control becomes possible.





H.F. distortion and cross-modulation avoided.

Less decoupling required and background noise reduced.



Distortionless remote volume control possible.

Hum and Motor-boating.

Coming to the more purely electrical advantages of this valve, the freedom from distortion is due to a marked absence of rectification. This is of the first importance apart from its effect upon quality, for much of the hum and motor-boating troubles with ordinary H.F. sets are due to rectification in the screen-grid valves. Both hum and fed-back currents take the form of a ripple on the H.T. supply, and with an ordinary screen-grid valve this ripple is combined with the desired signal and rectified. It then modulates the carrier, and so passes through succeeding tuned circuits, to give rise to audible hum or motor-boating, or both, in the output.

It is in order to eliminate this trouble that the decoupling components of the H.F. stages are usually given values which make them effective at low frequencies, for then they prevent the ripple from reaching the valves. Owing to the absence of rectification with the variable-mu tetrode, however, this modulation effect, which is analogous to cross-modulation, is almost entirely absent, and it becomes possible to reduce the amount of decoupling considerably. Decoupling of H.F. circuits, of course, is still needed in order to maintain stability, but this calls for both smaller condensers and lower values of resistances than have been necessary in the past.

Cross-modulation.

Background noises due to the intrusion into the H.F. amplifier of L.F. and mains disturbances are considerably reduced as compared with the ordinary screen-grid valve. This again is explained by the new characteristic, which is substantially free from rectification. Cross-modulation and beat interference, entirely due to rectification are practically eliminated, and this form of interference which has given impetus to the development of highly specialised band-pass filters, should cease to worry the designer. Many readers have probably experienced the trouble and have not been aware that it is due to rectification. A signal is tuned in, and the signal from another station too remote in frequency for direct interference to be possible, is heard at the same time. If the desired carrier wave is modulated both stations will be heard simultaneously; if unmodulated, only the undesired station will be audible, and when the desired station's carrier wave is switched off the interference ceases. To limit the frequency response of the aerial input circuit, band-pass filters have been found almost essential to combat successfully the evils of cross-modulation. Hitherto, overall selectivity has been determined largely by the response of the input circuit, but with the advent

Advantages of the Variable-mu Valve.—of the variable-mu valve the overall selectivity will depend upon the number of tuned circuits. It will, however, probably be found cheaper to embody two tuned circuits before the first valve than to add an extra H.F. valve and interstage coupling.

Where the field strength from a nearby station is high there is no need to reduce the length of the aerial

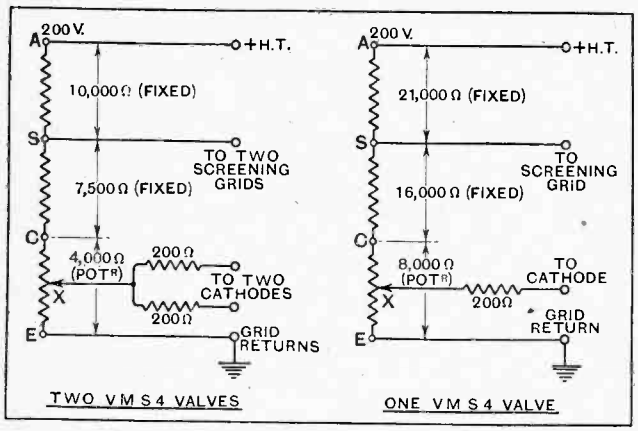


Fig. 1.—By means of these potentiometers for one and two VMS4 valves the screen voltage remains constant at about 80 volts throughout the bias control from 2 to 40 volts negative. The 200-ohm resistances in the cathode leads prevent the signal from encroaching into the grid-current area.

to the detriment of distant-station reception, as the new valve will accommodate the largest signal that is likely to be encountered; furthermore, "local-distance" switches would now seem to be unnecessary.

Experimental Results.

That the foregoing conclusions are of practical value has been most amply demonstrated by a series of experiments. A receiver with two H.F. stages was fitted with a dual-ganged volume control, one section controlling the aerial input and the other the screen voltages of the two screen-grid valves. The L.F. amplifier was one giving high amplification, and as a transformer output to speaker was used there was nothing to prevent the L.F. currents from passing through the smoothing circuits. Normal values of decoupling were used, and each H.F. anode supply was fed through a 10,000-ohm resistance with a 1 mfd. condenser shunted to the cathode.

When used with two normal screen-grid valves (mutual conductance about 3) the set proved unmanageable. At low volume settings the quality was poor, and there was considerable hum, due to rectification in the H.F. stages, and at high volume settings motor-boating set in. The necessary alterations for variable-mu tetrodes were then made, and these included the omission of the dual volume control and the substitution of a single control on the grid bias, and altering the voltage dropping resistances. In actual fact, the anode circuits were provided with no L.F. decoupling at all, since the H.F. stopping resistances were given a value of 600 ohms only.

With two Osram VMS4 valves all the above troubles disappeared. Quality was as good at low volume settings as at high, and at full volume was better than that usually associated with a powerful H.F. amplifier. The hum and motor-boating completely disappeared, and this when a reduction was made in the decoupling equipment!

It will be seen, therefore, that the advantages of the variable-mu tetrode over the ordinary screen-grid valve are rather striking; they may, perhaps, be tabulated as follows:—

1. Distortion in the H.F. amplifier is avoided.
2. Cross-modulation and beat interference are eliminated. Not only is this an advantage in straight sets, but also in signal frequency and I.F. stages of the superheterodyne the variable-mu characteristic will be valuable.
3. Modulation hum is eliminated.
4. Feed-back from the L.F. to the H.F. circuits is largely prevented.
5. The volume control is simplified to a single potentiometer which does not affect ganging. This means fewer components.
6. Distortionless remote volume control becomes possible.
7. Background noise is considerably reduced.
8. Automatic volume control with a greatly increased range is possible.

Against these numerous advantages must be set the following disadvantages:—

1. The lower mutual conductance of the present valves as represented by the VMS4 means lower amplification per stage.
2. The steady anode current per valve is slightly increased; the value in the case of the VMS4 is 9 to 10 mA.

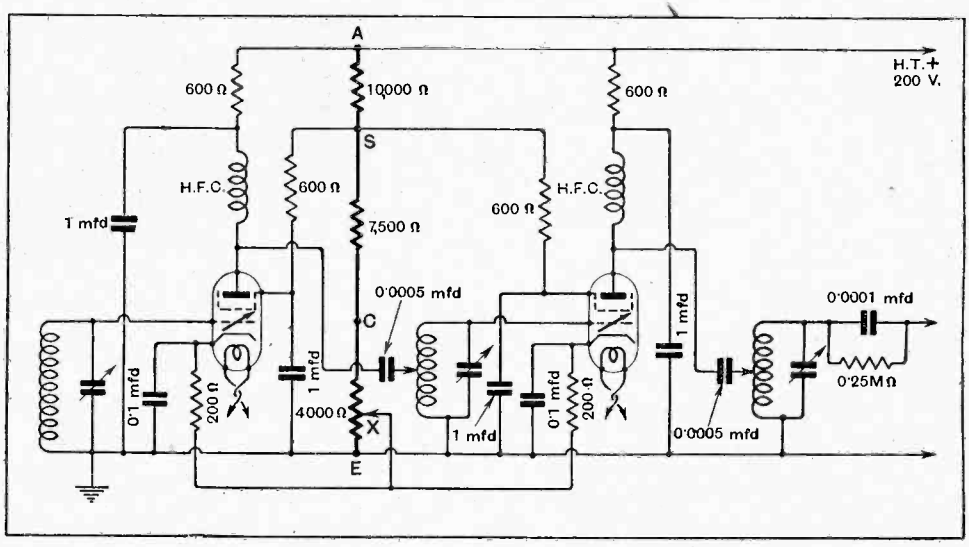


Fig. 2.—Simplified circuit details of an H.F. amplifier embodying two VMS4 variable-mu stages. The bias volume control CE and constant-screen-feed potentiometer are shown in heavy type. Note the new symbol for the variable-mu valve.

Advantages of the Variable-mu Valve.—

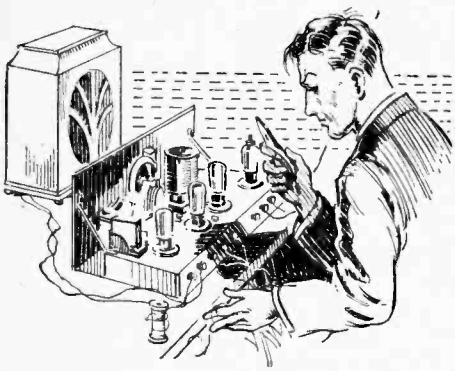
The advantages far outweigh the disadvantages except, perhaps, in the case of sets with one H.F. stage. In the case of a two-H.F. receiver, however, there does not seem to be much doubt which will be the victor in the present race for supremacy.

A New Receiver.

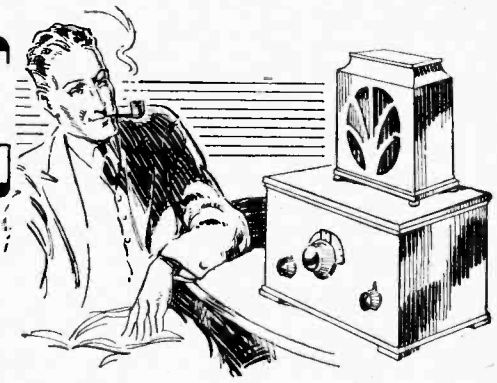
The success of the experiments already outlined has led the writers to design a receiver with two variable-mu H.F. stages, which will be described in next week's issue. One of the chief difficulties encountered is the maintenance of the correct D.C. voltage distribution between anode, screen, and cathode when the bias volume control is changed between maximum and minimum. For a distant station the volume control would be set to maximum; that is, the bias would be reduced to the minimum of approximately 2 volts negative, making the anode current about 9 mA. and the screen current 2 mA. With a powerful local station the bias might be increased to 40 volts negative, under which conditions the screen and anode currents would be practically zero. Now, in order to maintain the true variable-mu "tailing" characteristic the screen volts must remain constant throughout the range of bias control, which entails the use of a potentiometer across the H.T. supply having resistance values which compensate for the change in voltage brought about by the change in current flowing. The calculation of feed resistances to give constant screen voltage is somewhat complicated, and we are indebted to the Research Laboratories of the General Electric Company at Wembley for the potentiometer values for one and two VMS4 valves given in Fig. 1.

Taking the case of two valves; when the slider X of the potentiometer bias (volume) control CE is moved towards C the H.T. on the valve drops and there is a tendency for the screen volts to decrease, but as the screen current decreases with added bias, so does also the potential drop from A to S, thus counteracting the first effect, and the screen voltage remains constant provided the values shown in the diagram are used.

A suitable circuit for two stages of H.F. amplification shorn of the details of waveband switching and aerial coupling is given in Fig. 2. The modest decoupling resistances of 600 ohms whilst adequate to prevent instability only affect the feed scheme by about 2 volts.



DE-COUPLING



Why Decoupling is Necessary with Modern Sets.—How to Find Correct Values.

THE full amplification of highly efficient modern valves can rarely be obtained unless the circuits are fully protected from feed-back effects which are largely responsible for the instability and poor quality so often associated with badly designed receivers. In the case of battery-operated sets, especially, decoupling is essential if reliable results are to be obtained and excessively poor quality with ageing batteries is to be avoided.

A few years ago, perhaps, the most popular type of two-valve set employed the circuit shown in Fig. 1. The H.T. supply consists of a dry battery of about 120 volts, and when this is new the set is capable of quite good results. As the battery begins to age, however, the quality of reproduction deteriorates rapidly, until at length the defect actually asserts itself, for the set starts to howl; that is, commences oscillating at a fairly high audible frequency.

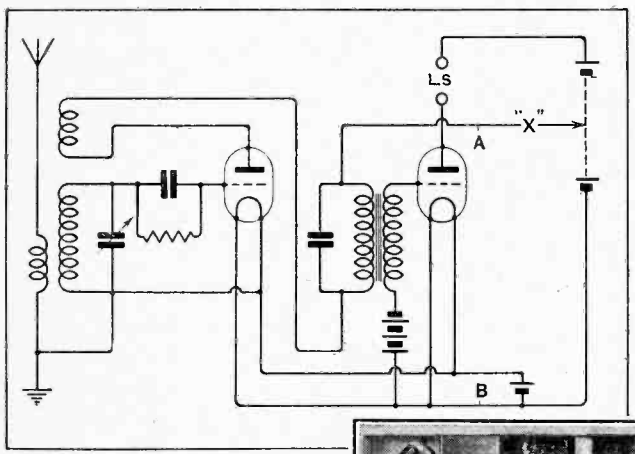


Fig. 1.—A simple two-valve battery receiver with no decoupling.

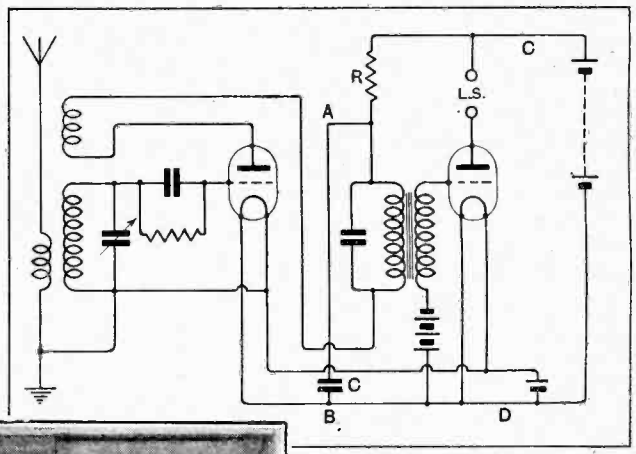
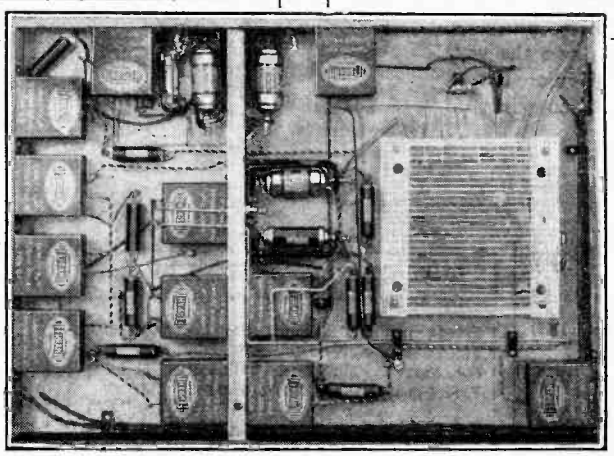


Fig. 2.—The same set as Fig. 1, but modified by the addition of the decoupling resistance R and condenser C.



An example of comprehensive decoupling. The underbaseboard of the "D.C. Super-Selective Five" receiver.

Battery Resistance.

A new battery must then be used although the old may be quite capable of working the set, if the howling could be stopped. It is well known that as a battery gets old its internal resistance increases enormously until towards the end of its useful life it may easily be as high as 1,000 ohms. It is this high internal resistance which causes howling in receivers which are not thoroughly decoupled, in the same way as it is high impedance of an H.T. eliminator which causes the motor-boating so often experienced.

The effect of high internal battery resistance is to give rise to feed-back, and this can be seen from an examination of Fig. 1. The signal voltage on the grid of the output valve causes an alternating current to flow in its anode circuit. This current must flow through the H.T. battery, and so a voltage is developed across the battery's internal

Decoupling.—

THE circuit diagram of a modern receiver often appears far more complex than that of an older set. Although there is generally no fundamental difference between the circuits, that of the modern set includes many resistances and condensers which were at one time never used at all. It is these components pressed into service for the purpose of decoupling, which lend a fictitious air of complexity to the circuit. The need for these devices arises from the high efficiency of modern valves.

resistance. This voltage, of course, is communicated directly to the anode of the detector, and so is transferred through the intervalve coupling to the grid of the output valve. This, of course, is a definite reaction effect, and is analogous to the normal H.F. reaction circuit. Just as an increase in the coupling of the reaction coil increases the sensitivity of the set, so an increase in battery resistance increases the L.F. amplification, but at certain frequencies only. In the same way, too much reaction causes the detector to oscillate, and too great a battery resistance causes the L.F. circuits to oscillate. Again, if the reaction coil be connected incorrectly its use reduces signal strength, and so if the transformer connections are incorrect, battery resistance reduces the amplification of certain frequencies.

It will be obvious, therefore, that L.F. oscillation can be cured by reversing the connections to the transformer; this is not sound practice, however, for it does not stop the ill-effects of battery resistance, but only changes them. Reversing the transformer connections merely changes the over-amplification of certain frequencies to under-amplification. The adoption of adequate decoupling is the only certain and safe cure for the evil effects of battery resistance.

The Decoupling Circuit.

If we insert a resistance at the point X in Fig. 1 and connect a condenser between the points A B, we have, provided that we use suitable values for these components, fitted decoupling and the circuit is now that of Fig. 2, where R and C are the resistance and condenser respectively.

The A.C. anode current of the output valve still flows through the H.T. battery resistance and still sets up a voltage across it; that is, across the points C D. The whole of this voltage, however, is no longer applied to the detector valve, for it is divided between the resistance R and the condenser C in proportion to their relative impedances, and only that portion appearing across the condenser is applied to the detector and is effective in producing feed-back. This portion we can make as small as we desire by using a high value resistance and a large capacity condenser.

The Choice of Values.

In the interests of economy it is important to use the smallest values of components which will be satisfactory, and so it is obviously desirable to have some ready means of choosing the values for any given case. With triode valves and an L.F. transformer ratio not exceeding 4-1, satisfactory results are usually obtained

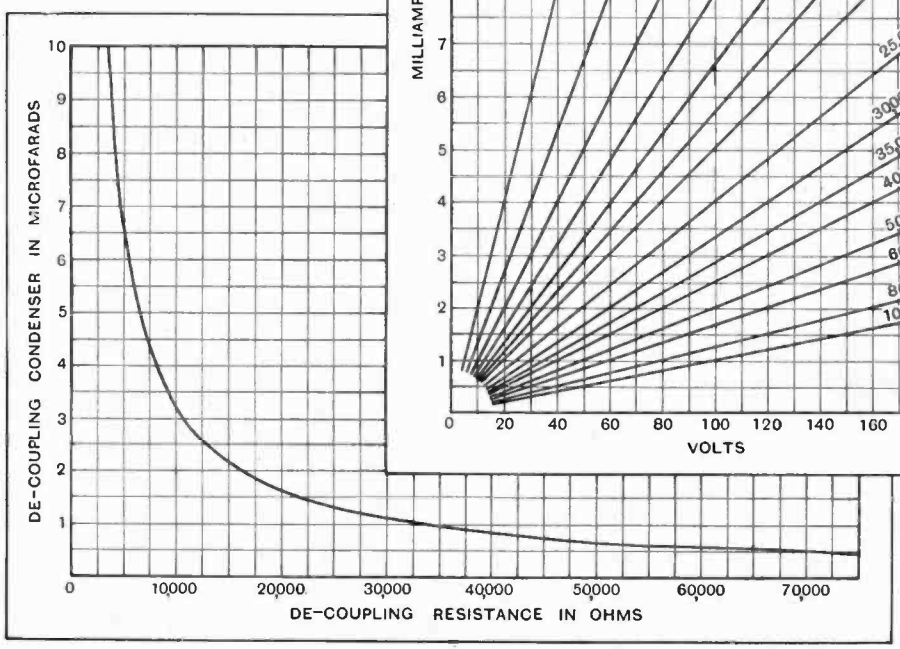
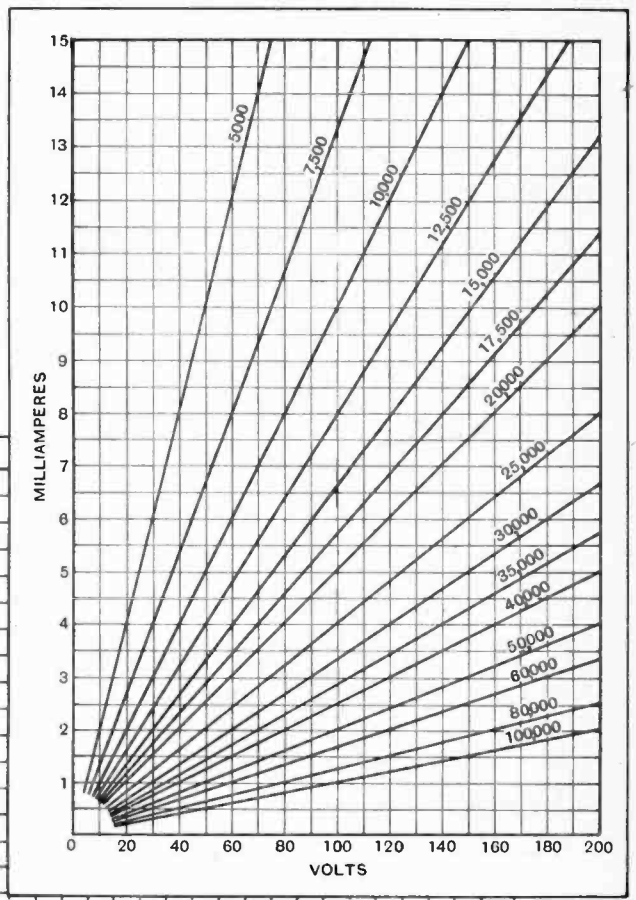


Fig. 3.—The relation between the values of the decoupling resistance and the condenser can be read off from this curve.



***Inset* Fig. 4.—From the known voltage drop and current, the values of decoupling resistances can be read from this chart. In cases where the intersections of the current and voltage ordinates do not occur on one of the resistance lines, the required value can easily be estimated.**

Decoupling —

when the condenser has a reactance, at a low frequency, of one-tenth the value chosen for the resistance.

The curve of Fig. 3, therefore, enables the required value of capacity to be instantly determined, and the values of capacity chosen will be satisfactory for the stated conditions. The curve is based upon fifty cycles as the lowest frequency amplified by the set. If the amplification in the set is above normal, as will be the case with a pentode, the capacity values obtained from the curve should be doubled.

Voltage Dropping.

It will be seen that the value of capacity which must be used depends upon the value which we assign to the resistance, and, furthermore, that the higher the value which we can use for the resistance, the smaller can be the condenser and the more economical will be the circuit. Let us now investigate the conditions which govern the value of the resistance. Referring to Fig. 1, it will be seen that the detector anode voltage is less than that of the battery. The battery may have a potential of 120 volts, whereas the detector will often work with about 65 volts and pass a current of about 2.5 mA. When we change to the decoupled circuit of Fig. 2, the detector H.T. supplied is obtained from the full battery, and the surplus, that is $120-65=55$ volts, is dropped in the decoupling resistance. This then determines the value we must use for this resistance.

We can read off the resistance value directly from Fig. 4, and in our particular case, when we must drop 55 volts at 2.5 mA., we see that the value required is 22,000 ohms. A glance at Fig. 3 then tells us that the decoupling condenser should have a capacity of 1.4 mfd. Now this is not a standard value, and in practice we shall have to use either a smaller or a larger capacity. With a battery set a 1 mfd. condenser would suffice, but in a mains set it would be wiser to choose 2 mfd.

That the choice of decoupling values is simple and rapid by this means is borne out by the highly efficient mains set of Fig. 5. Assuming that the H.T. supply is 260 volts, let us calculate the resistance and condenser values for the following conditions. The pentode anode voltage is 250 volts and the bias 10 volts, while the screen requires 200 volts at 5 mA. The detector must be supplied with 100 volts at 5 mA.

We have to drop $260-210=50$ volts at 5 mA. in the screen resistance R_1, and Fig. 4 shows that this must have a value of 10,000 ohms.; Fig. 3 shows, therefore, that the condenser C_1 must have a capacity of 3.2 mfd. There is no need to double this particular capacity even although a pentode is used, but the calculated value is not standard, and so we choose the nearest size of 4 mfd.

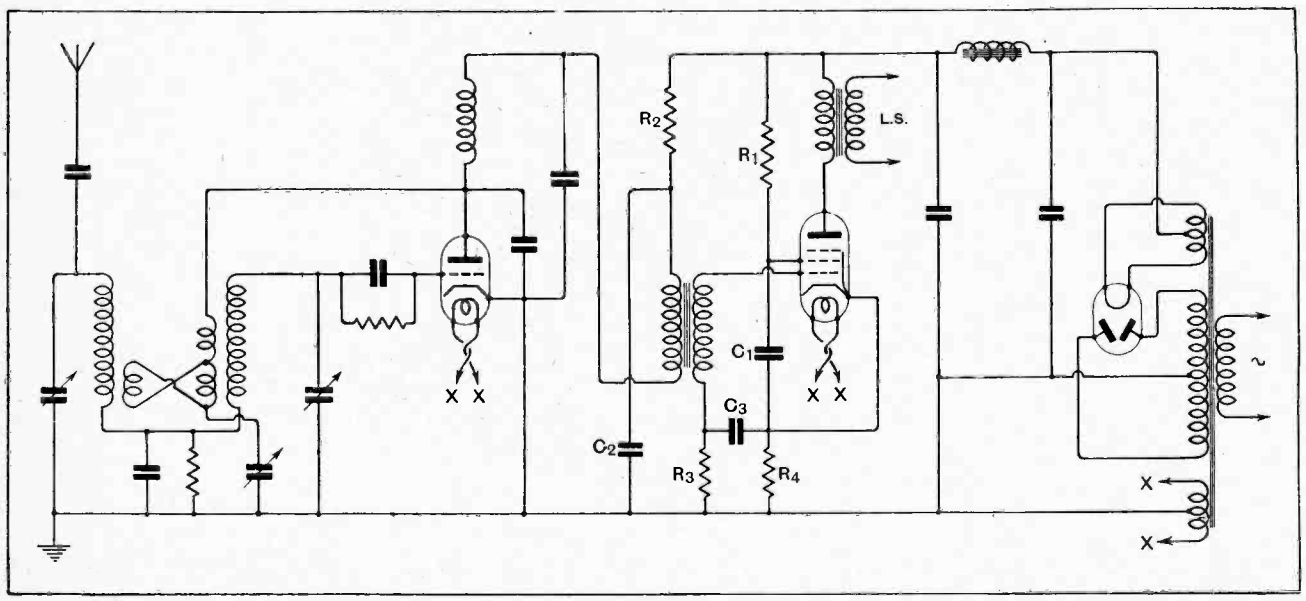


Fig. 5.—Modern practice is exemplified in this two-valve A.C. mains set with pentode output stage and provides a good example of complete decoupling.

For the detector we must drop $260-100=160$ volts at 5 mA. in R_2, and Fig. 4 shows that the value is 32,000 ohms, while from Fig. 3, C_2 must have a capacity of 1 mfd. This must be doubled, since a pentode is used, and so the final value is 2 mfd. There only remain the grid circuit decoupling resistance R_3 and condenser C_3, for we are not concerned here with the bias resistance R_4, which can be worked out from first principles. Now in the grid circuit there is no direct current flow through the resistance R_3, so we can use any convenient value. It is often convenient to choose a 100,000 ohms grid leak for the resistance, and with this the condenser C_3 need be no larger than 0.3 mfd., but the standard value of 1μF. is quite suitable.

When viewed in this light it will be seen that the addition of decoupling to an existing receiver presents no problems and that the advantages which accrue from its use are such as to render it imperature in a set with any pretentions to good-quality reproduction. In addition, it will appear that the multitude of resistances and condensers employed in the modern mains set is not so complex as it appears at first sight.

Air-Cored Chokes for Tone Correction

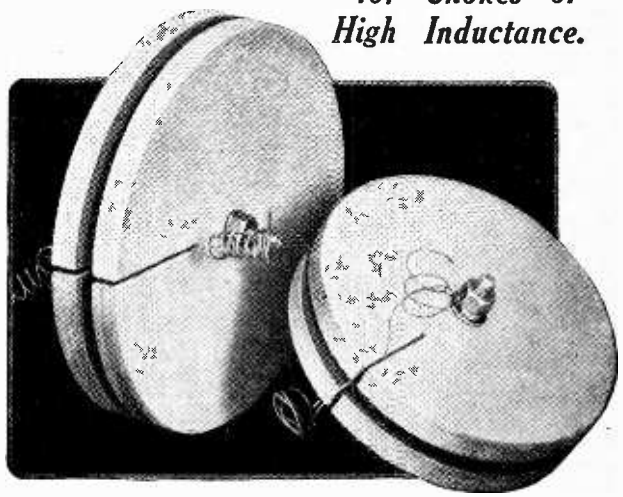
Constructional Data for Chokes of High Inductance.

A FEW weeks ago an article[1] was published in this journal dealing with a method of correction to compensate for the attenuation of the higher audible frequencies when selective tuning circuits are used. The arrangements discussed called for the use of some high inductance air-cored chokes of the order of 240 millihenrys and 480 millihenrys respectively. So far as the writer is aware, chokes of these values are not readily obtainable commercially, so that it is felt that the following constructional details may be of some assistance to those contemplating winding the chokes at home.

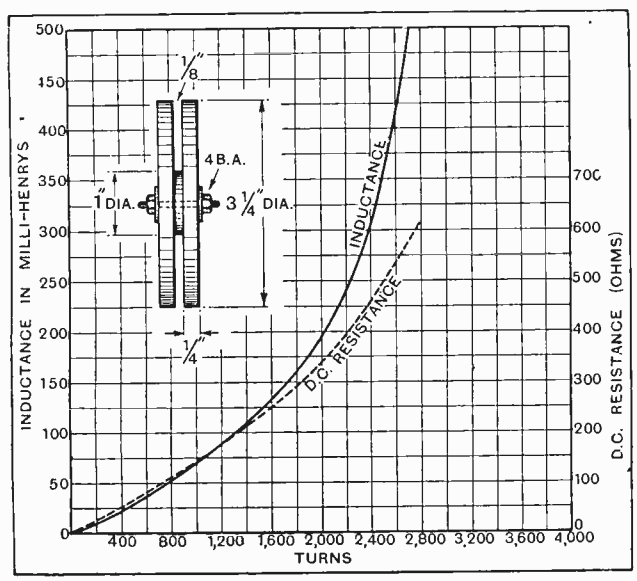
The data prepared are based on certain fixed dimensions, the principal being the diameter of the centre of the former and the axial length (or thickness) of the coil. In addition, a gauge of wire has been chosen which is easy to handle and enables the required inductance to be compressed into a convenient size.

A wooden former is employed, as this material is easy to handle. The outside cheeks are best made of three-ply wood about $\frac{1}{4}$in. thick, while the 1in. centre disc can be cut from any kind of wood, but it must be $\frac{1}{8}$in. thick. Although the formers shown in the illustration are circular in shape, there is no particular reason for this, apart from the matter of appearance, and they may quite well be cut square. The three pieces constituting the former are clamped together by means of a piece of 4 B.A. screwed rod with nuts run on each side. If the rod is cut to $1\frac{1}{2}$in. in length sufficient will protrude either side to accommodate strips of brass fashioned to form supports for baseboard mounting.

The former for the 240-millihenry choke is $2\frac{5}{8}$in. in diameter, and it is wound with 2,200 turns of No. 40 s.w.g. s.s.c. wire. The turns are run on as evenly as possible, while maintaining a constant tension throughout. An ordinary hand drill clamped in a vice will make a useful coil winder for the present purpose, and if the gear ratio is carefully worked out the number of turns put on can be counted quite easily by keeping a note of the revolutions of the driving wheel.



Illustrating the finished 240- and 480-millihenry inductances.



Curve connecting inductance with turns, also dimensional data of 480-millihenry coil.

As the wire used is rather fragile, the free ends which form the two connections should consist of thicker wire. Before commencing to wind the coil about 9in. of No. 30 s.w.g. d.s.c. wire—or any other gauge that may be available—should be soldered to the fine wire, and a piece of thin sleeving slipped over the joint as insulation. The end of the coil should be finished in a similar manner.

If the instructions have been followed faithfully the D.C. resistance of the 240-millihenry choke will be about 390 ohms. This must be regarded as part of the total resistance in the circuit, and will be deducted from the added resistance.

In the case of the 480-millihenry choke the former must be at least $3\frac{1}{4}$in. in diameter, and the winding will consist of 2,700 turns of No. 40 s.w.g. s.s.c. wire. The beginning and the end should be finished in the manner already discussed, and its D.C. resistance should be approximately 575 ohms.

The curves reproduced here have been prepared as a guide for those desiring experimental chokes of various values up to 500 millihenrys for any particular purpose. The data was obtained from actual measurements made with a number of chokes wound on the former specified. All measurements were made at a frequency of 50 cycles.

Possibly the larger size chokes could be improved slightly by winding them in two or more sections, but so far no measurements have been made with this type of construction. The curves would not apply in such cases as, for a given inductance, many more turns would be required.

H. B. D.

[1] See "Band Pass or Tone Correction," by F. M. Colebrook, Sept. 2nd, 1931.

CURRENT TOPICS

Events of the Week in Brief Review.

PILOTS FORE-WARNED. A typical scene at Heston aerodrome where a special transmitter, installed by Standard Telephones and Cables, Ltd., enables the Automobile Association to provide pilots with regular weather forecasts on 833 metres. The schedule is given on this page.

LOGGING A RECORD FLIGHT.

Short-wave listeners are to have an unusual opportunity to follow the flight of a non-stop 'plane. On or about November 22nd, Squadron-Leader Gayford is attempting a non-stop flight to Capetown in a long-range monoplane which will be fitted with a short-wave transmitter (master oscillator) operating on a wavelength of 33.71 metres (8,900 kc.).

It is understood that the start will be made at 6 a.m., and every two hours thereafter transmissions will be made in this form: "CQ, CQ, CQ v GEZAA," followed by the position and repeated three times. In the event of a forced landing being imminent the aircraft will transmit the SOS call three times together with the call letters and position.

The Air Ministry would like as many amateurs as possible to follow the progress of this attempt on the world's non-stop flight record. Any message received may be posted to the Air Ministry, Kingsway, W.C.2, but in the event of a distress call being intercepted the information should be immediately telephoned to Holborn 3434, Ext. 383, or communicated to the Air Ministry in some other way as soon as possible.

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LUXEMBOURG TO STEAL A WAVELENGTH?

The Compagnie Française Radioelectrique, builders of the new Radio-Paris, have been entrusted with the erection of the 200-kW. publicity broadcasting station at Luxembourg. It is stated that the wavelength will exceed 1,000 metres, but considering the congestion on the long-wave band, one wonders whether Luxembourg will beg, borrow or steal a wavelength already in use, and if so, which?

AU REVOIR, PCJ.

PCJ, the famous Philips short-wave station at Hilversum, closed down at the end of October for a period of six months. We understand that the transmitter is to be reconstructed.

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OTHER COUNTRIES, PLEASE COPY.

We understand that foreign tourists may now take their wireless sets into France without paying a tax or deposit. All that is necessary is to make a declaration at the post office for the district in which the receiver is to be used.

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"EMPRESS OF BRITAIN" TO ENTERTAIN ALGIERS?

The Bulletin of the Radio-Alger station announces that negotiations are in progress for the retransmission of a concert to be broadcast by the *Empress of Britain* when the boat passes within 400 miles of the port of Algiers on December 11th.

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A FREQUENCY-MEASURING CONTEST.

A fine gesture on the part of American amateur transmitters to show their eagerness to maintain their exact wavelengths took the form of a national frequency measuring contest on October 24th. At 9 p.m. Eastern Standard Time every amateur station in America closed down with the exception of sixteen transmitters specially picked by the Radio Relay League. These transmitted for fifteen minute periods, using special frequency control apparatus, and it was the aim of each contestant to obtain the highest degree of accuracy in measuring the respective frequencies of the stations transmitting.

The results are not yet announced, but it is believed that the best will be within one hundredth of one per cent.

"AULD REEKIE'S" RADIO SHOW.

To-day (Wednesday) at 2 p.m. Sir Gordon Nairne, one of the Governors of the B.B.C., will open the second Scottish National Radio Exhibition in the Waverley Market, Edinburgh. The Exhibition has the backing of the Radio Manufacturers' Association, and is the largest of its kind yet held in Scotland. More than 100 stands will cover almost the whole area of the famous "Market," and record crowds are expected.

The Exhibition will be open from 2 to 10 p.m. daily until Saturday, November 21st.

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ANOTHER SUPER-STATION?

The latest bid for "air supremacy" comes from Italian-speaking Switzerland, where a new "self-governing" association proclaims its intention of constructing a super broadcasting station on Mount Generoso, in the neighbourhood of Lugano.

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ENTER RADIO-FLORENCE.

The new transmitter at Radio-Florence will make its voice heard within the next few days, using the old Milan wavelength of 500.8 metres. Milan, we understand, will then take the wavelength of 332 belonging to Naples, while Naples will flit over to another wavelength as yet unspecified.

Although Radio-Florence will employ a power of 20 kW., and will be the most up-to-date station in Italy, it will remain a relay station for a long time to come, choosing its programmes from Rome, Milan, Naples or Turin.

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PRISON RADIO BAN.

The new Spanish Government has put its foot down to the extent of forbidding the use of wireless sets in prisons. The "tenants" are protesting.

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833-METRE TELEPHONY FOR AIRMEN.

As announced in *The Wireless World* of October 14th last, telephony weather reports can now be picked up eight times daily from a special transmitter at Heston Aerodrome, using a wavelength of 833 metres. The transmissions are for the special guidance of air pilots, and are being carried out by the Automobile Association under a special licence issued by the Post Office. The times of transmission are: 8.45, 9.30, 10.30, 11.30, 12.30, 14.45, 15.30 and 16.30.

Reports on the quality of transmission will be gladly welcomed by the Wireless Officer at the Aerodrome, Heston, Middlesex.

A 2,000 LOUD SPEAKER SET.

New York's latest and most luxurious hotel, the Waldorf-Astoria, has been equipped with what is probably the most elaborate radio receiving system in existence. A total of 2,000 loud speakers are fed from a central control panel which measures fifty feet in length and looks like the master control panel of a powerful broadcasting station. Six different programmes are available at all times in any one of the 1,940 guest rooms.

Six broadcast receivers, linked to a single aerial 600 feet above the street, are used to feed the control panel. Provision is made on the control panel for the handling of any speeches, musical entertainments, etc., which may be given in the hotel, to be relayed by wire to the broadcast networks for transmission to all parts of the country. Microphones can be plugged in to any one of 72 positions in different parts of the hotel, where events of importance are likely to occur.

In addition to the smaller speakers in the guest rooms, all the public rooms are equipped with large exponential horn speakers, each six feet high, which are concealed behind grilles.

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SHORT WAVES FROM THE CANARIES.

The Teneriffe short-wave station is now working on Saturdays and Sundays from 2100 to 2300 (G.M.T.), with a wavelength of 41.6 metres. On week-days the transmission begins at 1800.

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ONE BRITISH!

Of fifty "radio articles" exhibited at the recent Swiss Samples Fair, which was visited by 20,000 potential buyers, the management report that 28 were American, 22 German, 5 Austrian, 1 Swiss, 1 Hungarian, 1 British, and 1 Dutch.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 11th.

Television Society.—At 7 p.m. At University College, Gower Street, W.C.1. Lecture: "Television with Cathode Ray Tube," by Dr. V. K. Zworykin.

THURSDAY, NOVEMBER 12th.

Derby Wireless Club.—At 7.30 p.m. At Peartree Branch Library. Lecture: "Gramophone Pick-ups and Loud Speakers," by Mr. T. F. Robinson (British Thomson-Houston Co., Ltd.).

Edinburgh and District Radio Society.—Visit to Scottish National Radio Exhibition, Waverley Market.

Golders Green and Hendon Radio Society.—At 8.15 p.m. At Hampstead Art Galleries, 345, Finchley Road, N.W.3. Lecture (Part II): "Faultfinding and Testing," by Mr. A. Black.

FRIDAY, NOVEMBER 13th.

Bristol and District Radio Society.—At 7.30 p.m. In the Geographical Lecture Theatre, Bristol University. Lecture: "The Manufacture of Valves," by Mr. F. Voule (Marconiphone Co., Ltd.).

Newcastle-upon-Tyne Radio Society.—At 7.30 p.m. In the Connaught Hall, Blackett Street. Lecture: "Recent Research on the Moving-coil Speaker and its Bearing on Design," by Dr. N. W. McLachlan.

MONDAY, NOVEMBER 16th.

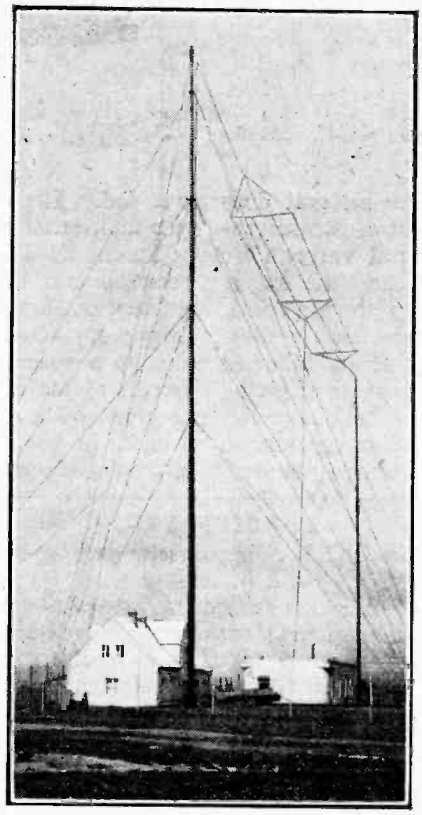
Huddersfield New Radio Society.—At 7.30 p.m. At Commercial Chambers, Chapel Hill. Lecture: "Valves," by Mr. Ratcliffe (Marconiphone Co., Ltd.).

TUESDAY, NOVEMBER 17th.

Southall Radio Society.—At 8.30 p.m. At the Villiers Rooms, Red Lion Hotel. "Measurements of Resistance and Capacity by the Simple Bridge Method," by Mr. A. Stephens.

WORLD'S HIGHEST TELEVISION TRANSMITTER.

The television station which the National Broadcasting Company is building at the top of the Empire State Building in New York, 1,250 feet above the street, is expected to be ready by the first of January next. According to a correspondent, it is proposed to use ultra-short waves in the initial tests, and a number of receiving stations will be established in the metropolitan area for observation purposes. It is hoped by those in charge of the work that Vladimir Zworykin's new cathode ray receiver will be ready by the time the station commences its initial tests.



CLOSING DOWN. The old station at Prague which will probably send its last signal within the next few days. It is to be superseded by the giant 200 kW. transmitter at Cesky Brod.

CATHODE RAY TELEVISION.

"Television with the Cathode Ray Tube" is the subject of a lecture to be given at 7 o'clock this evening (Wednesday) by Dr. V. K. Zworykin at a meeting of the Television Society at University College, Gower Street, W.C.1.

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FOREIGN STATION TUNING CHART.

Readers requiring additional copies of the Foreign Station Tuning Chart published with the New Readers' Number of *The Wireless World* can still obtain these post free at 3½d. from the Publishers, Dorset House, Tudor Street, London, E.C.4.

CLUB NEWS.

Dr. McLachlan in Newcastle.

Dr. N. W. McLachlan's lecture before the Newcastle-upon-Tyne Radio Society has been postponed from November 6th to Friday, November 13th. Dr. McLachlan's subject will be "Recent Research on the Moving Coil Loud Speaker and its Bearing on Design." The meeting will be held at 7.30 p.m. in the Connaught Hall, Blackett Street.

Hon. Secretary: Mr. W. W. Pope, 9, Kimberley Gardens, Jesmond, Newcastle.

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A Surprise Item.

Among a number of new members who were enrolled at the Tenth Annual General Meeting of the Ilford and District Radio Society, six had been attracted by reading *The Wireless World* club reports.

A surprise demonstration was given at the last meeting, when Mr. C. E. Largen showed his experimental receiver, comprising H.F. amplifier, anode bend detector, R.C. coupled L.F. amplifier, with a PX4 output valve operating a moving-coil speaker. The demonstration was preceded by a short talk on screened grid valves by Mr. H. L. Ranson.

Hon. Secretary: Mr. C. E. Largen, 16, Clements Road, Ilford, Essex.

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Matching Valve and Speaker.

The output stage—one of the most fruitful sources of wireless distortion—was dealt with at the last meeting of the North Middlesex Radio Society by Mr. G. Parr, of the Edison Swan Electric Co., Ltd. The lecturer stressed the interdependence of the output valve and loud speaker, and gave perhaps the clearest explanation the Society has yet heard of the operation of push-pull amplification and its attendant advantages and disadvantages. In a demonstration Mr. Parr showed the importance of securing correct matching between valve and loud speaker, particularly when the former is a pentode. An interesting feature of the demonstration was the very considerable speech output from a permanent magnet M.C. speaker, used in conjunction with a small Mazda pentode.

Hon. Secretary: Mr. M. P. Young, 40, Park View, Wynchgate, N.21.

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Metallised Valves.

Cross-modulation, one of the ever-present evils with low impedance, efficient screen grid valves, and valve manufacturers' efforts to cope with it by means of specially designed valves, was the opening theme of a lecture by Mr. Quarrington, of Messrs. A. C. Cossor, Ltd., at a recent meeting of the Bristol and District Radio Society. The lecturer proceeded to show how the new metallised valves, with a resultingly lower inter-electrode capacity, make for more efficient high-frequency amplification, and concluded his lecture with a description of the plant used for obtaining the high vacuum in valves.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrews Park, Bristol.

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Single-valve Short-wave Sets.

A discussion, ranging from the colour spectrum to short-wave receivers, occupied the members' time at the October meeting of the Liverpool Wireless Society. Much useful information was obtained on the operation of single-valve short-wave sets.

The next meeting of the Society will be held to-morrow (Thursday), November 12th. New members will be welcomed, and full particulars can be obtained from the Hon. Secretary: Mr. R. Reid Jones, 24, Oak Leigh, Tue Brook, Liverpool.

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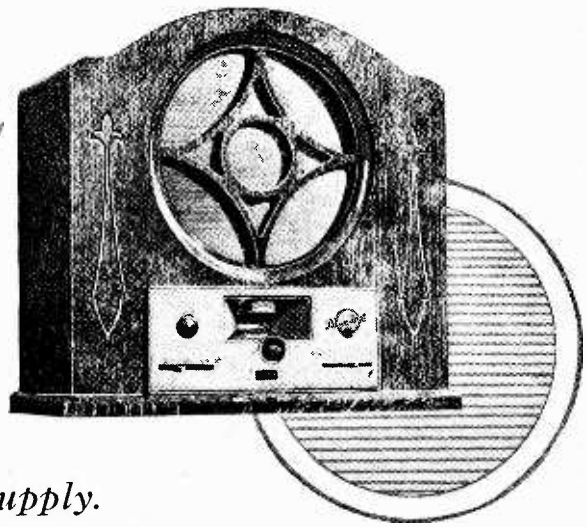
All About Rectifiers.

The lecture on "Rectifiers" given last week before Slade Radio (Birmingham) by Mr. S. A. Stevens, B.Sc., of the Westinghouse Brake and Saxby Signal Co., Ltd., proved of great interest. In a very comprehensive lecture Mr. Stevens touched upon the earliest types of rectifier, and finally described the manufacture of the latest types of dry metal rectifiers. With the aid of a large number of slides he made clear the circuits in which the many types can be used to the best advantage. The evening concluded with an interesting film showing the operation of the Brimsdown Power Station.

Full particulars of the Society's activities can be obtained from the Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.

Blue-Spot



ALL ELECTRIC MODEL W.S.400

Selective Single-dial Set for A.C. Supply.

IT is rare to-day to find a four-valve set that does not follow the customary arrangement of two screen-grid H.F. stages, detector and output valve. We are apt to think along orthodox lines, and the expert may approach other circuit systems with prejudice. It is interesting, therefore, to investigate what a four-valve set consisting of a single H.F. stage, followed by a detector and two L.F. valves, is capable of giving as to range and quality. Such a set is the Blue Spot, and the results given are sufficiently interesting to make one consider whether or not present-day tendencies are not sweeping aside the merits of other systems.

An examination of the set, purely on performance, reveals it to be sensitive. A small aerial was used as best exposing the weakness as to range of the single H.F. stage set. The aerial length was 30ft., and the average height 15ft., and with a single rotation of the dial thirty-five stations were clearly received on the medium waveband, together with about a score of carriers and seven more when switched over to long waves.

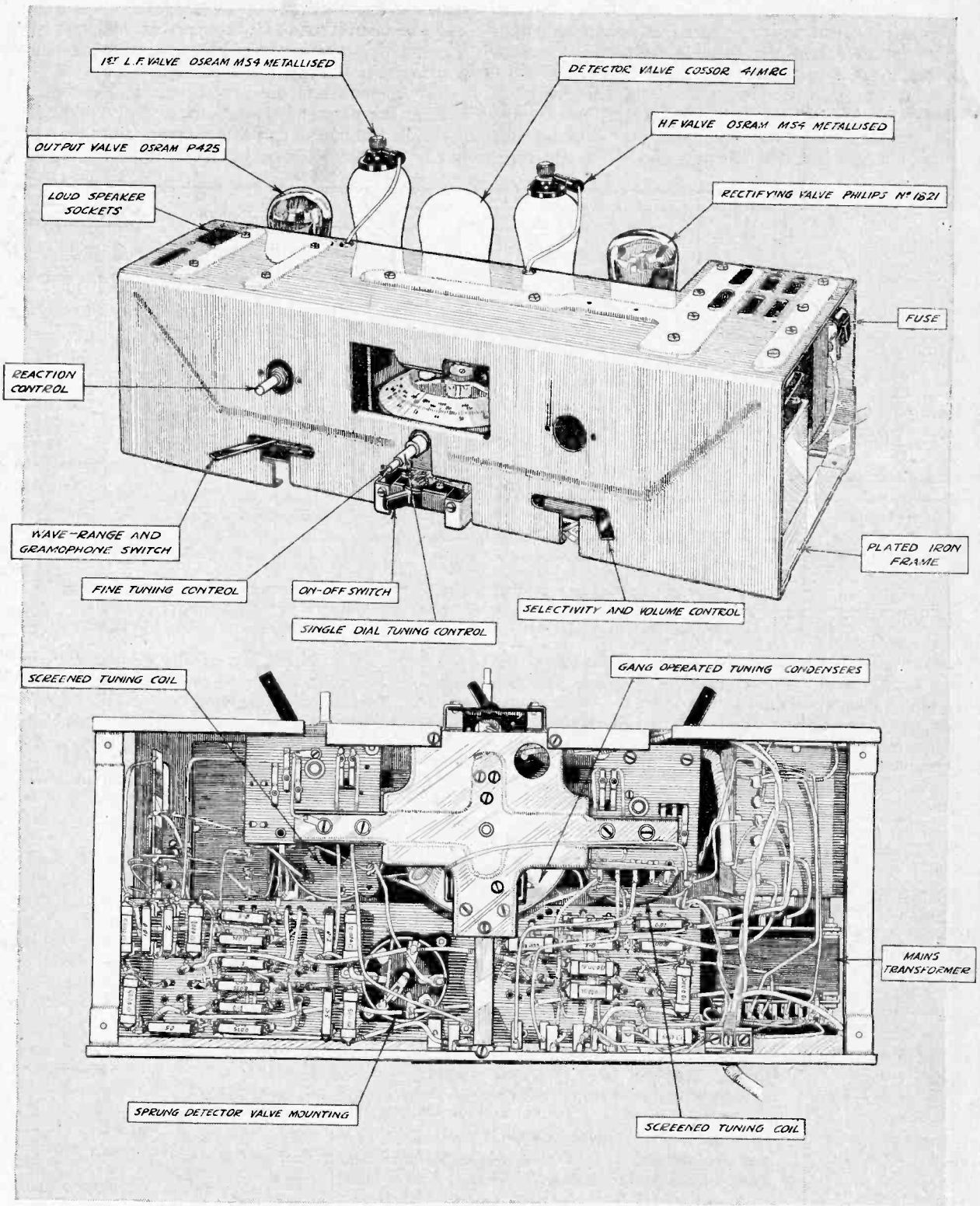
A plug connector at the back of the set makes it possible to dispense with the aerial altogether, and, in spite of only a single H.F. stage, the tuning-in of several foreign stations leads one to forget that the elevated aerial has been disconnected.

No set previously tested other than superheterodyne has possessed greater selectivity, and almost within the thickness of a line on its 100 division scale a station passes from full strength to extinction. As to quality it must be borne in mind that the particular model tested was fitted with the inductor type of loud speaker, and not a moving coil, and was designed for sensitiveness rather than large volume. A satisfactory standard of quality is maintained, providing excessive volume is avoided. The output is ample, being of the order of 300 milliwatts.

Tuning is effected by a single control operating a recessed and illuminated scale carrying a wavelength calibration, and a concentric vernier knob makes tuning easy. A reaction knob is unusually smooth in its effects, due to a special arrangement of by-pass in the anode circuit of the detector. Further adjustment of volume is given by a selectivity control operated by a lever, which, in use, suggests that lever control may have advantages over the rotating knob invariably adopted. Wave range is also controlled by a lever action, which in the centre position throws in the connections for gramophone pick-up. Circuit details can be gleaned from the accompanying diagram, although attention might be drawn to the more outstanding features. Wave-range switching is unusual, and involves completing the circuit of an open-ended coil so that for medium wave a pair of inductances are parallel-connected. The aerial circuit is loose coupled, while, following the H.F. valve, is a choke-fed tuned grid circuit which assists in providing good selectivity. Bias to the H.F. valve, an Osram M.S.4, is by cathode resistance. The pair of tuning condensers, which are of the solid dielectric type, are operated by a vertical spindle, the fine tuning control being arranged to rock one of the stators. The values used in the capacity-reaction circuit are such that the critical tuning appears to be unaffected by change of reaction adjustment. A swinging slab coil controls the amount of aerial coupling. In place of the commonly adopted power-grid detection we find an anode-bend detector with a high value of biasing resistance in its cathode lead, and it is to this that the high selectivity is due. It should be noted also that the method

SPECIFICATION.

Single H.F. Stage, detector and two-stage L.F. amplifier.
A.C. mains voltages of 100 to 240 volts.
Loose-coupled aerial with provision for mains aerial.
Filter-fed tuned-grid H.F. intervalve coupling.
Capacity reaction. Anode bend detection.
All-resistance coupled L.F. amplifier.
Valve rectification. Provision for pick-up.
Valves: Osram MS4, Cossor 41.MRC, Osram MS4, Osram P.425, Rectifier, Philips 1821.
Price: Type WS.400 with inductor loud speaker, 20 guineas.



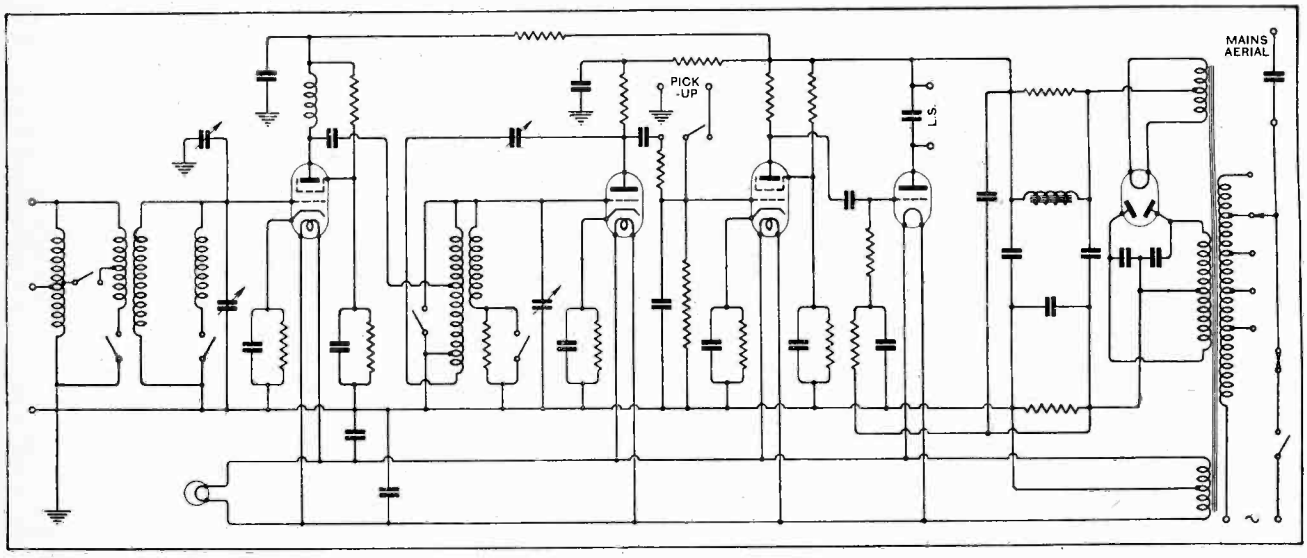
The compact chassis unit follows a form of construction that should reduce maintenance troubles.

Blue-Spot All Electric Model W.S.400.—

of bias brings about a condition of automatic volume control, for, as a generous signal tends to increase the anode current of the detector, the negative biasing potential developed across the cathode resistance increases also, making the valve less sensitive.

It has been said that only a single L.F. stage is needed following an anode-bend detector, as a large initial signal is required to operate it. Against this viewpoint is the fact that with an anode detector magamplification being corrected both in the intervalve couplings and in the anode of the output valve. The loud speaker is directly in the anode circuit of the P.425, and provision is made for using an external loud speaker. The rectifying valve is a Philips type 1821 delivering a maximum H.T. potential of 250 volts.

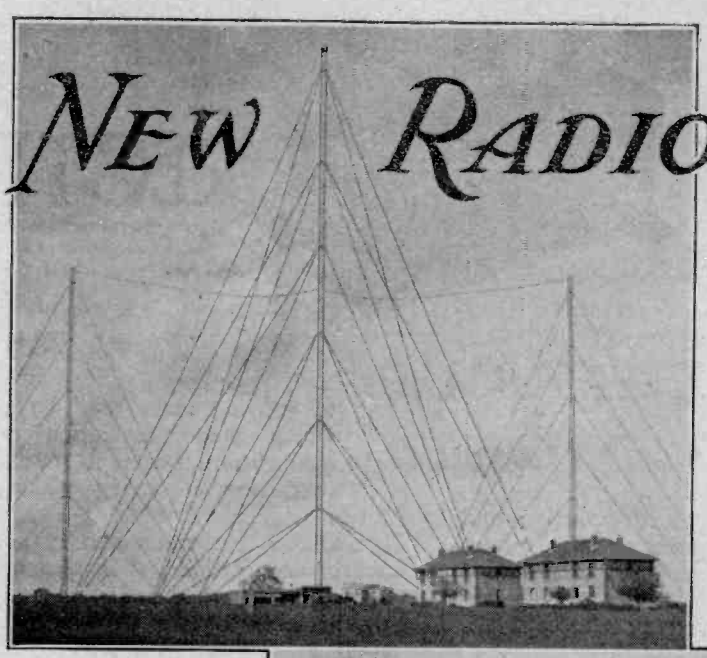
For compactness of construction and simple wiring layout, the chassis is remarkable. The condensers are assembled in packs, and there are no fewer than twenty-five resistances held in clips on the underside of the valve



The single H.F. stage is followed by an anode-bend detector and an all-resistance coupled two-stage L.F. amplifier.

nification is lost as compared with the detection of the signal on the grid, and it is for this reason that two L.F. stages are used in the Blue Spot set. A screen-grid valve, the Osram M.S.4, is used in the first L.F. stage, followed by the Osram P.425, giving an output of some 300 milliwatts. Resistance coupling is used throughout the L.F. amplifier, its overall properties for uniform platform. The chassis is a good specimen of mass production, being an assembly of stampings, screws, and rivets. Ventilation is provided over the mains transformer, which is fitted with a totally protected and easily accessible fuse. No live parts are exposed, and mains voltages from 110 to 240 may be applied by inserting a small insulated pin in its appropriate socket.

The NEW RADIO PARIS



Coming Shortly !

Power: 85-120 kW.

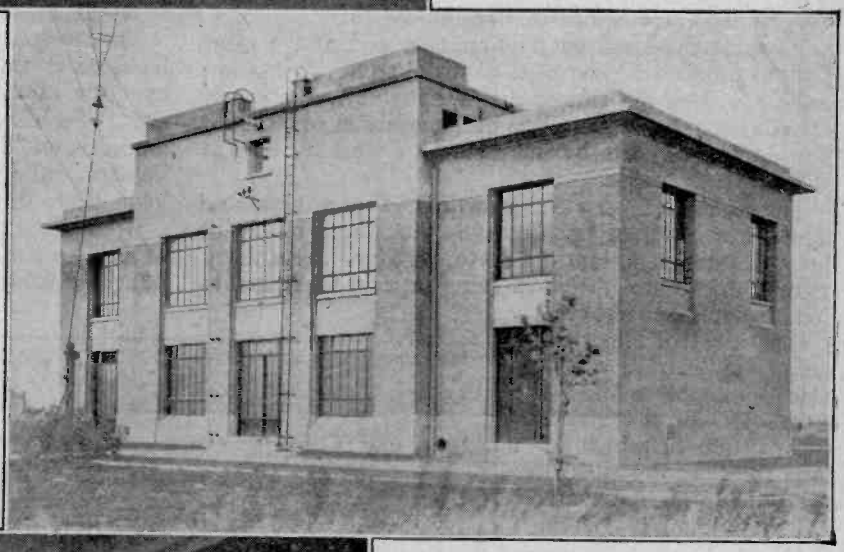
Wavelength: 1,725 Metres.

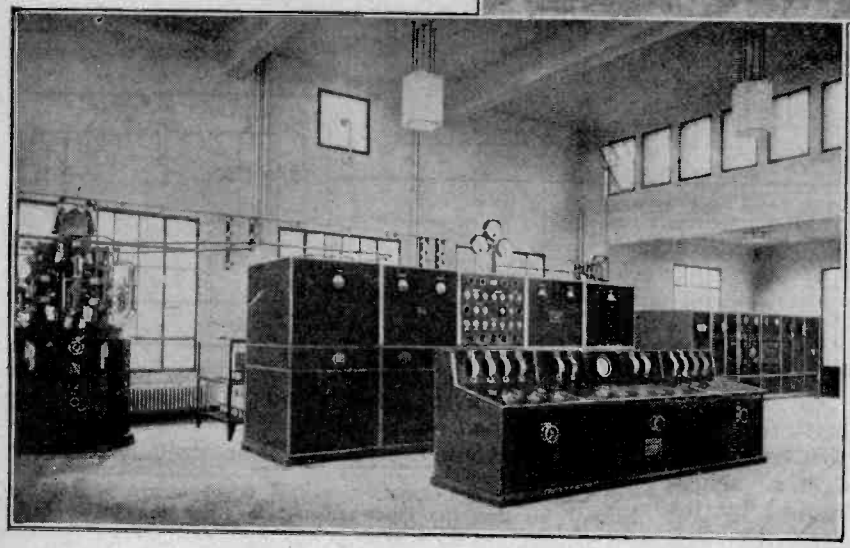
The aerial is suspended from three masts, each 600 feet high, in the form of a triangle, while the earth system consists of a huge wire mat buried at a depth of 2ft. The original proposal that the station should develop its own power was abandoned, and the station, therefore, takes its current from the public supply system.

The transmitter, which has been constructed by the Société Française Radioelectrique, comprises a master oscillator followed by two intermediate stages of push-pull, in the first of which are two 60-watt valves having a plate voltage of 1,200; in the second stage are two water-cooled valves carrying a plate voltage of 12,000.

TO rise with one bound from 17 kW. to 120 kW. output is what Radio Paris proposes to do within the next few days. At the moment of writing the precise date is still uncertain, owing to the landline troubles which seem always to dog French broadcasting arrangements, but there should be no uncertainty in the minds of British listeners when once the transmitter has started! With an official power rating of 85-120 kW., the new staton at Saint-Remy-l'Honore, twenty-three miles south-east of Paris, will, as the French Press joyfully proclaims, atone in some measure for France's backwardness in the past, and bring her nearer to terms of broadcast equality with her neighbours, Britain and Germany.

Like Moorside Edge, Langenberg, and other powerful stations, the new Radio Paris transmitter is built on a high plateau.





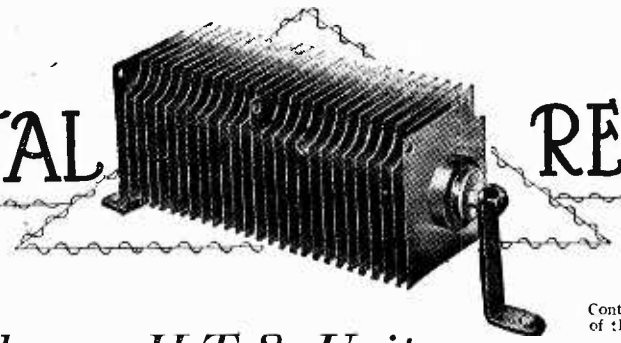
The station building (seen above) bears a striking resemblance to those of the B.B.C. regional stations. In the lower photograph the main control panel can be seen in the centre of the transmitter hall.

Finally there is the power stage comprising two circuits in parallel, each containing six 10-kW. water-cooled valves. It is interesting to note that mercury arc rectifiers are employed for the 3-phase high-tension supply.

A special underground cable in an aluminium casing connects the transmitter with the studios in Paris, and it is claimed that this cable will be equal to all demands made upon it by the requirements of broadcast music.

The authorities confidently state that this station will be the most up to date in Europe, particularly in regard to the standard of musical reproduction, which, it is claimed, will give a faithful rendering of all frequencies from 30 to 10 000 cycles.

NEW METAL RECTIFIER



Contributed by the Engineering Department of the Westinghouse Brake and Saxby Signal Company.

The Westinghouse H.T.8 Unit for Voltage-doubling Circuits.

THE increasing use of power-grid detection and power-type pentodes in all-mains sets necessitates that the available output from the rectifier should be in the region of 300 volts at 60 milliamperes before smoothing if sufficient margin of voltage is to be available to allow for adequate decoupling.

To meet these output requirements and at the same time to produce a new series of metal rectifiers at a low price has been the aim of the Westinghouse Company. Development has taken place in the direction of reducing the number of parts by increasing the working voltage of each rectifier disc.

The styles H.T. 5, 6 and 7 rectifiers were a direct and immediate result of this research, but these have not fully met the requirements set out above, particularly as their maximum current-carrying capacity is limited to some 30 milliamperes only.

One size of the new range of units being placed on the market is styled H.T.8, the general construction of which follows the lines described in the article which appeared in this journal of December 19th, 1928, but the characteristics of the rectifier discs used are somewhat different, having a higher impedance, so that a smaller number are required for any given voltage.

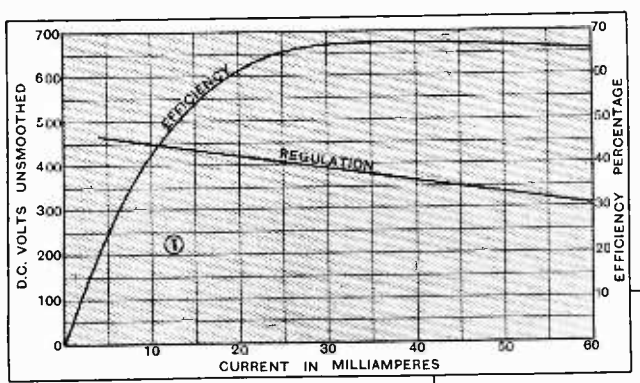


Fig. 1.— Regulation and efficiency curves of the H.T.8 rectifier. Input 205 volts and output (unsmoothed) using two 4-mfd. condensers.

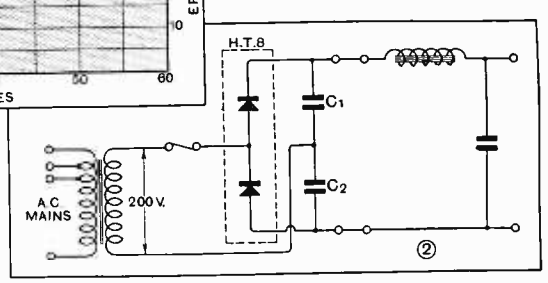


Fig. 2.—Voltage-doubling bridge circuit.

The rectifier type H.T.8 is intended for use in the "voltage-doubler" circuit in the manner shown in Fig. 2, and the output curve shown in Fig. 1 is that which would be obtained across the reservoir condensers C_1 and C_2 in series, provided that these are of the specified capacity of 4 mfds. In this connection it is interesting to note that the output of a voltage-doubler rectifier circuit is directly controlled by the capacity of these reservoir condensers, and the effect of varying them may be seen from Fig. 3, which shows regulation curves of voltage against output current, measured across the two condensers in series, when these each have values of 2, 4, and 6 mfds.

In addition to this method of controlling the total output of the rectifier, it is also quite permissible to operate it with a reduced input voltage, and Fig. 4 shows the output curves at different input voltages for reservoir capacities of 4 mfds. each.

The overall efficiency of these rectifiers is exceedingly high, as is revealed in Fig. 1, the curve being taken over the rated range. From the curve it will be seen that the efficiency is at a maximum at a load of 40 milliamperes, and that it is reasonably constant at this highest value at from 30 to 60 milliamperes, which will be the loads taken from it in ordinary circumstances.

From Fig. 1 the power input required for the H.T.8 at any load may be calculated, and it will be found at full rated load to be about 28 watts. On account of the reactive component taken by the reservoir condensers, however, the volt-ampere output of the transformer will be found to be greater, viz., about 40 volt amperes. Satisfactory transformer design therefore may be obtained on a basis of a secondary winding designed to carry a load of 200 milliamperes[1] at 200 volts, with an open circuit voltage rising to 210 volts, allowing for a 5 per cent. regulation.

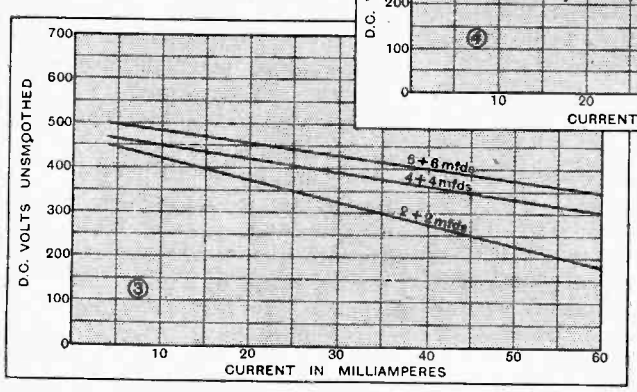
It is important to note that if accidentally short-cir-

[1] The "voltage-doubler" circuit is of course a "current halver," so that the input current is twice the total output current.

New Metal Rectifier.—

cuited, the rectifier is not damaged. The reason for this immunity from trouble arises from the fact that, with the voltage-doubler circuit used there is a definite maximum value of short-circuit current which can flow, i.e., that which will be passed by the condensers C_1 and C_2 being charged to the peak value of the A.C. input and discharged to zero during each cycle. In the particular case of this rectifier units operating under its rated conditions the magnitude of the short-circuit current on the D.C. side of the rectifier will be about 240 milliamperes and that flowing through the transformer winding will be about 480 milliamperes.

An advantage of the metal rectifier, perhaps not so well known, is the fact that it always provides a conducting path across the smoothing filter and so prevents switching-off surges.



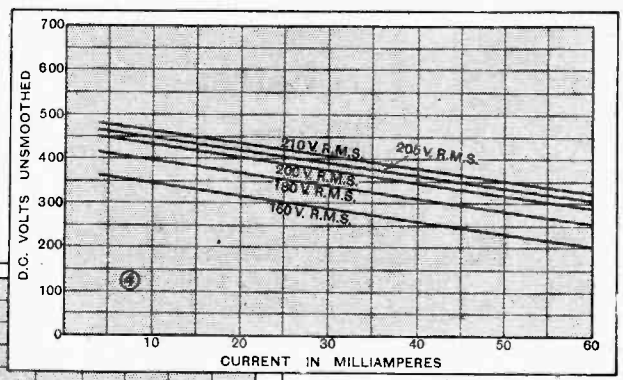
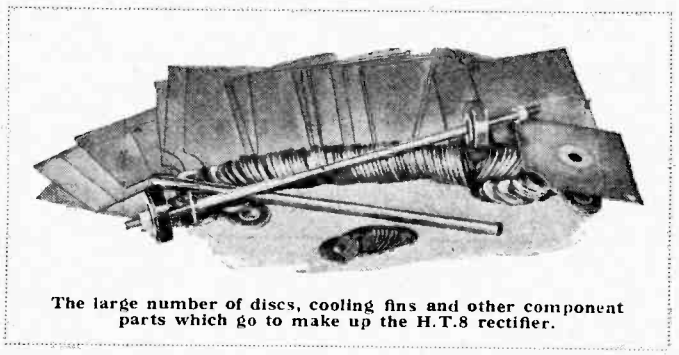


Fig. 3.—The output of rectifiers connected as a voltage-doubling bridge is considerably influenced by the values of the two series condensers. The effect on current and voltage of two 2, 4 and 6 mfd. condensers is here shown.

Fig. 4.—An alternative method of output control consists of changing the input voltage. The curves are plotted using two 4-mfd. condensers in series.

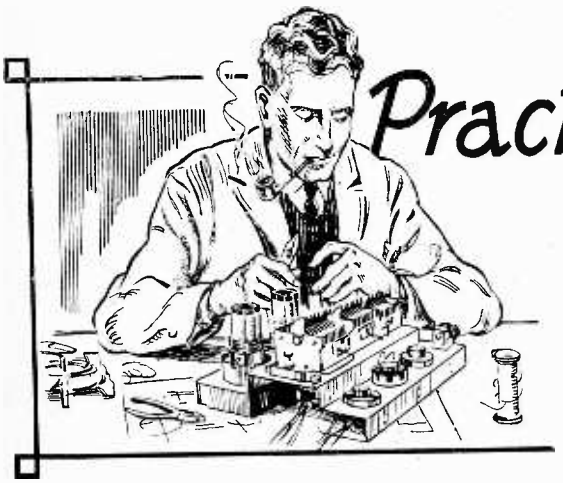
It might appear from the rated input voltage of this rectifier that a transformer would not be essential for use in conjunction with it, and for exciting the field magnets of high-resistance moving-coil speakers—for which the rectifier is suitable—a transformer certainly is not necessary in those cases where the supply voltage is 200 or 210, and where the field winding is adequately insulated from earth. When operating moving-coil loud speakers this rectifier unit will deliver an input of some 18 watts to a field winding having a resistance of 5,000 ohms, with the voltage-doubler circuit using two 4 mfd. reservoir condensers. In this case, of course, no smoothing choke should be needed, as the inductance of the winding is normally sufficient to smooth out the ripple, but should any slight residual hum be found, then a 2-mfd. condenser connected across the winding will serve to remove it. If the supply exceeds 210 volts, it would be better to use a step-down transformer instead of a resistance, on account of the risk of voltage rise across the rectifier should the magnet be accidentally disconnected. With reasonable care, however, the risk is not very great, and, providing the point is kept in mind and such obvious temptations as a plug and socket connection in the D.C. lead to the field magnet dispensed with, there is no objection to the use of a 200-ohm resistance in series with the A.C. circuit to the rectifier in lieu of a transformer. Voltage adjustment by series resistance must on no account be adopted with a half-wave rectifier. The resistance must, of course, be capable of carrying 200 milliamperes continuously. Where A.C. mains are available, this is the cheapest method for providing field excitation.

Those amateurs who choose H.T. accumulators as a means of operating their receivers will find that the H.T.8 rectifier provides a convenient method of charging from A.C. supply if the following points are noted. Using the rectifier in a half-wave scheme, with its terminal marked A.C. left unconnected, it is capable of charging an accumulator of not more than 150 volts at an initial rate of 60 milliamperes, with a ballast resistance of 200 ohms, when the battery is in a discharged state. As the battery becomes charged and its voltage rises, the charging rate naturally diminishes. Although it is possible to charge in this manner a higher-voltage battery with less ballast resistance, such a procedure is not to be recommended on account of the instability which results from small changes in supply and battery voltage.



The large number of discs, cooling fins and other component parts which go to make up the H.T.8 rectifier.

By the use of a step-up transformer it is possible to charge an accumulator of 200 volts nominal E.M.F. with a ballast resistance of approximately 800 ohms and an input to the rectifier of 350 volts A.C. As an alternative one can charge a 200-volt accumulator using the voltage-doubler circuit and the normal input voltage. In this case, using 200 volts input and two 4 mfd. reservoir condensers, a ballast resistance of approximately 1,500 ohms will be needed in series with the battery leads, while if reservoir condensers of only 2 mfd. each be used a resistance of 500 ohms will be sufficient.



Practical Hints and Tips

Simplified Aids to Better Reception.

THE last trace of hum is notoriously difficult to eliminate, and this is particularly the case when, in an endeavour to use up old components, a smoothing choke is used with a lower inductance than one would like.

ELECTROLYTIC CONDENSERS

The addition of sufficient capacity after the choke will usually cure the hum, but this is often expensive, since many microfarads may be needed, and in a compact receiver there is little room for additional high-voltage-test paper condensers.

The new electrolytic condensers are very useful in cases of this kind. A capacity of 8 mfd., designed for working at 400 volts, can be obtained in a case little larger than that of a 2-mfd. paper condenser of the same voltage rating. Room for one of these condensers, therefore, can be found in most sets, and it will often prove most efficacious in silencing an obstinate case of hum.

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IN the "Hints and Tips" section of *The Wireless World* for October 28th it was suggested that pains are sometimes taken to make unnecessarily good long-wave coils, but a warning should be offered against going to extremes, particularly if all tuned circuits of the receiver are to be controlled by ganged condensers. There is a real risk of inefficiency, for example, if the long-wave section is made up in the form of a "bunched" winding in a single slot. Such a winding will have a very high self-capacity; this may not be highly undesirable in itself, as it is seldom a matter of any real difficulty to cover the normal long-wave broadcasting band, even if stray capacities across the circuit are high. But experience shows that when the coils are wound by hand it is almost impossible to ensure that their self-capacity shall be reasonably equal; in practice, this means that trimming adjustments made on the normal waveband will not hold good on switching over to the long-wave side.

WINDING LONG-WAVE COILS.

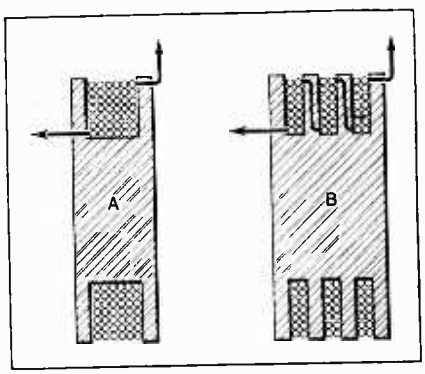

Fig. 1.—Long-wave windings of the type shown in sketch A are likely to have excessive (and varying) self-capacity: sub-divided windings, as in diagram B, are generally preferable, especially for a set with ganged tuning.

A single-section coil of the type in question (Fig. 1A) can almost invariably be improved from the point of view of constancy by rearranging the turns in three narrow adjacent slots, as shown in diagram B. Machine-wound coils of the single-section type can, however, be quite satisfactory.

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WHEN a receiver originally designed for use with batteries is connected to an eliminator, various unpleasant things can happen. Of these the commonest is motor-boating, which is due to the fact that the eliminator, unlike a battery in good condition, has a high internal impedance.

SAVING H.T. VOLTS.

The cure, as is well known, is the introduction of decoupling devices into the anode circuits, and especially into the anode circuit of the detector. But if the eliminator is designed to deliver voltages not much higher than those for which the set was originally designed, it may happen that the introduction of resistances in series with the H.T. supply reduces the voltage available at the anode of the valve to such a degree that the performance of the set suffers.

In such a case it should not be forgotten that it is often practicable to use a choke in place of a resistance, and that the introduction of the choke will only reduce the available voltage to a very small extent.

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AFTER an accidental short-circuit of the source of H.T. supply it is a good plan to assure oneself that the automatic bias resistance which is included in most modern sets has not been damaged by this accident.

AN H.T. SHORT-CIRCUIT: A Possible Result.

Of course, if the damage suffered by this resistance takes the form of a complete "burn out," no harm will be done to the set by attempting to put it into operation; it will merely refuse to function. But it

is by no means unusual to find that, as a result of passing an unduly heavy current through a compact wire-wound resistance, a number of the turns become short-circuited; in a case that the writer has in mind the value of a 400-ohm resistor was reduced in this way to a trifle under 50 ohms. No other damage was done, but had an attempt been made to operate the receiver without replacing the damaged resistance the output valve would inevitably have been damaged by running it with a much-reduced negative bias.

Troubles of this sort are only likely to arise when the bias resistor is connected in the common H.T.-negative lead, and not when it is inserted in the cathode lead of the valve concerned.

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"LOCAL-DISTANCE" DETECTOR VOLTAGE.

IT has recently been suggested in these notes that a lower detector voltage is desirable for long-range reception than for local-station listening; the smoothness of reaction control is almost invariably improved by applying a pressure considerably less than that necessary for best

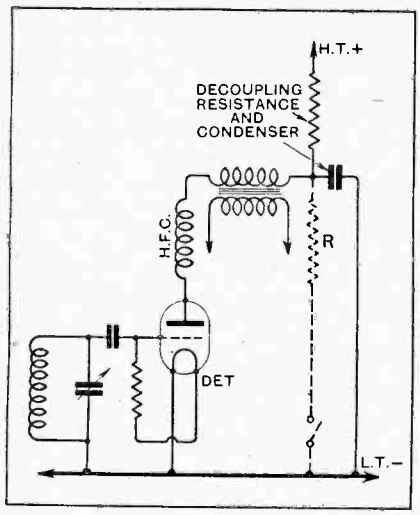

Fig. 2.—Alternative detector anode voltages: suggested additions shown in dotted lines.

detection from the point of view of quality.

A simple way of providing for this alteration is shown in Fig. 2. This suggestion is mainly intended for those with mains-operated sets or with H.T. eliminators, to whom the expenditure of an extra milliampere or two of current is a matter of no importance.

When the detector is fed through a series decoupling resistance, voltage can always be reduced by adding another resistance (R in the diagram) in such a way that the feed circuit is converted into a fixed potentiometer. As a general rule, this extra resistance may have the same value as that of the existing decoupling resistance, and it may be put into action by means of a simple on-off switch, as shown.

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ACCURATE VOLTAGE MEASUREMENTS.

THE average H.T. battery eliminator of the less expensive type generally includes two fixed outputs and a third positive output terminal, delivering a voltage which is under the control of the user. When using an eliminator of this type for feeding the popular H.F.-det.-output type of receiver it is usual to apply maximum voltage to the anodes of H.F. and output valves, to feed the detector from the intermediate tapping, and to use the variable output for the screening grid of the H.F. valve. Generally speaking, it will be satisfactory to make this adjustment on the trial-and-error principle, setting the control at a value found to give maximum signal strength. The actual operation is best carried out when listening to a strong signal made artificially weak by detuning one or more of the circuits; thus the misleading effects of stray reaction are obviated.

If a low-reading milliammeter and a high-resistance voltmeter are available, it is possible to set the applied voltage to a predetermined value without the usual serious inaccuracy that occurs when a voltmeter only is used. The measuring instrument should be connected as shown in Fig. 3, and the variable resistance or potentiometer adjusted until the desired voltage is shown. Now take a reading of the screening grid current, and, after removing the voltmeter entirely, readjust until the original value of current is restored. As the milliammeter resistance will be negligible, one can rest assured that the voltage actually applied when this instrument is disconnected will not be affected.

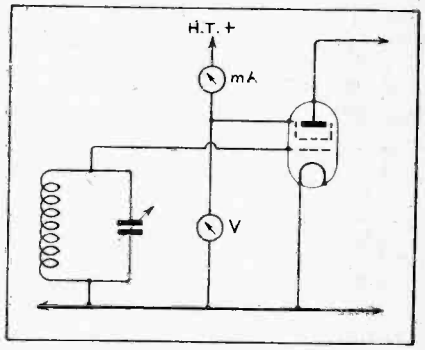

Fig. 3.—Setting screening grid voltage, as supplied from an eliminator, with the help of a voltmeter and milliammeter.

This simple method of adjusting voltage is, of course, applicable to any anode circuit of a receiver, provided that it is fed through a variable control.

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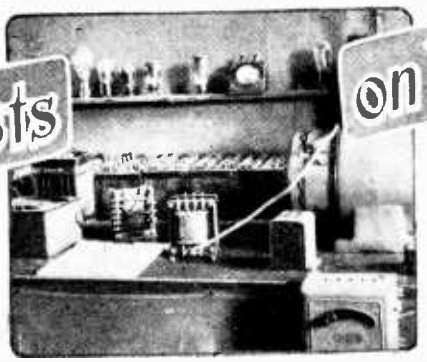
THE BOOSTER BATTERY.

A DRY-CELL H.T. battery is still capable of doing useful work when its initial voltage of, say, 150 volts has fallen to as little as 100 volts. But long before this reduced figure is reached the performance of the receiver will have deteriorated seriously, both with regard to sensitivity and quality, and it is clearly desirable to provide means whereby anode voltage may be maintained, if only approximately, at the value for which the set was designed.

At one time the obvious expedient of connecting a new battery in series with one partially exhausted was considered bad practice. But this was before the days of decoupling, which enables us to offset the bad effects of increasing internal battery resistance, which is a natural accompaniment of decline in voltage.

Provided, then, that the anode circuits are decoupled to a sufficient extent, there is no real objection to this practice, provided it is not carried to absurd lengths. It offers the advantages of economy and allows the set to be maintained at maximum efficiency. Generally speaking, it is permissible to use a "booster" battery of considerably lower capacity than the original battery.

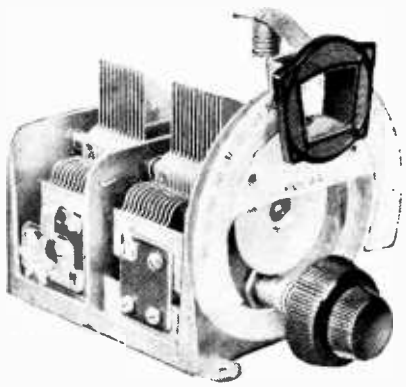
Wireless World Laboratory Tests on New Apparatus



NEW SEASON'S POLAR CONDENSERS.

The most noteworthy addition to the Polar range of condensers is the "Uni-knob" two-gang model, consisting of two 0.0005 mfd. condensers mounted in a neat and compact die-cast frame. The back condenser is fitted with a mica-dielectric trimmer, while in the front compartment is a small air dielectric trimmer controlled by a small knob mounted concentrically with the main tuning knob. An illuminated disc drive is fitted, having a 0-180 scale and a seven-to-one reduction drive.

The measured maximum capacity of the semi-variable trimmer on the sample tested is 60 mmfds., while that of the air dielectric one is 48 mmfds. Both condensers are reasonably well matched, but the ability to bring both circuits accurately in tune in a simple and convenient manner will considerably enhance the performance of the set.



Polar "Uni-knob" condenser with one trimmer controlled from the front.

The price of the "Uni-knob" is 21s. complete.

The Polar No. 4 and the Polar No. 2 are new models also, and are sensibly the same, the only difference being that the No. 2 is fitted with a fast and slow motion drive. Both have aluminium vanes and end plates, while the supports are made of brass. They are very compact, the depth from back to front being a shade over 2¾in. in the case of a 0.0005 mfd. size. Other sizes made are 0.00035 mfd. and 0.0003 mfd. respectively. The price is 4s. for the No. 4 and 6s. 6d. for the No. 2 irrespective of capacity.

A 0.0005 mfd. sample of each type was measured, the minimum capacities being 16 mmfds. in each case. The maximum of the No. 4 was 0.0005 mfd. exactly, while that of the No. 2 was 0.000509 mfd.

Other new items include a range of small solid dielectric type variable condensers, styled the Compax, made in sizes of from 0.00005 mfd. to 0.0005 mfd., the prices being 2s. 6d. each up to 0.0003 mfd. and 2s. 9d. for the 0.0005mfd. model. These have quite low minimum capacities, a 0.00015 mfd. sample showing the very small value of 4 mmfds., while that of a 0.0005 mfd. size was 5 mmfds. only. These low minima values are obtained by using bakelised material for the end plates and the small quantity of metal employed. The moving vanes are supported by an extension arm attached to the spindle.

A new short-wave condenser has just been introduced, its title being the Type C. The vanes are widely spaced, and it is made of brass throughout. Phosphor bronze ball-bearings are used, and a fast and slow motion drive fitted. There are two sizes, viz., 0.00015 mfd. and 0.00025 mfd., the prices being 10s. 6d. and 12s. 6d. respectively.

The makers are Wingrove and Rogers, Ltd., Arundel Chambers, 185-189, Strand, London, W.C.2.

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NEW DIGBY CABINET.

The latest addition to the range of wireless cabinets made by F. Digby, 9, The Oval, Hackney Road, London, E.2, takes the form of a small pedestal model measuring approximately 3 feet 4 ins. high. It is made in two separate parts, the cabinet and a stool to match, and is available in figured walnut or polished walnut, the prices being £3 10s. and £2 15s. complete; the cabinet only in each case costing £2 and £1 10s. respectively.

The inside dimensions of the cabinet are 16¾ ins. wide, 15¾ ins. high, and 10¾ ins. deep. There is sufficient space to accommodate a three- or four-valve receiver and a loud speaker. This will be mounted above the set, as the loud-speaker grille is located in the top half of the cabinet. A small baffle board is fitted, in which is cut an opening 8 ins. in diameter.

Handsome pedestal-type cabinet made by Digby.

The sides of the cabinet are made of seven-ply wood ¾ in. thick, while the front is of three-ply about 3/16 in. thick. A loose back is fitted, in which is cut an 8-in. diameter opening, tinsel covered and located immediately behind the loud speaker. It gives free egress for the sound waves radiated from the back of the cone.

The sample examined exhibits excellent workmanship; it is highly polished, and at the price stated can be confidently recommended as good value for money.

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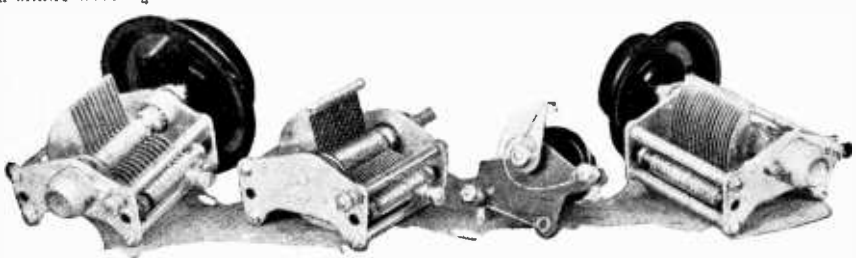
AN INFLATED WORLD.

Mr. S. Aki Shoten, 30, City Road, E.C.1, has sent us a sample of a "Pocket Silk Globe," made in Japan, of pure Habutai silk, which, when inflated, forms a useful terrestrial globe about ten inches in diameter, on which the principal railways, steamer, and air routes and wireless stations are shown. A small metal disc surrounding the air valve at the North Pole indicates the corresponding times at



Specimens of Polar Type C short-wave condenser, the No. 4, Compax, and No. 2 condenser.

various meridians, and a flexible rule is provided to measure the Great Circle distance between any two points on the globe. The printing of the continents and towns is clear, and it is claimed that the silk globe can be well inflated without danger of bursting.

The price is 8s. 6d. complete with plain stand, or 12s. 6d. with stand allowing the globe to revolve. It can also be supplied with an internal tubular lamp for 15s. 9d.

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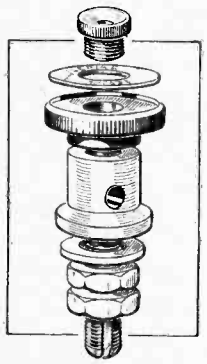
NEW "EELEX" TERMINAL.

This is an improved model of the well-known Eelex treble-duty indicating terminal, the latest innovations taking the form of detachable indicating discs and non-removable heads. The indicating disc is now held in position by a screwed collar which serves as a socket for a wander plug when the occasion arises to use a connection of this kind. Indicating discs in a wide variety of colours and marked to comply with every present-day need are now available There are forty different markings.



Eelex new model T.2.L.C. terminal with detachable name plate.

The new treble-duty terminals cost 3d. each, and the makers are J. J. Eastick and Sons, 118, Bunhill Row, London, E.C.1.

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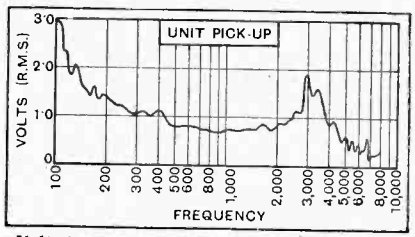
"UNIT" PICK-UP.

From a mechanical point of view, this pick-up is extraordinarily well turned out. Free use has been made of die castings and mouldings specially adapted to the design, and the finish throughout is of a very high standard.

The tone arm is extensible and the pick-up itself can be swivelled to give the best angle, from the point of view of needle track alignment, for any given length of tone arm.

The "Unit" pick-up and adjustable tone arm.

The movement is of the half-rocker type and the armature is very lightly damped. The characteristic shows a satisfactory increase of output towards the bass; in the middle register it is remarkably uniform, and the upper register is strengthened by a resonance between 3,000 and 3,500 cycles. There is still quite an appreciable output at 8,000 cycles, and the general form of the curve is from every point of view ideal.



Voltage output of the "Unit" pick-up with H.M.V. "Half-tone" needle.

The makers are Electric Gramophones, Ltd., 7, The Quadrant, Winchmore Hill, London, N.21, and the price is 35s.

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FORMO "MULTIVO" BATTERY ELIMINATOR.

This is an A.C. unit designed for use on supply mains of from 200 to 250 volts at 40 to 120 cycles. It is especially suitable for employment with multi-valve sets requiring some 20 mA. of current at about 150 volts. Three output voltages are available: one is variable and rated at 0-100 volts, while the two fixed tappings are stated to give 50-90 volts and 150 volts respectively. In addition, the unit embodies an L.T. trickle-charger which can be used for 2-, 4-, or 6-volt accumulators, the charging rate being about 0.4 amp. in all cases. Westinghouse rectifiers are used throughout.

The potential at the 50-90-volt tapping is obtained through a series resistance, while a potentiometer is used in the case of the variable voltage tapping. Separate by-pass condensers are fitted to all output tappings, so that the various H.T. voltages are adequately decoupled.

This model has been submitted as being especially suitable for use with the Band-Pass Pentode Three and *The Wireless World* Two receivers described in this journal recently, and exhaustive tests show that it is satisfactory in every respect, being perfectly silent in operation.

The output voltages on load are correct for the first-mentioned receiver, provided the following arrangement of the various H.T. leads is adopted. H.T.+3 and H.T.+4 are joined and taken to the 150-volt tapping; the detector supply—H.T.+2—is connected to the 50-90-volt tapping, and H.T.+1, which supplies the screen in the S.G. valve, should be joined to the variable tapping.

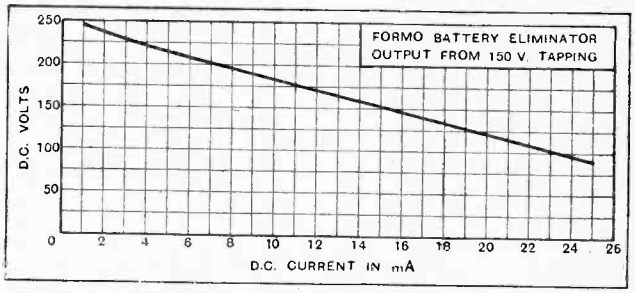
To obtain the correct screen voltage, the potentiometer control knob must be set at about the half-way point. The total current taken by the set was found to be 16 mA., and the maximum voltage available was a shade under 150 volts. It would be an advantage to reduce the grid bias resistance R_3 to about 60 ohms.

In the case of *The Wireless World* Two, the total current consumed is low—about 7.6 mA. in all—so that to reduce the voltage to 150 an external resistance is required. The following connections are advised. Join H.T.+2 and H.T.+3, and connect a 10,000-ohm. resistance between them and the 150-volt tapping, and from the junction point connect a 2-mfd. condenser to the chassis. The H.T.+1 lead supplying the detector can be joined to the 50-90-volt tapping. It would be advisable to reduce the grid bias resistance to 600 ohms, otherwise the pentode valve will be slightly over-biased.

Formo "Multivo" A.C. battery eliminator and trickle charger.

Although the output is in excess of the needs of this set, it is a good investment, as it will prove useful in the future, when a more ambitious receiver is installed.

The makers are Arthur Preen and Co., Ltd., Golden Square, Piccadilly Circus, London, W.1, and the price is £5 5s.



Regulation curve of the output from the 150-volt tapping on the Formo "Multivo" battery eliminator.

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A USEFUL CATALOGUE.

Messrs. Hobbies, Ltd., Dereham, Norfolk, have forwarded us their catalogue for 1932, which is not only a comprehensive price list of fretwork machines, light lathes, tools, and accessories for woodworkers, but also gives concise instructions for making various articles of furniture, including wireless and gramophone cabinets, loud speaker cases, etc. A useful book of reference for woodworkers at the moderate price of 9d.

UNBIASED

By

FREE GRID.

A Public Distress System.

IN a moment of mental aberration I accepted the invitation of a so-called friend to accompany him to Southend-on-Sea the other Sunday. We went on one of the boats which, during the summer, daily make the journey between London and the town of winkles.

We had not proceeded far down the Thames, however, when a nerve-shattering roar burst on our ears.

A nerve-shattering roar.

My friend and I proceeded to investigate the cause of the trouble, which was not due to the ship's siren, as I had at first supposed, but to the efforts of an out-size in loud speakers which was immediately behind us. The roar of the announcer's voice was succeeded by a ghastly noise, which some section of the crowd evidently understood, for they proceeded to assume a melancholy look and to go through the dreary evolutions which nowadays do duty for a dance.

My friend and I eventually tracked the source of sound to a heavily overloaded radio-gramophone—or perhaps I should say electric gramophone, as there appeared to be no provision for radio reception—operated by a lugubrious-looking individual in a cabin amidships. At intervals he switched the amplifier over to a microphone and told us of the places of interest we were passing on the bank.

To put it mildly, the quality was simply appalling, but a cursory examination showed that this was not an organic, but a purely functional, trouble, as the apparatus was of the best type. Judging by the sound, I should imagine that the grid-bias batteries had ceased to function, and the amplifier was, therefore, simply running amok.

All joking apart, I was mightily pleased to get to Southend, and gladly forwent the privilege of using my "return half," and came home by train instead. Why must these things be when a radio-gramophone and public address system, properly operated, can provide ideal entertainment on such occasions as these?

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Super Tax?

IN these hard times the radio trade seems to be the only one that is at all prosperous—although you will never get any member of the radio or any other trade to admit that they ever make a penny profit—and an excellent sign of this prosperity is the enormous factory extensions which many radio manufacturers are being compelled to make.

I have recently had the privilege of inspecting one of these extensions at the invitation of one of the proprietors, and was very much impressed not only with the factory but with the thorough soundness, from all points of view, of the goods which were being turned out. Although I was naturally told that trade was quiet, and the extensions were merely being carried out in order to give employment to various firms engaged in the many trades associated with the building industry, I do not think that any of the relieving officers in that locality are likely to be troubled by the proprietors or staff of that particular firm of manufacturers for some little while yet. Indeed, from what I saw, I think it much more likely that it will be the myrmidons of Mr. Snowden who will be troubled to the extent of sending out super-tax demands in addition to the ordinary income-tax demands with which you and I are pestered.

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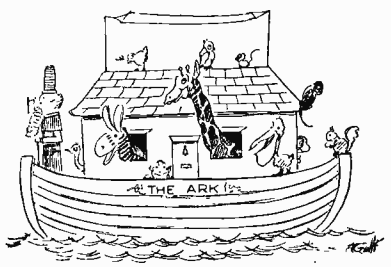
Hickory Dickory Dock.

I HAVE always admired *The Wireless World* for its scientific accuracy. I was all the more sorry, therefore, to see a glaring inaccuracy in the journal a few weeks ago; in fact, not only was there an inaccuracy in the text of an article, but the title—"Something New in Cabinet Design"—was itself what our friend with the funny hat would call a terminological inexactitude.

The writer of this article lauded the designer, crediting him with having at last made a "breakaway" in cabinet styles by housing his set in the casing of a grandfather clock.

Now, as a lover of grandfather clocks, I feel highly incensed that a ten-dollar electrical monstrosity, minus weights, pendulum, and all the other appurtenances of a genuine "grandfather," and masquerading in a futuristic-looking coffin stood on end, should dare to call itself by this honoured name. Even if the idea is not as old as the Ark, I would at least



As old as the Ark.

point out that a good wireless set suitably housed in the body of a genuine grandfather clock—made by one of our oldest firms of clock-makers—has been on the market since 1925; in actual fact, a relative of mine was among the first to purchase one of these sets, and both clock and receiver are still going strong.

Broadcast Brevities

A photo-cell "stunt" featured in a recent running commentary by the N.B.C. when Mlle. Josette Laval, daughter of the French Premier, released a light bomb from an aeroplane by sweeping her hand across the cell.

Last Days at Savoy Hill.

When I paid what may be my final visit to the old Savoy Hill control room last week I felt sorry for the dozen or more perspiring engineers. They had less elbow room than the players in a circus band wagon.

Perspiring Engineers.

The truth is, of course, that, one after another, new control panels have been added during the past few years to cope with the enormous expansion in "S.B." work and the general network of stations, but there has been no corresponding enlargement of the engineers' accommodation.

Compound Expansion.

"We started in that little room," the engineer-in-charge told me, pointing to a cubicle about 12ft. × 12ft. in the corner. "That was nine years ago. Next we occupied a part of this present room, and for a time we were fairly comfortable. Finally, we tore down a wall and brought in the outside corridor. It wasn't enough, but there were no more walls that could be torn down without landing us in the street."

Counting the Days.

That is one reason why the engineers are beginning to count the days until the time, probably four months hence, when they will take up joyful occupation of the large, airy control room at "Broadcasting House."

Change and Decay.

Incidentally, the control gear at Savoy Hill is beginning to show signs of age. The wiring now needs a good deal of attention—there must be at least 100 miles of it—and the emery paper is in pretty constant use among the thousands of contacts.

Radio Research Board: Please Note.

I saw no cobwebs in the control room, but I was told that the place is a little heaven for mice. Apparently they sleep in the daytime and chew the insulation tape at night. Hence the prevalence of atmospherics after dark.

A North Regional Breakdown.

Northern Regional, occupying the highest broadcasting site in Europe, did not escape unscathed from last week's autumn gales. Not much damage was done; in fact, three downleads were all that suffered, but the mishap stopped the Regional transmission for an hour. I shall be pleasantly surprised if the North Country winter fails to find any more weak spots in the Moorside Edge transmitters.

Why Not More Stunts?

The Americans adore broadcast stunts, and, although we may pretend to be a little more sophisticated, I still think that there is room for greater excitement in the B.B.C. programmes.

Daredevilry faded out at Savoy Hill a year ago with the departure of John Macdonell, who made such a success of the Surprise Items.

Why can't the Surprise Items be renewed?

How They Chose the Pianos.

Practically all the pianos in "Broadcasting House" will be of one make. I have just learnt the secret of how this British piano was chosen from among thirteen competitors.

The procedure was very similar to that adopted by wireless societies to judge the merits of rival loud speakers.

A Fair Test.

The pianos were each given a number which was unknown to my informant, who, incidentally, was the gentleman entrusted with the rather fearsome task of judging. Then three pianists took a turn at each instrument, and the results were heard in a loud speaker in the judge's room. To make the test a thoroughly fair one, various studios were used, including No. 10, the famous warehouse.

Tired Ears.

Hour after hour my friend sat, comparing the tone and timbre of each piano. Then his ears grew tired, and he went home. Next day the numbers were reshuffled, and, in effect, the test started afresh. Yet again the test was repeated, but the net result was that the same instrument came out top on each occasion.

How Pianos Vary.

The experiments proved that no two makes of piano yield the same results at the microphone, however excellent each may be in other respects. Some give too much prominence to the bass; others may sound satisfying down below, but tinny and snatchy up in the treble.

Scotland's National Transmitter.

This is Scotland's Radio Week, and many visitors to the National Radio Show in Edinburgh will be casting a thought towards the Regional station now being erected near Falkirk.

The building is already complete, but it is a mere shell at present, pending the arrival of the transmitting gear. This is undergoing adjustments and additions at the Marconi Company's Chelmsford works, where it was taken after being displayed (in part) at the Faraday Exhibition in London.

Broadcasting from Edinburgh Exhibition.

A fitting wind-up to the Scottish National Radio Exhibition will be the broadcasting of a characteristic Scottish Concert from the Model Studio on the evening of November 21st. A feature of this concert will be that many of the songs sung by Mr. Dudley Stuart White, the Edinburgh baritone, will be drawn from the Scottish Students' Song Book, that perennial favourite. Mr. White will be supported by a chorus of male voices from the Scottish Wireless Singers.

Stephen Leacock Burlesque

Described as one of the most extravagant farces ever attempted for the microphone, an adaptation by Edward Lewis of "Borzoi," a burlesque by Stephen Leacock, is to be heard on the Regional wavelengths on November 25th and on the National wavelengths on November 27th.

An Irish Broadcasting Corporation?

Despite what is said from time to time about the "bureaucratic methods" of the B.B.C., other countries in the Empire are imitating its constitution. Within the past fortnight we have had the news that both Australia and New Zealand intend to set up organisations "on the B.B.C. model," but most interesting of all is the suggestion that the Irish Free State may follow suit, and for an unexpected reason.

Plea for Freedom.

It is argued in the Dublin "Sunday Independent" that an Irish Broadcasting Corporation "could possibly achieve more than the service as at present constituted can ever hope to do." However, it seems that "until it can be to some extent freed from the restrictions imposed upon it by its civil service affiliations and dependence on external departments, it will never be able to blossom into a really national service."

Sponsored and State-controlled.

This brief remark emphasises the comparative freedom of our own B.B.C. Irish broadcasting is, in effect, run by the Post Office; the iron hand of the State is behind even the commercially sponsored programmes. Think of it! Commercial programmes ladled out by the Post Office! No wonder the "Sunday Independent" sighs for an I.B.C.!

Rugger Broadcasts.

On December 5th, National listeners will hear a running commentary on the Wales *v.* South Africa Rugby match at Swansea. A running commentary on the Oxford *v.* Cambridge Rugby match will be relayed from Twickenham on December 8th for London Regional listeners.

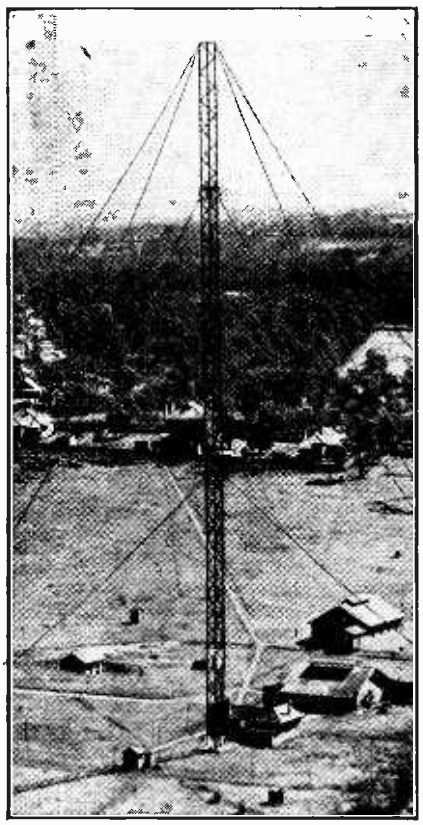
National Lecture on "Painting."

The third National Lecture this year is to be broadcast on November 20th by Sir William Rothenstein, whose subject is "Whither Painting?"

Sir William has drawn practically everybody of note during the past forty years. He was a friend of Wilde and Whistler, knew the poet Verlaine, and lived in Paris when Yvette Guilbert gave her first performance at the Moulin Rouge more than fifty years ago.

B.B.C. Pamphlet in Braille.

The value of wireless to blind persons—who can already receive from the Wireless for the Blind Fund a receiving set as a gift, and from the Post Office a wireless licence free of charge—is advanced a stage by the publication of a B.B.C. brochure on "The Modern State," the first of the Corporation's pamphlets to be issued in Braille.



AN AUSTRALIAN BROADCASTER.
An aerial view of station 2FC, situated at Pennant Hills, New South Wales.

A Siddons Centenary Item.

In commemoration of the actress, Mrs. Siddons, whose centenary occurs this year, a playlet entitled "A Lesson from Mrs. Siddons" is to be given in the vaudeville programme of November 28th. The cast will include Dame Madge Kendal, Rupert Siddons and Betty Siddons Angus, the two latter being great-great-grandson and great-great-granddaughter of the great Sarah. Mr. Rupert Siddons is director of the Sarah Siddons players.

FUTURE FEATURES.

National (261, 301, and 1,554 metres).

NOVEMBER 16TH.—"Boite à Joujoux," a play.
NOVEMBER 18TH.—B.B.C. Symphony Concert—5, from Queen's Hall.
NOVEMBER 19TH.—The Ridgeway Parade—4.
NOVEMBER 20TH.—National Lecture by Sir William Rothenstein: Whither Painting?

London Regional.

NOVEMBER 16TH.—Operatic programme.
NOVEMBER 17TH.—"Boite à Joujoux."
NOVEMBER 19TH.—Royal Philharmonic Concert.
NOVEMBER 20TH.—The Ridgeway Parade—4.
NOVEMBER 21ST.—Plantation songs.

Midland Regional.

NOVEMBER 18TH.—French orchestral programme and a [illegible] a Souris," by Des Rossaux.
NOVEMBER [illegible] Roosters Concert Party.
NOVEMBER 21ST.—A Wagner orchestral programme, from the Town Hall, Birmingham.

North Regional.

NOVEMBER 16TH.—"War When It's Over," a village postscript to the Great War in two scenes, by F. A. Carter.

West Regional (Cardiff).

NOVEMBER 17TH.—A Welsh programme.

Glasgow.

NOVEMBER 21ST.—Scottish Concert, from the Model Studio, Scottish National Radio Exhibition, Edinburgh.

A Pillar of the Kirk.

One of the best-known figures in the Scottish Kirk will appear before the microphone on November 22nd to take his first broadcast service. On that evening Sir George Adam Smith, Principal of Aberdeen University, will give an address from the Aberdeen studio. I hear that this service is being relayed from Daventry on the National wavelength.

One Programme: Two Announcers.

A New York friend tells of an interesting innovation just put into effect by the Columbia Broadcasting System at its New York studios. A sponsor has been found for one of its programmes who wishes his commercial announcement to be broadcast throughout the United States, but not over WABC, Columbia's key station in New York. Ordinarily, in such a case, the programme would not be broadcast locally, but in this particular case the programme in question is so popular with New York listeners that there would be an outcry if it were taken off WABC, yet there is no spare time in the programme schedule to repeat the programme for local consumption only. The difficulty has been overcome in this way.

Avoiding A Silence.

The programme is performed once only, but two sets of announcements are sent out, one commercial, for the network stations, and one non-commercial, for the local station. To do this, two soundproof telephone booths on rubber-tyred wheels are used and two announcers take charge of the programme, one in each booth. Between items one announcer reads a commercial announcement introducing the next item, while the other reads a non-commercial announcement of the same length.

Theatre Lights.

A discussion between Irene Vanbrugh and Sir Barry Jackson in the former's dressing-room at the Birmingham Repertory Theatre, will be heard by London and Midland Regional listeners on Friday next, November 13th. These two stage celebrities are to exchange views on the repertory theatre movement.

How They Do It "Over There."

When a department store in Marquette, Mich., caught fire recently an announcer from a local broadcasting station arrived with the fire brigade, and began to broadcast an eye-witness account of the destruction. Shortly afterwards a salesman for the broadcasting station happened along, spotted the announcer at work, and buttonholed the proprietor of the burning store. "You ought to sponsor this broadcast," he said, "so that you can advertise to-morrow's fire sale." The proprietor agreed.

WIRELESS ENCYCLOPEDIA

CAPACITY. *That property of an electric circuit by virtue of which energy is stored in an electrostatic or electric field extending between conductors whose electrical potentials are different.*

No. 6

Brief Definitions with Expanded Explanations.

CAPACITY is one of the three "constants" of an electric circuit, the other two being resistance and inductance. It is present to some extent in every circuit, but whether it is a desired quality or not depends on circumstances. In those cases where capacity is desired, a *condenser* is employed, this being an arrangement of two sets of conductors whereby a confined or condensed electric field is produced when a potential difference exists between them.

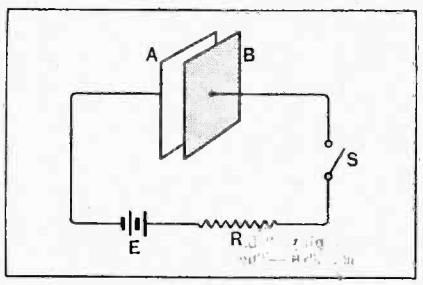
The simplest condenser comprises two flat conducting plates situated parallel and close to each other with an insulating medium between them. This medium may be either air or a solid dielectric such as mica. When a potential difference is applied between the plates energy is stored up in the electric field set up in the dielectric, and the value of the capacity could be expressed in terms of the amount of stored energy when the potential difference between the plates is one volt; but there is a simpler and more convenient method than this.

In the accompanying diagram a simple condenser is represented by the two parallel plates A and B. Between them is connected a circuit consisting of a battery whose E.M.F. is E volts, a resistance R ohms, and a switch S. Suppose that before the switch is closed no potential difference exists between the plates, so that the elementary condenser carries no "charge" and no electric field exists in the dielectric. On closing the switch S the battery immediately tries to drive a current of electricity round the circuit, but owing to the gap between the plates no continuous current will be able to flow.

Now, an electric current is nothing more than a stream of negative electrons passing in one direction from atom to atom within the conductors comprising the circuit, so the tendency is for the battery to drive electrons round the circuit in a clockwise direction. The result is that electrons are drawn off from plate B, passed through the battery (which may be regarded as a sort of electron pump) and accumulated on plate A. Consequently, plate B loses some negative electricity, whilst plate A acquires negative electricity; in other words, the potential of plate B becomes more positive with respect to that of A.

Clock Spring Analogy.

The stream of electrons passing from B to A constitutes the charging current, and the initial value of this charging current will obviously depend on the E.M.F. of the battery and the value of the resistance R. But as the charging proceeds, the potential difference is building up between the plates of the condenser, and this potential difference is in such a direction as to oppose the action of the battery. Consequently, the charging current diminishes until, when the potential difference between the plates becomes equal to the E.M.F. of the battery, the current ceases altogether, and the condenser is fully charged. Energy is given to the condenser by virtue of the fact that the E.M.F. of the battery transfers electrons from one plate to the other against a back pressure.



The parallel plates A and B represent a simple condenser. The circuit enables the process of charging to be studied.

It should be noted that in charging a condenser no electricity is put into it at all—negative electricity is merely transferred from one set of plates to the other. But a certain amount of energy is required to effect this transfer, just as energy is required to wind up a clock spring, during which process all we are doing is to alter the relative positions of the molecules comprising the spring.

Now let us suppose that the charging current of a condenser can be maintained constant at the initial value of, say, 1 ampere, until it is charged up to a voltage E, and that it takes t seconds. Then the quantity of electricity transferred from one set of plates to the other will be $Q = I \times t$ ampere-seconds or *coulombs*, and this is what constitutes the charge. In these terms the capacity of a condenser in *farads* is defined as the quantity of electricity or charge required to change the potential difference between the plates from zero to one volt. Consequently, if a charge of Q coulombs or ampere-seconds produces a potential difference of E volts, the capacity of the condenser is $C = Q/E$ farads.

The farad is an enormously large unit, and so in general practice the capacity of a condenser is usually expressed in microfarads (mfd. or μF), that is, in millionths of a farad. Even the microfarad is a large unit for high-frequency work, and capacities are often expressed in micro-microfarads (mmfd. or $\mu\mu$F). But farads are nearly always used in making calculations.

CORRESPONDENCE.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

BAND PASS OR TONE CORRECTION?

Sir,—I am very interested in Mr. Colebrook's article on the above in the September 2nd issue of *The Wireless World*, and I have also read with great interest Mr. Willans's patent specification number 233417.

Referring to Mr. Lewis's letter in *The Wireless World* of September 30th, I think he is wrong in suggesting that increasing the high audio-frequency response reduces the overall selectivity, unless he gives to the term "overall selectivity" a meaning which is not properly applicable to broadcast reception. A selective broadcast receiver should aim at selecting the whole of one transmission and excluding others. It cannot properly be called more selective merely because it reproduces the low-toned part of a transmission more than the high-toned part. I submit that the term "overall selectivity" does not mean the same thing when applied to broadcast reception as it does in the reception of C.W. morse, for example.

Referring to Mr. Lewis's last paragraph: A considerable increase of effective resistance of the tuned circuit would reduce the strength of the low-toned sidebands nearly to the level of the high-toned sidebands, and this effect would admittedly nearly be counteracted by the omission of the tone corrector; but it would also reduce the strength of the whole transmission, including the outer sidebands, in relation to other transmissions outside the sideband area, and this would obviously constitute a loss of selectivity.

Retroaction, or the reduction of damping in the tuned circuit, gives a general increase in selectivity, whereas the counteracting effect of the tone corrector is necessarily limited to the useful sideband area.

It should be noticed that the selectivity of such a receiver is not measured by the rise in the H.F. response curve up to the tune point, but only by the rise as far as the outermost useful sidebands. The selectivity gain obtainable from reaction is, therefore, far less than might appear at first sight. The method has the great advantage of giving a strong carrier wave, which is conducive to detector efficiency.

To cope with an overcrowded waveband one might find it desirable to make the amplifier cut off sharply at about 5,000 cycles, or even lower, as implied by Mr. Scroggie.

Perhaps I ought to apologise to Messrs. Colebrook and Willans for butting in on their territory.

R. ST. Q. LENG.

Sir,—Mr. Colebrook, in his letter in your issue of October 14th, accuses me of contradiction because I state that one can receive *at full strength* with only "rather more than one side-band." To be consistent he should accuse me of suggesting that reception of the actual stations takes place—an embarrassing situation in these days of enormous steel and concrete structures. I erred in assuming that the separate reference to side-bands would indicate sufficiently clearly that by "stations" I meant "carrier-waves."

Leaving aside the matter of terminology, Mr. Colebrook apparently is not able to dispel my doubts as to the existence, in broadcasting practice, of 10 kc. modulation, which doubts amount to a practical certainty in the case of gramophone records. In order to justify his demand for 10 kc. audio reception, however, Mr. Colebrook must grant that the existing stations, spaced 9 kc., actually do modulate up to that frequency. For the same reason (viz., restricted space) that he refrains from disclosing the basis of his faith, I did not take account of various known complications, such as that dealt with by Prof. Howe on p. 408 of *The Wireless Engineer* for August, 1931, and it is not practicable to do so now; but I should like to ask Mr. Colebrook whether he is prepared to contend that the system he describes, tuned to a station's transmission fully modulated up to 10 kc., is able to maintain an audio-frequency characteristic substantially level over that band, without any interference from the four other transmissions nearest in frequency, spaced at 9 kc., of equal field strength, and all likewise modulated up to 10 kc. Although Mr. Colebrook regards equal field strength as a "bad case," unless he assumes local station reception only, many cases are far worse, for the field strength of the interfering station (if it is a Regional model) is likely to be many times greater than that of the wanted station. He is inclined to under-estimate the difficulty of the existing situation in other respects also, for, even leaving out of account the numerous pirates and wanderers of the ether and considering only the righteous 9-kc. people, the conditions that he regards as exceptional, and justifying the restriction of audio-frequency acceptance, viz., heterodyning, is actually the normal state of affairs.

I may say that it is because I claim to be a humble member of the class of music lovers he refers to that I regard the ability to receive a doubtful 9kc. modulation as poor compensation for the discomfort of a continuous note of that frequency from the neighbouring stations.

M. G. SCROGGIE.

Edinburgh.

GOOD REPRODUCTION.

Sir,—The recent letters on the subject of reproduction have interested me very considerably. Reproduction of the original (in the sense in which a man's face can be reproduced in his looking-glass) is not yet possible from either radio or gramophone. The best that any of us can do is to produce a likeness which may, under favourable conditions, amount to realism. When removed from their orchestras, even the famous conductors might be taken unawares and imagine for a moment that the difference was negligible. Be this as it may, it always seems to me that the domestic loud speaker should be regarded as a species of musical instrument. Its duty is to provide a clear, well-defined and attractive picture of what is going on at the source. Personally, I always criticise sets on this principle. I know it is not possible to include in the performance certain frequencies at the extreme ends of the musical scale, but I maintain that a sufficiently wide band of frequencies can be picked up to make the likeness of the whole very striking. In the existing state of things only extreme aural discomfort could be caused by the reproduction of the frequency band 8,000 to 10,000 cycles at their true strength, mainly because we cannot reproduce the acoustic radiation of the original which makes the upper frequencies fit so snugly in with the rest of the band. To make them tolerable it would be necessary to place the loud speaker in a highly resonant room. I do not think we need worry too much about the low notes coming through, even from the gramophone disc. Has not Mr. Turner heard the 30-cycle note played on the Albert Hall organ 32ft. stop as recorded on H.M.V. D1135? But even with a cut-off below 50 cycles one has little to grumble at.

In my roamings round Olympia I noted that there was a general cut-off above 4,000 cycles. The reasons for this are clearly stated in Mr. Baggs' admirable letter. But, honestly, this is going below the reasonable limit. It should be realised by set designers that such a cut-off has an injurious effect on the middle band. The "chromotonic mean" is definitely lowered, and the reproduction lacks clarity. The average human eye is far better developed than the ear, and people will pass in tone qualities defects which they would instantly condemn in a photograph. The clipping-off of the ends of piano notes, blurring of massed sounds in an orchestral item, the inadequate separation of accompaniment from soloist—these are some of the points which are often missed save by a trained critic. Further, we may get all these things right and be cheated of success through allowing the picture to be marred by a hardness of tone. I have proved that "hardness" is due mainly to a rising characteristic in the 800- to 2,000-cycle band, where the response curve should at all costs be made as straight as possible.

At present what seems to be wanted in our radio and gramophone reproduction is: (1) a reasonably straight-line frequency response from 50 to 5,000 at least; (2) crisp definition in the production of each and every sound; (3) a softness in the general quality to make the whole agreeable and attractive. Obviously, we must assume the absence of all elementary defects.

London. NOEL BONAVIA-HUNT.

Readers' Problems.

Readers' technical enquiries are not replied to through the post, but in these pages replies to questions of general interest are dealt with week by week.

Push-Pull Transformers.

THE question is raised by a reader as to whether an output transformer designed for a push-pull circuit could be successfully employed as a coupling between a single triode output valve and the loud speaker. It is proposed to use only one half of the primary winding.

Apart from the difficulties of matching valve and loud speaker, it must not be forgotten that, in the design of a push-pull output transformer, it is unnecessary to take into account the direct current flowing through the primary winding. In a push-pull circuit the current consumed by one valve neutralises the magnetising effect of that consumed by the other.

In consequence, there is the probability that if the transformer were used in the way suggested, its magnetic circuit would become saturated, and so the plan cannot be recommended.

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Double-acting Volume Control.

IT has been asked whether the special method of input volume control included in the "Wireless World Three" (A.C. model) might be applied to a battery-operated receiver. It will be recalled that this arrangement includes provision for simultaneous control of signal input to the H.F. valve grid, and for desensitising this valve by over-biasing its grid. In certain circumstances it is hardly drastic enough to make provision for reducing input unless the valve is desensitised at the same time.

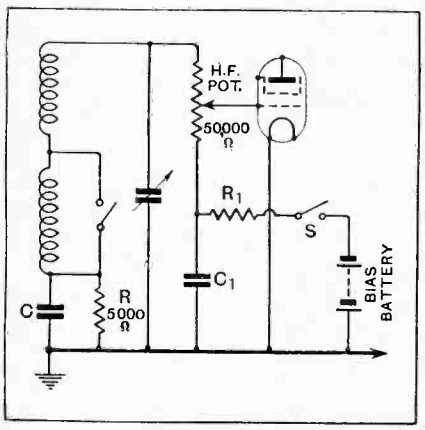

Fig. 1.—H.F. input control and valve bias adjustment combined. The by-pass condenser C may be the coupling capacity of a band-pass filter; the precise value of C_1 is immaterial, provided it is fairly large.

Although the method in question is most easily applied to a mains-operated receiver, it is possible, at the expense of a little complication, to make use of the principle in a battery-fed set. Connections are as given in Fig. 1, from which it will be seen that the H.F. potentiometer, in series with the decoupling resistance R_1 (of some few hundred ohms) is connected *via* a switch to the negative end of the main bias battery. The circuit is completed through the grid tuning coil, and another resistance of relatively small value (R). When the potentiometer slider is set at maximum sensitivity at the top end of the resistance, negative bias applied is at minimum, its actual value being that developed across R. As the slider is moved downwards, H.F. input is progressively reduced, and at the same time bias voltage is increased up to the full value of the bias battery, less the amount lost in R_1. Any desired proportion of the available voltage can be utilised by varying this resistance.

This arrangement has the obvious disadvantage that current is drawn from the bias battery; in order to prevent a continuous drain, a switch (S) must be interposed, and this is preferably combined with a mains on-off switch. In the example given, current will amount to no more than about one-fifth of a milliampere—almost negligible.

The value given for R is that suitable when the bias battery has a voltage of about 9 or 10 volts.

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Current for a Dial Light.

EXCEPT in a few instances, the operation of an A.C. mains receiver becomes more convenient if the tuning dial (or dials) are illuminated. There is no difficulty in obtaining current for the dial lamp, and the fears of several readers who are contemplating this addition will be set at rest by the statement that the operation of the receiver will be in no way impaired by connecting it across any convenient low-tension secondary winding of the power transformer.

Dial lamps of the kind most readily obtainable do not have a very long life if they are overrun: to avoid the need for frequent replacements, it is as well to underrun them, as in any case brilliant illumination is not needed. For instance, 3 volts, obtained by making connection between the centre tapping and one of the outside terminals of a 6-volt winding, will be ample for a lamp rated at 4 volts.

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Moderate Magnification.

READERS whose receivers include a detector valve coupled either by a resistance or a choke to an output pentode sometimes complain that this arrangement gives insufficient volume when it is converted to act as a gramophone amplifier.

Provided that everything is in order, it can generally be assumed in such cases that an exceptionally insensitive pick-up—which may be in every other respect quite satisfactory—is being used, and the most obvious remedy is to add another stage of L.F. magnification. Except in special circumstances, there is no point in trying to get much magnification from this extra stage; for instance, in an A.C. set one might use a power valve of the A.C./P type with a coupling resistance of some 20,000 ohms in its anode circuit.

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Artificial Aerial.

WHEN making initial adjustments to a band-pass filter, with the help of an oscillator, there is a risk of interfering with the reception of near-by listeners if the aerial is connected during the tests.

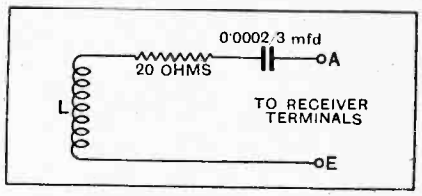

Fig. 2.—An artificial aerial for connection to a receiver. A larger resistance—25 to 30 ohms—may in some cases more nearly simulate actual working conditions.

But if the aerial be disconnected, on the other hand, operating conditions will not be quite the same as when the set is put into normal operation. To avoid uncertainty, it is a good plan to use what is known as an artificial aerial, and several readers have asked what is meant by this expression.

An artificial aerial is actually an extremely simple device, consisting merely of a condenser, a resistance, and a small inductance, arranged as shown in Fig. 2. These components, connected in series, are merely joined across the aerial and earth terminals of the receiver. The inductance coil L may often be omitted without greatly upsetting results, but it is convenient to include it as a means of coupling up with the oscillator coil; half a dozen turns of wire will be enough for this winding.

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"The Wireless World" Three.

ENQUIRIES have been received from prospective constructors regarding the overall dimensions of the "Wireless World Three" (battery model). In several cases it is desired to mount this set in an existing cabinet or piece of furniture.

The chassis of this set is exceptionally compact, and the space actually required is 10¾in. in width and 8¾in. in depth (back to front). The overall height is 6½in.

Stray Earths.

WHEN we are told that a receiver works just as well—or just as badly—with or without an earth connection, we are always tempted to make the obvious suggestion that the earth connection must be an extremely poor one. This is almost certain to be true in dealing with a battery set, but it must not be forgotten that all-mains sets are automatically earthed—more or less imperfectly—through the source of supply.

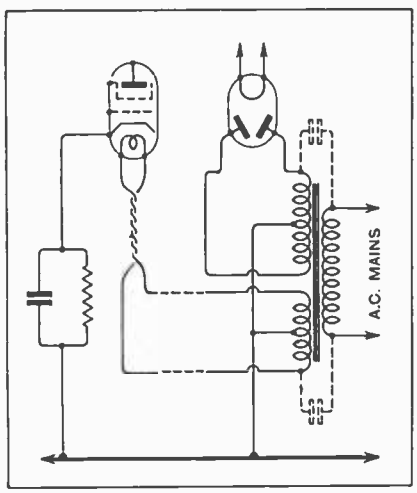

Fig. 3.—Stray capacity earths (indicated by dotted lines) between primary and secondary windings of a power transformer.

A reader with an A.C. set which does not seem to respond to the connection of an ordinary earth, falls into the error of thinking that the only possible connection between his receiver and earth is that provided by the capacity between the filament-heating secondary winding and the primary winding of the power transformer. As the L.T. secondary is of very small dimensions, and well separated from the primary, he deduces that this capacity must have a very low value. Actually, the inter-winding capacities between *all* secondaries and the primary coil is effective in helping to earth the receiver; for example, the fact that the large H.T. secondary is connected to the receiver earth line must not be forgotten. This part of the conventional circuit is reproduced in Fig. 3. Further, although the rectifier filament-heating winding is apparently "in the air," it is actually tied down to the earth line by means of a very large capacity.

This must not be taken as even an implied suggestion that an earth is unnecessary for a mains set; in many cases a low resistance connection to earth is highly important from the point of view of stability.

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Un-insulated Spindles.

IN the "Band-Pass Pentode Three," described in *The Wireless World* for October 28th, the differential reaction condenser and on-off switch are mounted on an aluminium bracket. The bracket is earthed, and it has been asked why it is unnecessary to make provision for insulating the spindles of these components. With regard to the switch, the answer is a simple one: the necessary insulation is included in the Telsen switch that was specified, as its contact blade is not in electrical connection with the spindle.

The need for insulating the reaction condenser spindle—and consequently its moving vanes—is avoided by adopting a special reaction circuit, in which the rotor is deliberately earthed.

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Testing Fixed Condensers.

A READER who has been testing the condensers in his eliminator, with the help of a battery and milliammeter, has found that on completing the circuit, a momentary deflection of the meter needle is produced, and that this deflection is not of equal magnitude when testing each of the components. In one case no deflection at all is obtained, and he asks whether this indicates a fault and, if so, of what nature.

If the test conditions are fixed, the condensers with the greatest capacity will take the greatest charging current, and so the disparity of readings that has been noticed is normal.

With regard to the condenser that shows no deflection at all when the testing circuit is connected across it, there is certainly a fault, and this will be in the form of an internal disconnection—probably between the terminal and the foils. We are assuming, of course, that large condensers with capacities in the order of microfarads are concerned.

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Suppressing Long-wave Interference.

THERE is some misconception regarding the purpose of the I.F. acceptor circuit fitted to the "Super-Selective Six." It should be made quite clear that this device is for eliminating interfering signals of the frequency of the I.F. amplifier only, and it cannot do anything in preventing morse interference on wavelengths adjacent to the signal being received.

It can always be assumed that if adjustment of the acceptor tuning condenser makes no difference to the strength of an interfering morse signal, this interference is of the latter type.

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Short-circuited Milliammeter.

ALTHOUGH he does not say so, a correspondent has encountered an effect that would rather suggest that his receiver is operating satisfactorily without any anode current at all! These are the facts: an eliminator was obtained for use with a set originally fed from an H.T. battery, and was connected up in accordance with the makers' instructions. Results were entirely satisfactory, but on connecting a milliammeter (known to be in working order) in the H.T. negative lead, no current reading whatever was shown, but the set went on working.

In all probability, the explanation of this effect also applies to a somewhat similar case, where an automatic bias scheme was found to be inoperative when an eliminator was added. Many commercial eliminators have an earthing terminal mounted on the metal case, and in some instances this terminal is in electrical connection with the negative H.T. output terminal. If this terminal be directly earthed, as well as the set itself, any connection made between the H.T. negative terminals of each piece of apparatus will be ineffective, and a meter connected in this position would obviously be short-circuited. An automatic bias resistance connected in the negative H.T. lead would similarly become inoperative.

❖ ❖ ❖

Smoothing for the Super-selective Six.

CONSTRUCTORS of the "Super-Selective Six" who have used a type of smoothing choke other than that specified have found in several cases that the background is not as quiet as it might be. Emphasis should be laid on the fact that this set includes a tuned smoothing circuit, in which an inductance of between 25 and 30 henrys is tuned by a condenser having a capacity of 0.01 mfd., in order that it may form an effective barrier to 100-cycle ripples. This is a highly effective and also economical method of smoothing, provided always that the right choke is used.

Where the choke is not of entirely suitable design, hum can be reduced by using the usual 4-mfd. smoothing condenser, or alternatively, a different value of inductance can often be used successfully, provided that the parallel capacity be altered to suit. When inductance is expressed in henrys and capacity in microfarads, the L.C. product must be between 2.5 and 3. This, of course, applies to 50-cycle mains only; 25-cycle mains require in the smoothing circuit an L.C. product of between 10 and 12.

FOREIGN BROADCAST GUIDE.

BORDEAUX SUD-OUEST

(France).

Geographical position: 44° 50′ N., 0° 34′47″ W.*

Approximate air line from London: 462 miles.

Wavelength: 237.5 m. Frequency: 1,263 kcs. Power: 3 kW.

Time: Greenwich Mean Time (France adopts B.S.T.).

Standard Daily Transmissions.

G.M.T. 11.30, gramophone records; 18.30 dance music (Sunday); 20.15, main evening entertainment, followed by weather and news bulletins.

Man and woman announcers. Call: *Allo! Allo! Ici Radio Sud-Ouest à Bordeaux.*

Opening signal: Fanfare of trumpets (gramophone record).

Interval signal: One note (twice) on a dulcimer.

Closes down with usual French formula, followed by *La Marseillaise.*

*May be later transferred to Pau (Lower Pyrenees) when power will be increased.

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EDITORIAL COMMENT.

Loud Speakers.

THE present issue is largely concerned with the subject of the loud speaker, which, next perhaps after the valve, is the most important unit in the modern receiver.

By publishing the results of tests carried out in our laboratory on a representative selection of new types of loud speaker we endeavour to provide the reader with information which is essential to him, not only to enable him to choose a good speaker for his requirements, but also to make it possible for him to be sure that he is using the speaker under the best conditions when he has got it.

The moving-coil speaker, the inductor-dynamic speaker, and the more familiar reed-driven type each have their own particular merits, and special articles are included dealing with the two latter types, which owing to the particular popularity of the moving coil sometimes seem to receive less attention than they deserve. This issue will, we think, be of great interest to our readers, providing, as it does, information for which many of our readers have specially asked.

The Variable-mu Valve.

IN recent issues *The Wireless World* has indicated to readers the special advantages resulting from the use in wireless receivers of the new valve having special characteristics which have earned for it the name of "variable-mu." It has always been the aim of *The Wireless World* to introduce to readers new ideas in circuits or in design of valves or components, both in theoretical and in the practical form of a constructional article as soon as we are satisfied as to the merits of the new devices put forward.

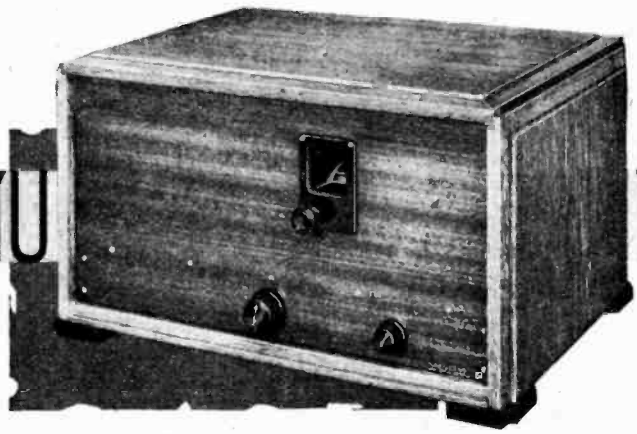
For some time past we have realised the possibilities of this new addition to the range of modern valves, but in this particular case the product involves a new principle rather than being merely a new or improved type of valve.

Although it is well not to be too dogmatic, yet we believe that it is safe to predict that the variable-mu valve will, in a comparatively short time, supersede the screen-grid valve in many of its applications and that it will also be responsible for modification in the design of high-frequency circuits.

The special advantages of the valve have already been referred to in an article in our issue of last week, so that it is unnecessary to stress these again here. The constructional design given in this issue enables the reader to build a set of ultra-modern character and acquaint himself first hand with the possibilities which the valve offers. The receiver, although it is designed for all-mains A.C. operation, is simplified in construction and reduced in cost by the absence of a low-frequency stage, the pentode detector operating the loud speaker direct with ample volume for all ordinary requirements.

In This Issue

The VARIABLE-MU THREE



A Long-range Receiver for A.C. Mains with Many New Features.

By W. I. G. PAGE, B.Sc., and W. T. COCKING.

IT has become the standard practice in a three-valve receiver to employ only one of the valves as an H.F. amplifier. As a result, such receivers can rarely incorporate more than three tuned circuits, and must include some form of reaction in order to maintain signal strength and selectivity at a maximum. The four tuned circuits which are desirable if reception is to be carried out close to a modern high-power transmitter cannot usually be employed unless two stages of H.F. amplification are fitted. Even then, with the usual pentode output stage the overall amplification is rather high for the selectivity. If sufficient output could be obtained directly from the detector, therefore, we should have a receiver in which the overall selectivity and sensitivity would be well balanced, and an adequate range could be secured from a three-valve receiver without the use of reaction.

Now it has been shown in the pages of this journal [1] that when a pentode is used as a large input power-grid detector it is capable of giving sufficient output to feed a loud speaker and a single-valve receiver on these lines was described.[2] Experience with this receiver at short distances from a broadcasting station showed that the power output was sufficient for normal volume in a medium-sized room with a reasonably efficient loud speaker One of the most important characteristics of such an arrangement is a marked absence of distortion, due partly to the absence of feed-back effects, but chiefly to the overload characteristics of a power-grid detector as compared with those of an ordinary output valve. The detector distortion at maximum output is almost negligible, and any attempt to obtain a greater output by increasing the input gives not merely increased distortion but reduced output, so that there is no temptation to work the valve in an overloaded condition.

A single-valve set of this type is, of course, unsuitable for distant reception, and with the advent of the new variable-mu tetrode it was decided to design a three-valve set incorporating two stages of H.F. amplification with a pentode power-grid output valve. The circuit diagram is shown in Fig. 1, and it will be seen that the input circuit consists of a band-pass filter, while the inter-valve couplings are of the tapped tuned-anode variety.

THE first constructional receiver embodying the new variable-mu H.F. valves, the chief advantages of which are: No H.F. distortion or cross-modulation; new system of distortionless volume control; background noises avoided and decoupling equipment simplified. The receiver contains three valves, two variable-mu H.F. amplifiers, followed by an A.C. pentode which feeds the loud speaker direct without any L.F. stages. The undistorted output is 600 to 700 milliwatts and is adequate for ordinary purposes. Absence of L.F. stages permits the minimum of smoothing equipment and simplified tuned-anode H.F. couplings to be used. All-mains operation and one-dial control. High and constant selectivity obtained by the use of four tuned circuits, including a "mixed" band-pass filter. Selectivity enhanced by the demodulation effect of the linear detector and by the absence of cross-modulation in the H.F. valves.

The Tuning Circuits.

The input filter is of the mixed type, that is, the two tuned circuits are coupled together by the 0.05 mfd. condenser C_6, which is shunted by the 1,000 ohms resistance R_1 to allow of grid bias being applied to the first valve, and by the negative mutual inductance provided by the link circuit. This results in the peak separation being substantially constant over the range of wavelengths from 270 metres to 550 metres. Below 270 metres, the peak separation narrows rapidly, and so helps to maintain the overall selectivity of the receiver at a constant

[1] "Pentode as Detector Amplifier," by E. Y. Robinson, September 10th, 1930.

[2] "The Regional One," by W. I. G. Page, August 13th, 1930.

The Variable-mu Three.—

figure, since the resonance curves of the single tuned circuits broaden out at the low wavelengths.

Tapped tuned-anode intervalve coupling is used in preference to tuned grid, since it is simpler and cheaper and slightly more efficient. The usual objections to this circuit of accentuating the effects of feed-back and of giving rise to hum disappear when variable-mu tetrodes are employed, owing to the absence of rectification in these valves. The tuning coils are matched with those used in the filter circuit, so that ganging can be achieved; in theory, of course, a fixed condenser of 0.05 mfd. capacity should be connected in series with each inter-valve tuning condenser to maintain perfect ganging, since such a condenser, C_6, is used in the input filter. The maximum deviation caused by the absence of these condensers, however, is of the order of 1 per cent., and careful tests have proved it to be entirely negligible, so that there is no necessity for their inclusion.

gang condenser fitted with trimmers, and the aerial is connected to the first circuit through an adjustable condenser C_1 in order to obtain the maximum signal strength. As explained later in this article, this condenser is used for ganging instead of the trimmer on the first gang condenser section.

Volume Control.

Since variable-mu tetrodes are employed, the volume control is carried out by the variation of grid bias, and no more than a single 4,000 ohms potentiometer is necessary in order to reduce the local station to a whisper. It will be seen that the full output of the smoothing circuit —some 200 volts—is applied to the anodes of the H.F. valves, for the voltage drop in the 600 ohms decoupling resistances R_7 and R_9 is negligible. A potentiometer, consisting of the 10,000 ohms resistance R_{10}, the 7,500 ohms resistance R_5, and the 4,000 ohms volume control R_4, is bridged across the H.T., and supplies the screen

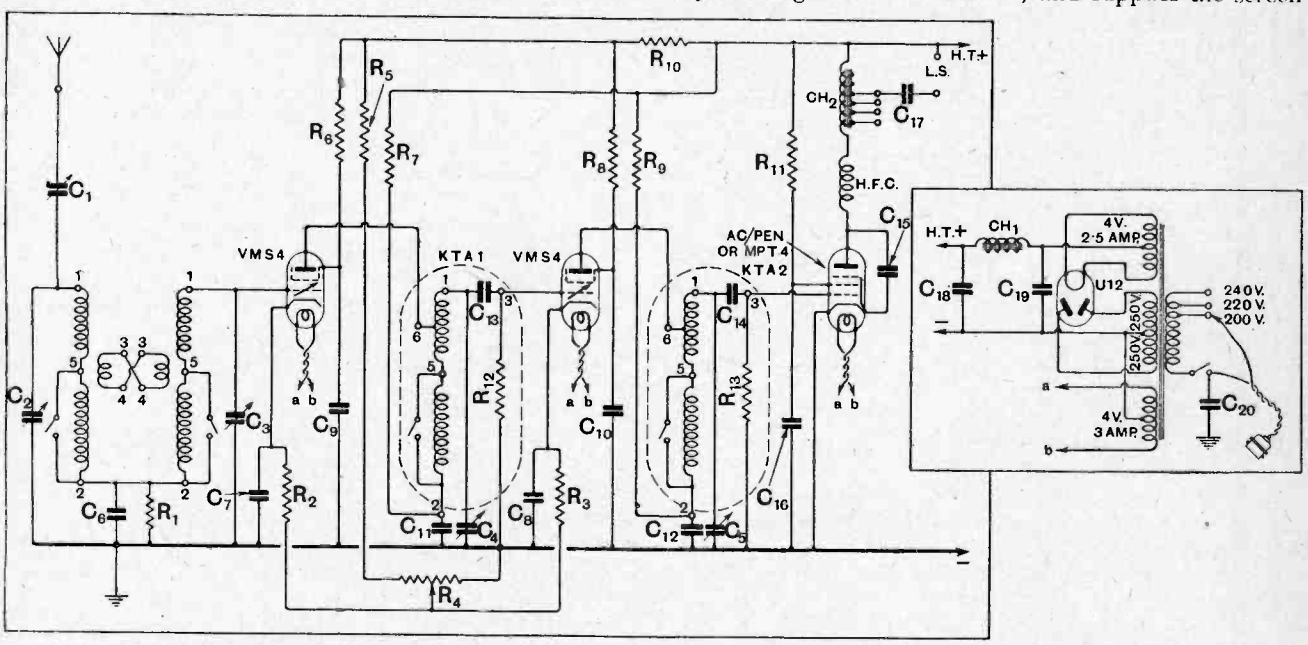


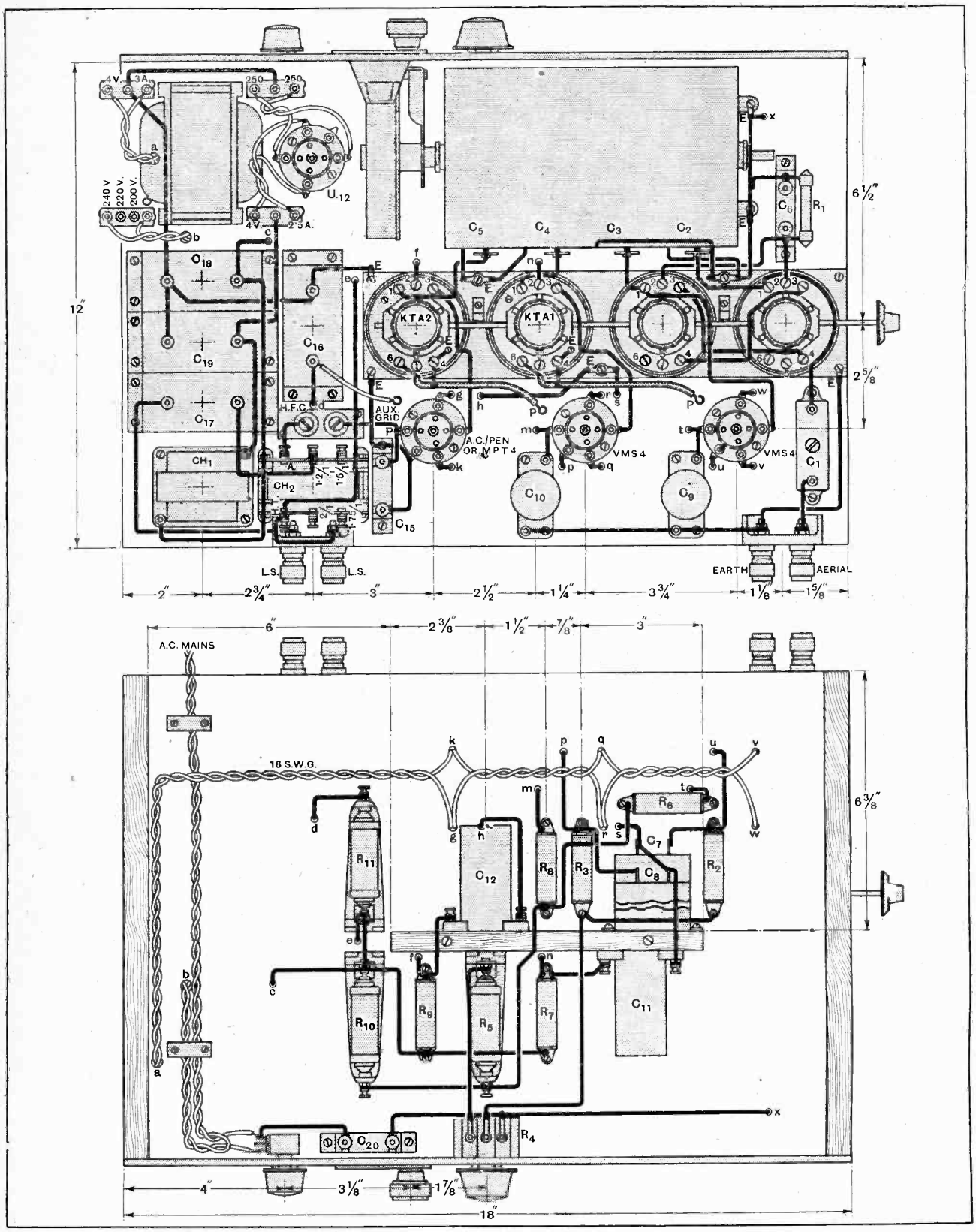
Fig. 1.—Complete circuit diagram. Within the dotted enclosures are the components contained in the coil screens and bases. Values are as follows: C_1, 0.0001 mfd. (max.); C_2, C_3, C_4, C_5, four-gang condenser 0.0005 mfd.; C_6, 0.05 mfd. (mica dielectric); C_7, C_8, 0.1 mfd.; C_9, C_{10}, 1 mfd.; C_{11}, C_{12}, 1 mfd.; C_{13}, 0.0005 mfd.; C_{14}, 0.0001 mfd.; C_{15}, 0.005 mfd.; C_{16}, C_{17}, C_{18}, C_{19}, 4 mfd., 400 v. working; C_{20}, 0.001 mfd.; R_1, 1,000 ohms; R_2, R_3, 200 ohms; R_4, 4,000-ohm potentiometer; R_5, 7,500 ohms; R_6, R_7, R_8, R_9, 600 ohms; R_{10}, 10,000 ohms; R_{11}, 15,000 ohms; R_{12}, 0.5 meg.; R_{13}, 0.25 meg.

In order to maintain the maximum selectivity, and to prevent any trouble from instability, the medium-wave tuned-anode coils are centre tapped for the valve anode connection. The coupling between the two variable-mu valves has been designated K.T.A.1, and, in order to keep stray couplings at a minimum, within its screening can are contained not only the tuning coil and wave-range switch but the coupling condenser C_{13}, of 0.0005 mfd., and the grid leak R_{12}, of 0.5 megohm. The same arrangement is adhered to in the case of the coupling K.T.A.2, between the second H.F. valve and the detector, save that in this case the condenser C_{14} has a capacity of 0.0001 mfd. and the grid leak R_{13} a value of 0.25 megohm.

All four circuits are tuned by a completely screened grids through the 600 ohms decoupling resistances R_6 and R_8. The two 200 ohms resistances R_2 and R_3 serve the dual purpose of providing the requisite bias when the volume control is at a maximum, and of decoupling the cathode leads to the control.

As explained in last week's article, the constants of the potentiometer arrangement are so arranged that the potential difference between the screen grids and the cathodes remains nearly constant despite the setting of the volume control, which varies the grid bias between about 2 volts and a little over 40 volts negative.

By-pass condensers of 1 mfd. are used for the screen and anode circuits, as shown at C_9, C_{10}, C_{11}, and C_{12}, but 0.1 mfd. condensers of the non-inductive type are employed in the biasing circuits at C_7 and C_8. It will be



General layout of components and wiring plan. It is important to wire the heaters with 16-S.W.G. to prevent voltage drop. The screened metal braiding slipped over the H.F. anode leads is earthed at No. 4 coil terminal.

B 20

The Variable-mu Three.—

found that the current drawn by the screen-grid valves varies considerably with the setting of the volume control; with normal bias it may be about 22 mA., but with full bias it falls to zero. The output voltage of the eliminator, and hence the detector anode current, depends upon the volume-control setting. It is for this reason, therefore, that a milliammeter connected in the detector anode circuit is of little use, since it will not behave normally to indicate the true rectified current; its reading will depend not only upon the H.F. input voltage applied to the detector, but also upon the setting of the volume control.

The Detector.

The detector circuit is unconventional, and comprises an A.C. high-voltage pentode acting as a power-grid rectifier, the output of which is sufficient to feed the L.S. direct without an L.F. stage. Every grid detector functions as if it consisted of two component valves, one acting as a diode and the other as an L.F. amplifier. Naturally, the more efficient a valve the greater will be the power output from the L.F. amplifier portion per given input. The indirectly heated pentodes, which are among the most sensitive valves available to-day, are capable of delivering some 600 to 700 milliwatts undistorted output when acting as detectors. In fact, it has been found that the input and output of these valves are about one-half and one-third respectively the values realised under ordinary amplifying conditions.

The volume of sound from the receiver is sufficient for ordinary needs, and a moving-coil loud speaker can be used quite satisfactorily.

Demodulation Aids Selectivity.

The detector valve, which may be an Osram MPT4 or a Mazda AC/Pen, affords a striking example of the value of demodulation as an aid to selectivity. With strong signals rectification is linear and has the important property of decreasing the strength of a fairly weak signal on a nearby wavelength which would otherwise cause interference. The process of demodulation by a linear power-grid detector assumes greater importance as the number of powerful Continental stations increases. A rough explanation as to why selectivity is considerably enhanced consists in assuming that the carrier waves of the strong (wanted) and the weaker (unwanted) stations heterodyne, and the modulation of the weaker is lost at the intermediate frequency, which is above audibility. It was found when testing "The Variable-mu Three" on 356 metres that it was possible to hear certain foreign stations the wavelengths of which were little different from that of London Regional, but as soon as the carrier wave of the latter was switched on the other stations completely disappeared. Tests with an oscillator to simulate conditions of interference demonstrated conclusively the silencing effect of a strong station. With a square-law detector no demodulation occurs.

Note the screened flexible anode leads to the two variable-mu valves.

The Variable-mu Three from the rear. The baseboard is raised to accommodate decoupling equipment.

Detector Overloading Automatically Controls Volume.

There is another interesting effect due to the special properties of the pentode detector-amplifier. If a local transmission overloads the detector, instead of the usual objectionable distortion it will be found that the volume

The Variable-mu Three.—

just drops and that the station will tune to a maximum at two points. When this takes place it is, of course, necessary to adjust the volume control until there is a single resonance point.

The quality of reproduction, when the component values shown in the output circuit are used, is pleasing enough, especially with a moving-coil loud speaker. There are, however, types of moving-iron instrument in which the impedance rises very considerably with frequency where it might be an advantage to shunt the output choke or the speaker with a limiting device to prevent slight shrillness. Details and values of the components necessary will be found in an article elsewhere in this issue entitled "The Output Stage and the Loud Speaker," by A. L. M. Sowerby. It can be said with confidence that the quality does not suffer by virtue of the absence of a low-frequency stage or because a pentode supersedes the conventional triode as a detector.

The output choke is tapped to give various ratios so that different speakers may be properly matched. To obtain full volume in the bass with most moving-iron speakers it is usually necessary to work with about 2 to 1 ratio (centre-tapped), but with a moving-coil instrument 1 to 1 (speaker connected to anode), or, perhaps, 1.2 to 1, will give the best results. The correct ratio must be found by trial, always switching off the set before a new connection is made, otherwise high voltages will be developed which may puncture the dielectric of the by-pass condensers.

With tapped-choke output the speaker is in shunt with the last condenser of the H.T. smoothing equipment, and final traces of ripple which are often difficult to remove may be heard as a slight background of hum. It has, therefore, been found expedient to join the return lead from the speaker to H.T.+ rather than to H.T.−. To prevent the possibility of modulated hum a 0.001 mfd. condenser has been connected between mains and earth. The set has a particularly silent background, and this in spite of the modest decoupling and smoothing components, which, it must be admitted, are the very minimum in quantity and individual value.

Ganging.

The constructional work involved is simple and straightforward. The four screened coils and the gang condenser comprise the whole intervalve couplings, and the H.F. valves require in addition only the by-pass condensers and decoupling resistances. Metallised variable-mu tetrodes (Osram VMS4) are employed, so that valve screens are unnecessary, and in order to prevent stray couplings the anode leads are encased in a braided metal shield. This material is supplied fitted with internal sleeving, so that the anode lead can be run straight through it.

The ganging adjustments are few in number and are easily carried out. It will be observed that the end plates of the condensers sections are split, and that the capacity can be altered by bending them. This is not arranged for the purpose of ganging, but for the matching of the condenser sections at the factory, *and on no account should an attempt be made to carry out the ganging by bending these vanes.* The ganging is adjusted by means of the internal trimmers, which are actuated by the small star-shaped wheels. The trimmer on the first section of the input filter should be fully unscrewed, since ganging on this circuit is normally carried out by the adjustment of the aerial series condenser C_1.

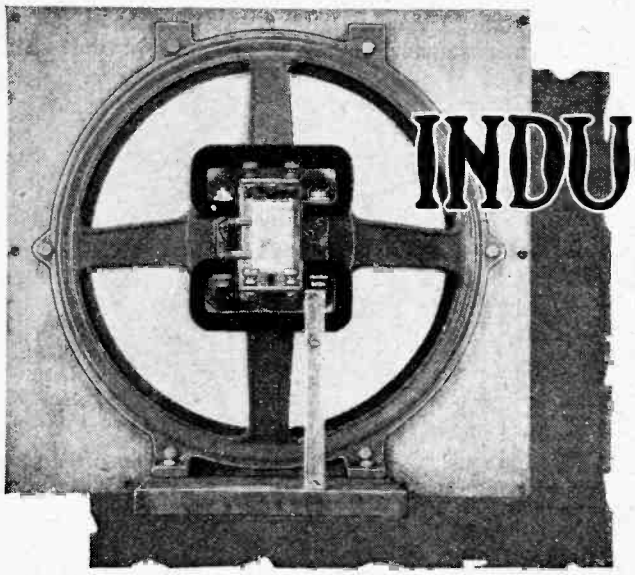
A station on as low a wavelength as possible should be tuned in, for a first attempt the London National will do, and the three trimmers on the two intervalve couplings and the secondary of the filter, in addition to the condenser C_1, adjusted for the maximum response, keeping the volume control at a low setting so that the detector does not overload. A station on a somewhat lower wavelength, and one which can only be just heard with the volume control at *maximum*, should now be tuned in, and the ganging re-adjusted as before. It is necessary to carry out the final adjustment with the volume control at maximum, not because the volume control itself affects the tuning, but because the amount of regeneration through the various minute stray couplings varies with the volume-control setting, and this affects the sharpness of tuning on each circuit. Once the ganging is correctly adjusted at a low wavelength, and this is an operation readily performed, it will be found to hold over both wavebands.

A word of warning should be given about the condenser C_1, however, for if this be readjusted at a high wavelength it will be found that the signal strength increases. This is not due to the ganging being faulty, for readjusting this condenser actually upsets the ganging, but to the greater transference of energy through this condenser overbalancing the reduction in sensitivity caused by upsetting the ganging. It will be seen, therefore, that it is imperative to adjust this condenser only at a low wavelength, as misleading results will be obtained if it be touched at a high wavelength.

Further constructional details and notes on the performance of this receiver will be included in our next issue.

LIST OF PARTS REQUIRED.

1 Variable condenser, 4-gang. .....(Utility W.306/4).
1 Slow-motion dial ..... (Utility W.296).
1 Set of four coils on metal chassis (Colvern, 2 band-pass "Link" coils: 1 coil KTA1, 1 coil KTA2)
1 Mains transformer, 250-0-250 volts; 4 volts 3 amps.; 4 volts 2.5 amps. ..(Sound Sales SS/VM3)
1 L.F. choke .....(R.I. "Hypercore")
1 Pentode choke, 1.2, 1.5, 1.75 and 2 to 1 ratio (R.I. "Multi-ratio Pentomite" DY/30)
4 Fixed condensers, 4 mfds. 400 volt D.C. working (Formo)
4 Fixed condensers, 1 mfd. 300 volt D.C. working (Formo)
1 Fixed condenser, 0.05 mfd. .....(T.C.C. Type 34)
2 Fixed condensers, 0.1 mfd. .....(T.C.C. Type 50)
1 Fixed condenser, 0.001 mfd...(Dubilier Type 620)
1 Fixed condenser, 0.005 mfd...(Dubilier Type 620)
1 H.F. choke....(McMichael "Binocular Junior")
1 Pre-set condenser, 0.0000075 to 0.0001 mfd. (Formo Type "F")
4 Valve holders, 5-pin .....(W.B. Rigid Type)
1 Metallised resistance, 1,000 ohms, 1 watt (Dubilier)
1 On-and-Off switch (B.A.T. Type 161, Claude Lyons, Ltd.)
1 Potentiometer, 4,000 ohms ("Clarostat" Type M4, Claude Lyons, Ltd.)
1 Resistance, 7,500 ohms and holder (Varley "Popular" Type)
1 Resistance, 10,000 ohms and holder (Varley "Popular" Type)
1 Resistance, 15,000 ohms and holder (Varley "Popular" Type)
2 Resistances, 200 ohms .....(Varley "Tag" Type)
4 Resistances, 600 ohms .....(Varley "Tag" Type)
4 Ebonite shrouded terminals, aerial, earth, L.S., L.S. .....(Belling Lee)
2 Terminal mounts .....(Belling Lee)
1 Cabinet ..... (Clarion Radio Furniture)
1 Panel, wood, 18in. × 9in.
1 Baseboard, wood multi-ply, 18in × 12in. × ⅜in.
Screened metallic flexible tubing, 16in. for H.F) anode leads. (Ward & Goldstone.
Screws, wire, sleeving, flex, plug adaptor, wood battens, etc.
Valves required: 2 Osram VMS4 metallised; 1 Mazda AC/Pen or Osram MPT4 and Marconi or Osram U12.
Note: Components C_{13}, R_{12} and C_{14}, R_{13} are contained within the base of the coils KTA1 and KTA2 respectively and are supplied with them.



THE INDUCTOR DYNAMIC LOUD SPEAKER

Merits Revealed by Measured Performance Data.

By D. A. OLIVER, B.Sc.

(Research Laboratories of the General Electric Company, Wembley, England.)

THE fact that the inductor loud speaker is excited by two permanent magnets of only moderate size and that its sensitiveness is good is intriguing, but, in addition, the remarkably good response over a wide frequency range, rendering it comparable with the moving coil types, is equally important.

The general details of construction are revealed by reference to Fig. 1. It will be noted that the armature moves to and fro in a direction parallel to the pole faces and consists of a pair of small iron bars braced rigidly together. Fig. 1 also shows the complete unit as well as the cone chassis, the dust cover having been removed.

One outstanding characteristic of the inductor loud speaker is its marked ability to reproduce the bass, and particularly those tones having frequencies below 150 cycles per second. This represents an additional one to one and a half octaves greater range in the musical scale than is covered by an ordinary electromagnetic loud speaker. This fact is borne out by ear and is supported by measurements on many loud speakers of this type, the output from the inductor dynamic being often greater at the low frequencies than the output from the moving coil class of instrument. It is, of course, realised that much depends upon particular design features of the loud speakers being compared, and this is precisely the reason why accurate measurements are needed to give quantitative information of a kind that listening tests can never yield.

IN the absence of performance data based on laboratory measurement uncertainty has existed as to the merits of the inductor type loud speaker in relation to the vibrating armature and moving coil types. As well as giving precise details of the behaviour of the inductor this article includes useful information concerning the working conditions.

It is necessary at this point to mention briefly the way in which loud speaker tests are conducted. In outline, the method employed is to mount the loud speaker in a baffle integral with one end of a sound-proofed room. The acoustical measuring chamber which was employed for these tests is about 16 feet long by about 8 feet high and 10 feet wide, and is lined with several inches of cotton-wool over the walls, floor, and ceiling to prevent any appreciable room reflections from taking place which would affect and complicate any measurements of sound pressure. Recent investigations have shown that a practically completely absorbing room has been achieved. The front of the cone is arranged to radiate into the absorbing chamber, and somewhere in front of it, and usually on the axis, a condenser microphone is suspended at a suitable distance. In Fig. 2 is given a general idea of the relative dispositions of microphone and loud speaker. The microphone is used first in the axial position and the loud speaker supplied with an alternating current which is constant at all frequencies. A response curve taken on a typical Gecophone inductor loud speaker in this way is given in Fig. 3, and the curve, as plotted, shows, for a position on the axis of the speaker, the variation of the acoustical power output at any frequency being compared with the power output at 1,000 cycles per second. In the near future it may well be that 400 cycles per second will be adopted as the standard reference frequency in order to bring loud speaker testing into line with radio-set testing.

The first considerable rise in Fig. 3, giving the quite appreciable response as low as seventy cycles per second, can be traced to the controlled low-frequency resonance of the inductor speaker. This resonance takes place between the total effective mass of the armature and cone combination, and the total effective stiffness of the system. The magnetic stiffness is kept comparatively small, and this feature enables low fundamental resonances to be attained, thereby ensuring that the really low notes are adequately radiated. It should be noted that in some commercial inductor loud speakers the bass resonance is exaggerated and well above the general level of the

The Inductor Dynamic Loud Speaker.—

response. This is a source of distortion in speech and music. However, in the model to which the response curve relates, eddy-current damping is introduced which is most effective at the low frequencies where it is required and becomes less important as the frequency rises, which is a desirable state of affairs. To illustrate and support the above statements, some measured results will be given. In Fig. 4, curve A is one of two very similar curves obtained on two inductor loud speakers of commercially manufacture, while curve B is typical of a commercial-produced type, similar to that dealt with in Fig. 3. The test conditions were identical, and the results are given up to 1,000 cycles per second at which zero level is quoted. Comparison of curves A and B shows that greater uniformity and fidelity are obtained when the fundamental resonance is properly damped, and curve B is better, too, for mean deviation from zero level.

In Fig. 2 it is indicated that means are provided for swinging the microphone round into different angular positions relative to the cone diaphragm. Important auxiliary data to an ordinary measurement of response are measurements of the sound pressure at different angles from the axis of the loud speaker. These measurements of the polar distribution of radiation are made at fixed frequencies and values of alternating current. The fact that the changing polar distribution with frequency exists, has been used to cast doubt on the value of the response curve measured on the axis of the loud speaker. This is a mistaken viewpoint, for polar measurements are complementary to axial response measurements, and vice versa. In Fig. 5 are given curves of relative sound pressure round the inductor speaker for frequencies of 50, 500, and 5,000 cycles per second, and these curves can be used in conjunction with the response curve in Fig. 3 to ascertain the general fall-off in frequency response for specific angular directions away from the axis. It was checked that closely similar curves were obtained when the loud speaker was rotated through 90 degrees. However, the greatest value of the polar response measurements is in deducing the total sound energy radiated at different frequencies, but details of the way in which this can be done will be found elsewhere.[1]

Let us turn our attention again to the response curve shown in Fig. 3. In examining this curve it should be kept in mind that variations of three or four decibels in the characteristic should not be regarded too seriously from the point of view of faithful reproduction as judged by ear at ordinary levels of volume output. The extremely sharp and narrow absorptive resonance about 3,300 cycles per second, which, even in steady state measurements, is very difficult to determine on account of the frequency stability demanded, can be taken to be of negligible effect in ordinary reproduction. This inductor characteristic has an upward trend with frequency which is an advantage in a curve taken at constant current. It is well known that an ordinary loud speaker, when connected in the output circuit of an ordinary triode power valve, has a drooping current-frequency characteristic for constant applied alternating voltage on the grid of the power valve. The magnitude of this falling-off in current is a function of the individual impedances of the component parts of the output network, and can be regarded in its acoustical effects as a fixed-tone control accentuating the lower frequencies at the expense of

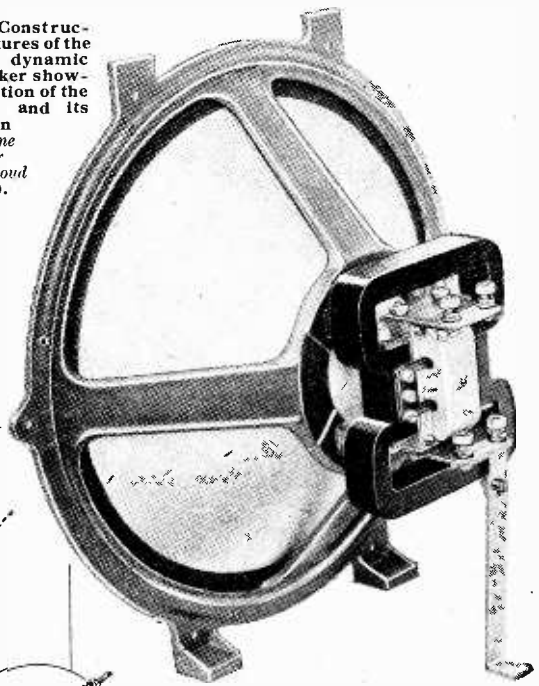
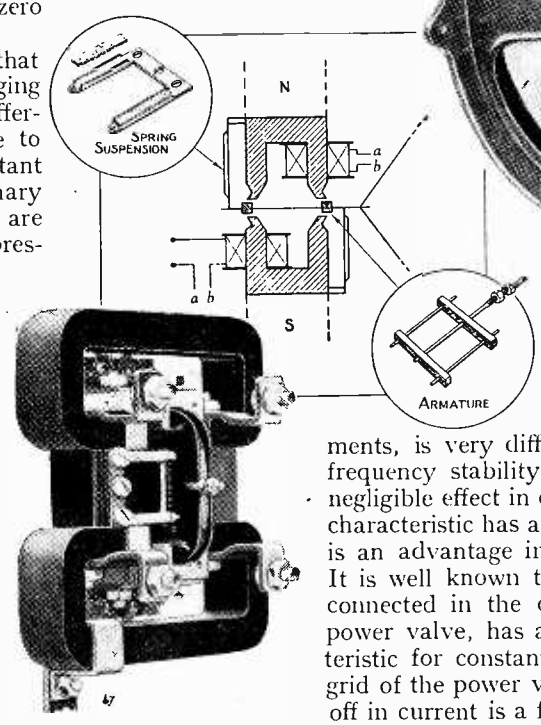


Fig. 1. — Constructional features of the inductor dynamic loud speaker showing the action of the armature and its suspension (*Gecophone inductor dynamic loud speaker*).



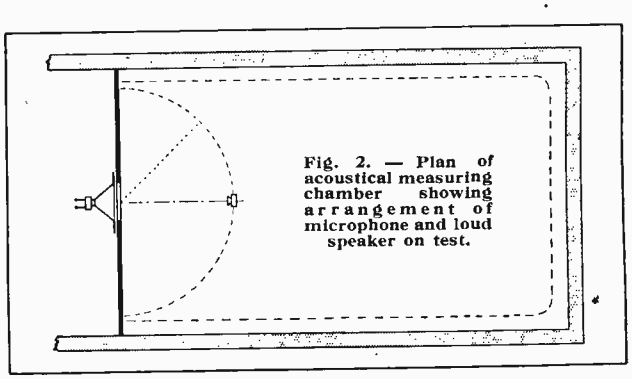
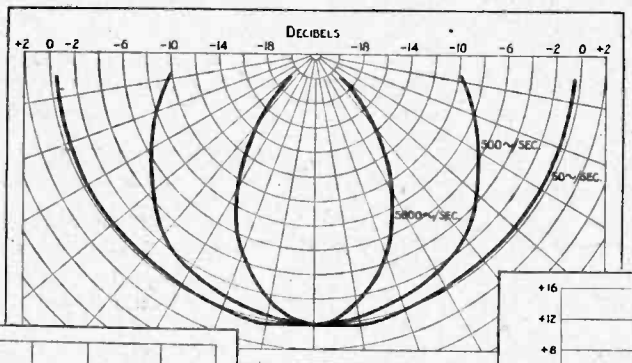


Fig. 2. — Plan of acoustical measuring chamber showing arrangement of microphone and loud speaker on test.

[1] Oliver. E.W. and W.E., Vol. VII, p. 653, 1930.

The Inductor Dynamic Loud Speaker.—

the higher ones. The precise amount of the fall-off that is desirable depends upon the magnitude of the upward trend of the response at constant current, the polar distribution of radiation and the acoustics of the room in which the reproduction is made. The acoustics of rooms in which a particular make of loud speaker may be destined to work, vary over wide limits so far as their frequency characteristics of absorption are concerned, and this greatly complicates any objective prediction of whether a specified loud speaker will give an average impression of correct tonal balance in a room selected at random. The mean of many measurements in representative living rooms will have to be taken before guidance in typical circumstances can be given, but steps are being taken to acquire this information. Rooms with heavy curtains and thick carpets absorb the higher frequencies readily, and thus a set and loud speaker which sounds too "bright" in a small room, with hard plaster walls and linoleum on the floor, can give perfectly satisfactory results in rooms with the former type of furnishing.



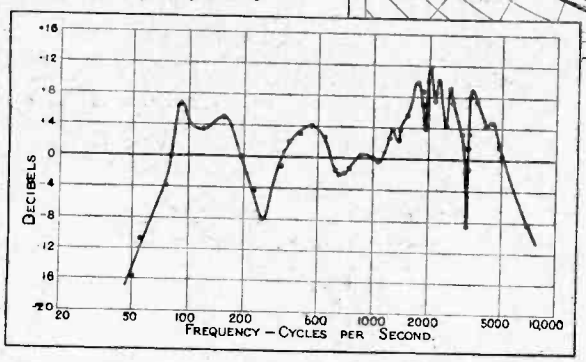


Fig. 3.—The response of an inductor dynamic loud speaker (Gecophone) when measured on its axis with the microphone at a distance of 60 cms. The input to the loud speaker was kept at the constant value of 5mA. *(Zero on decibels scale refers to 5.5 dynes per sq. cm.)*

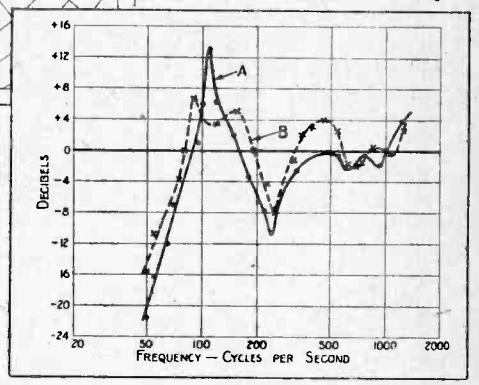
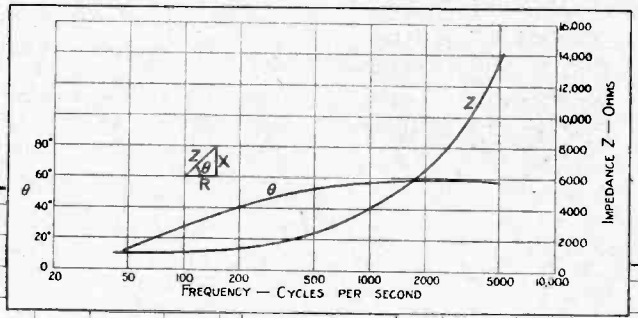


Fig. 4. — (Right) Curves showing a comparison between commercial inductor loud speakers.

Fig. 5. — (Above) Distribution of sound pressure at three different frequencies.

Returning to the question of the overall response on the axis of the combined power valve, coupling unit, and loud speaker, Fig. 6 shows the curves of current variation with frequency for standard Osram P2 and Osram LP2 valves respectively, for constant alternating voltage on the grid of the valve, when valve and speaker (Gecophone, low winding) are coupled with a 20-henry choke and 2-microfarad condenser.

The overall axial response of the inductor, choke, and condenser, coupled to the P2 valve, is given in Fig. 7. It is seen that with this particular valve the response curve now varies about an approximately horizontal line. If the reproduction is desired with more emphasis on the higher frequency tones, then an overall characteristic nearer to the one obtained at constant current can be secured by using a pentode



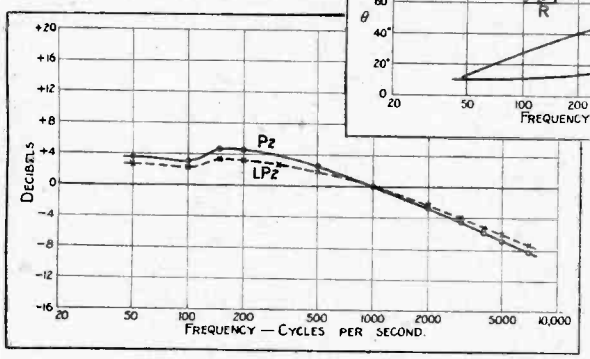


Fig. 6.—The current variation through the loud speaker winding (Gecophone low-resistance coil) when used with P2 and LP2 valves. At zero level the currents through the winding are 4.3 and 3.8 mA.

Fig. 8.—(Above) Impedance-frequency curves of the low-resistance winding of the Gecophone inductor.

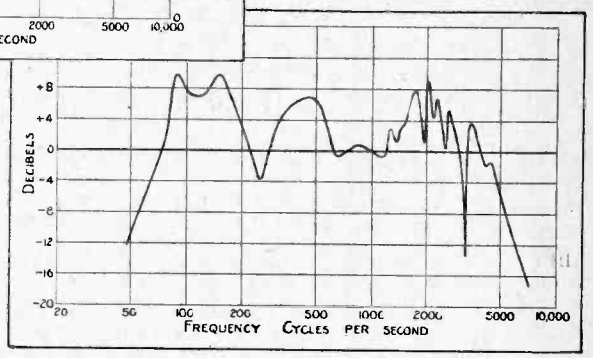


Fig. 7.—The overall response performance taken at a distance of 60 cms. along the axis and in conjunction with a P2 output valve. *(Zero on the scale of decibels refers to 4.7 dynes per sq. cm).*

The Inductor Dynamic Loud Speaker.—valve, which is now standard practice in the output stages of many commercially manufactured receiving sets. Finally, a curve of impedance with frequency for the low winding of the inductor speaker is given in Fig. 8, together with the polar phase angle.

It may be added that tests at many frequencies proved that the relation between sound pressure and alternating current through the loud speaker is strictly linear. Likewise, it was proved that linearity exists between the A.C. voltage on the grid of the power valve and the sound pressure set up in the sound field, and thus it can be confidently stated that, provided an undistorted low-frequency signal is applied to the grid of a correctly operated power valve, reproduction of high quality, both in purity and frequency range, will be obtained.

CORRESPONDENCE.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

A COMPLIMENT.

Sir,—The current issue of a contemporary reveals that, after a long series of experiments, a notable advance has been made by them in home construction. The prepared metal base with hidden-away wiring, similar to that which has been a particular feature of several recent *Wireless World* receivers, is described as a "new set idea," and its merits are extolled. No claim to originality is made, however, for the method of band-pass tuning adopted in this new metal baseboard-assembled set, for among the many possible systems of band-pass preference is given to the "Link" arrangement which was first described in your journal and which is being employed in *Wireless World* designs. If my memory is not at fault the sponsors of this new set adversely criticised band-pass tuning following its first appearance in the pages of your journal.

Such consistent imitation is certainly flattering!

Lewisham, S.E.13. H. DAVIES.

THE INTERFERENCE PROBLEM.

Sir,—As there seems little chance of the other members of the International Broadcasting Union agreeing to scrap some of their wavelengths for the sake of a 12-kc. separation, I suggest that the B.B.C. should offer to exchange our present channels of 1,148 (London National), 1,040 (relays), 995 (N. Regional), 968 (Cardiff), 842 (London Regional), 797 (Glasgow), 752 (Midland Regional), and 626 (N. Regional), for those of Wilno (1,229), Berne (1,220), Trieste (1,211), Juan-les-Pins (1,202), Barcelona (1,189), Gleiwitz (1,184), and Toulouse (1,175).

This change, if accepted, would endow the B.B.C. with a band of 72 kc. clear of interference from other stations except at the two extremes.

It should then be a relatively simple matter for Mr. Ashbridge and his staff to provide at least one programme of first-class quality for every British licence holder. J. E. FISHER.

Dover.

AN AID TO SELECTIVITY.

Sir,—We are probably near the limit when tuning alone will suffice to separate stations unless we make the band width so narrow that programmes will not be worth listening to, and the ingenious modification of Bellini and Tosi's old directional scheme described on page 410—"New Wireless Compass"—suggests a line of attack which has been rather neglected.

It is interesting to note that a frame aerial earthed at one end can be made to give a cardiod reception diagram, cutting out half what is usually supposed to be receivable with a frame aerial. For instance, in a mains set where the cathodes are earthed one has, on account of the pick-up of the mains and earth lead, the combination of open aerial and frame aerial, and it is merely necessary to balance these effects—the "open aerial" effect increases greatly with increase of wavelength—in order to secure a cardiod reception diagram.

Further, this diagram is not only plane with the ground, but the abnormality extends to signals from above also.

Hence, 261.3 London, which is usually unworkable here (sixty miles) after dark on account of night effects, is markedly improved with a frame aerial balanced in this way so as to be little inferior to 356 M London.

There is probably a good deal to be found out concerning variation of the reception diagram with size and shape of the frame aerial.

Perhaps some of the older hands experienced in direction finding can assist while our mathematical friends are sharpening up their pencils.

It will be seen that there is some resemblance to the coil earthed at end of Gen. Squier, described by Philip Comsey, "Radio Experimenters' Handbook," p. 17, 1922.

Ashford, Kent. W. A. RICHARDSON.

BROADCAST TRANSMISSIONS AND THE CONDUCTOR.

Sir,—With reference to the note, "Broadcast Transmissions and the Conductor," in your issue of October 7th, I would like to point out that this question of "dual control" was somewhat fully dealt with in an article by Mr. Lennox Berkeley (the composer) and myself, in *Nineteenth Century* for May, 1930.

The undesirability of this divided responsibility is, of course, obvious, but it was our contention that it is far more desirable for the conductor to take *full* control without any artificial means (such as the glass chamber—which, by the way, has been fitted to at least one studio abroad). The wireless conductor should train himself to appreciate how his orchestra will be heard "on the air," and thus be independent of such elaborate devices, just as every conductor has to be trained to realise that the balance of the orchestra as he hears it is not that which is heard by the concert listener, and to make allowances for this.

France. R. RAVEN-HART.

FREE VALVE TESTS.

Innovation by the Six-Sixty Company.

A VERY large percentage of the wireless troubles met with by the non-technical public arise from attempts to run new sets with old valves which are either not equivalent types to those specified or are unequal in performance to the requirements of the set. It has been a happy move, therefore, on the part of the Six-Sixty Radio Co., Ltd., to establish a chain of valve service stations throughout the country in order to help that big majority of listeners who possess no measuring instruments which would reveal loss of emission, reduced amplification, etc. Thanks to the new service any listener can now have his valves examined free of charge. By sending a post-card to Six-Sixty House, 17-18, Rathbone Place, London, W.1, any listener can be put in touch with the nearest depot, and will have at his disposal a service comprising (*a*) advice regarding the modern Six-Sixty valves which would best suit any particular receiver in use; (*b*) an examination of existing valves brought to the service station and a fair report on their condition and suitability; and (*c*) a home demonstration, anywhere in the neighbourhood, of a new set of Six-Sixty valves to determine the actual difference that new or more modern valves would make in any particular receiver.

Perhaps one of the most important aspects of the service, so far as *Wireless World* readers are concerned, is that friends experiencing valve trouble can now be recommended to try the Six-Sixty valve service. In this way one is saved the task of advising on the purchase of new valves—a delicate and sometimes difficult responsibility.

PRACTICAL HINTS AND TIPS.

SIMPLIFIED AIDS TO BETTER RECEPTION.

WIRING A.C. VALVE HEATERS.

WE have all become accustomed to dealing, in our wireless receivers, with very small currents, and so it is not surprising that we tend to forget the need that sometimes arises for avoiding serious loss of voltage in connecting leads.

In an ordinary set, heavy currents are passed only in the heating current of A.C. valves. It is generally appreciated that it is dangerous to overrun these valves, but, although the fact has been mentioned in these pages, it is not fully realised that the life of the valve may equally be seriously reduced if its cathode is insufficiently heated.

As an illustration of the possibility of losing volts, the diagrammatic sketch given in Fig. 1 may be considered. A total of three amperes will be consumed, and, if the valves are wired as in diagram (*a*), a total resistance of only a small fraction of an ohm can be tolerated if voltage is to be properly maintained across the heater of V_1, which is most remote from the power transformer.

Unless a reasonably short and heavy conductor—equal, say, to at least No. 16 S.W.G. wire—is used, it is better to wire each heater with a separate pair of leads, taken directly from the transformer terminals. By doing this, no conductor is called upon to carry more than the current for one valve, and so voltage loss is greatly reduced. It is always a safe plan to twist together any leads carrying raw A.C.

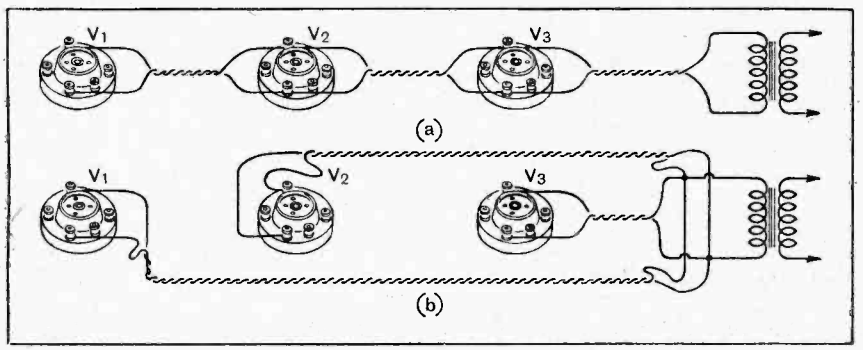


Fig. 1.—Alternative arrangements of A.C. valve heater wiring. By providing separate pairs of leads for each valve, loss of voltage is reduced.

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HUM AND THE PICK-UP.

IT often happens that an all-mains wireless set, when used for receiving broadcast matter, is practically free from hum, but that when adapted for the reproduction of gramophone records this background of complete silence is lost, and hum becomes a serious nuisance.

There are one or two different causes, any one of which may give rise to this effect, and of these the least likely to be suspected is the gramophone motor. Sparking at the commutator is a very common defect, well known and easily cured; it gives rise, however, to scratching noises of various types rather than to hum. But the stray magnetic field from the motor, if allowed to interact with the pick-up, may induce a 50-cycle voltage in the windings; and if the speaker is capable of reproducing this, and, still more, if it should happen to have a resonance at this frequency, the resulting hum may be intolerably loud. Moreover, the cure is difficult, for there is nothing much that can be done except to cut down the response of the amplifier to the very low frequencies, or to insert a rejector circuit tuned to 50 cycles (10 henrys in parallel with 1.0 mfd., or its equivalent) into the pick-up leads.

If the hum is caused, as is more often the case, by stray field from the motor interacting with a tone-corrector, the cure is simple; it is only necessary to move the latter about until a position is found for it at which the picked-up hum becomes negligible.

Electrical hum of this type is often confused with mechanical hum, which may arise if the motor vibrates a little, and if, in addition, the gramophone cabinet happens to act as a sounding-board and so accentuates the vibration. This can generally be cured by alterations in the manner of supporting the motor, or by mounting the motor-board, complete with turn-table and pick-up, on shock-absorbing material.

Where the amplifier is separate from the gramophone, hum can again arise by induction into the connecting wires from light or power leads in the vicinity. The best precaution against this is to use lead-covered wire, of the type used in many districts for wiring a house for electricity, to connect gramophone and amplifier. If the lead covering is earthed, the chance of picking up hum is very much reduced.

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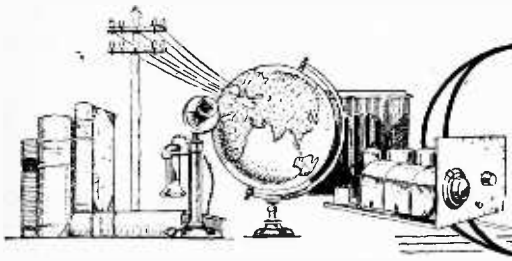
COIL CANS—and Matched Inductance.

IT is a matter of some importance that the individual screening covers of tuning coils in a receiver with ganged tuning should fit reasonably well, and it is worth while taking some pains to see that this condition is realised before the operation of setting the trimmers is undertaken.

If, for example, initial adjustments are made when one of the covers is seated imperfectly on its base, it may be found that the tuning of this particular circuit is changed quite appreciably when the screening cover is pushed down firmly.

Similarly, coil inductance can be affected to a noticeable extent if the covers are partly displaced laterally.



Current Topics

Events of the Week in Brief Review.

HILVERSUM THE NEXT?

One by one the Continental transmitters are increasing their power, and therefore their capacity for interfering with their neighbours. We now learn that Hilversum, which has never used more than 8.5 kW., will launch out with a 60-kW. transmitter in May, 1932. An increase to 20 kW. is probable within the next few weeks.

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WESTWARD HO!

The Post Office "pirate" detection vans will shortly start on a campaign in the Bristol area. It is stated that they will be labelled "G.P.O. Wireless Investigation Service," so listeners will have no chance of mistaking them for a travelling circus.

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SETTING AN EXAMPLE.

The Belgian Post Office has copied the "pirate"-hunting methods adopted in this country, and, according to a correspondent, the sight of the special gendarmerie appointed to track unlicensed listeners has frightened more than 120,000 into buying licences within the past two or three weeks.

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TOP OF THE POLL.

In a loud speaker voting competition recently organised at a Birmingham radio exhibition, ninety-five per cent. of the total points went to the moving-coil "R.K." instrument, costing 31s. 6d., which is marketed by the Edison Swan Electric Co., Ltd.

UNDERGROUND STUDIOS AT ROME.

Eight studios—all underground—are contained in the sumptuous "Palace of Broadcasting" which will be opened in Rome at the beginning of next month. According to a correspondent, one of these studios is the size of a large theatre and will be used exclusively for grand opera, which features regularly in the Italian programmes.

The three storeys of the palace which rise above the street contain the administrative offices and artistes' rooms.

The Italian broadcasting authorities are evidently of the opinion that the best sound-insulating medium is the earth itself.

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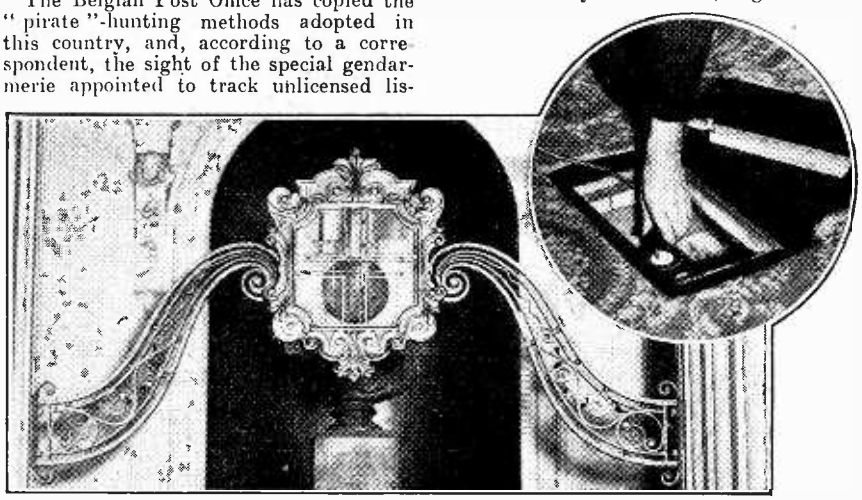
BRITISH RADIO FOR RUMANIA.

At a time when our radio export trade shows fewer signs of prosperity than the home industry it is refreshing to learn that the British Marconi Company has won a contract for the supply of wireless apparatus to the Rumanian Army at a cost of £500,000.



THE ARCHITECT AND THE LOUD SPEAKER. Most public buildings are now incorporating loud speakers, and architects are faced with the problem of harmonising these instruments with their surroundings. The above photograph shows with what artistic effect this has been done with the Marconiphone loud speakers in the Egyptian Hall of the Mansion House, London. The architect is Mr. Sydney Tatchell and the loud speaker mountings were executed by W. Bainbridge Reynolds, Ltd. (Inset) A microphone point which can be concealed beneath the carpet.

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RADIO AND THE WEATHER: NEW VERSION.

Wireless has so often been blamed for bad weather that it comes as a pleasant change to hear of someone who believes that it can be the producer, if necessary, of eternal summer. The optimist is a Frenchman, Professor Ledarp, who, according to the Paris Press, is on the verge of a discovery which will show that Hertzian waves, if properly controlled, can produce "very fine days."

While he is about it, M. Ledarp might evolve a device which would produce any kind of weather to order. Then he would be sure of a fortune.

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A WIRELESS DICTIONARY.

Doctor Siebs, of Breslau University, has accepted a special commission from the German broadcasting authorities to prepare an official "Dictionary of Radio."

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McMICHAEL S.W. SUPERSONIC SET.

With reference to the description of the McMichael Colonial Short-wave Supersonic receiver, in the issue of October 28th, it should be noted that the H.T. lead from the pentode valve should be taken to the H.T. positive 2 terminal and not to the H.T. positive 1 as shown in the circuit diagram on page 508.

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THE NEW H.M.V. STUDIOS.

Sir Edward Elgar, conducting the London Symphony Orchestra in his "Falstaff" Suite, gave an impressive note to the inauguration of the new H.M.V. recording studios in St. John's Wood, London, on Thursday last. The orchestra recorded a fine performance in the largest of the three studios—a vast hall containing platform and auditorium together capable of accommodating 1,250 people. Besides this and two other smaller studios, the new buildings house a complete recording plant comprising a main control room, recording cabinets, a generator room, and commodious waiting and retiring rooms for artistes.

To ensure good balance between the various instruments and vocalists, each studio contains six microphones, all of which can be separately controlled. The acoustic response of the studios can be constantly checked by cathode-ray oscillograph, and necessary adjustments can be made to suit any particular combination of voices or instruments.

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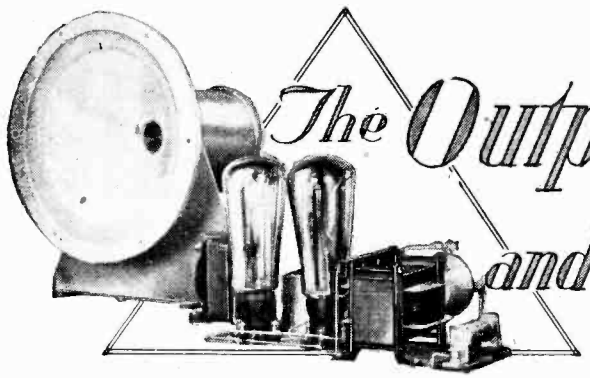
YOUR 1932 DIARY.

So great has been the demand for the 1932 edition of *The Wireless World Diary* that a reprint has been necessary. Readers who wish to make sure of obtaining a copy are advised to order at once from a newsagent or direct from our publishers at Dorset House, Tudor Street, London, E.C.4. The price of the Diary is 1s. 6d. or, post free, 1s. 7d.



The Output Stage and the Loud Speaker

By A. L. M. SOWERBY, M.Sc.

Obtaining the Greatest Volume with the Least Distortion.

EVERYBODY knows, in a general kind of way, that the choice of output valve and loud speaker for a set is rather an important matter. But those who have not had practical experience involving the direct comparison of one speaker with another, or of one output valve with another, do not always realise how enormous the influence of these two factors can be. But, after all, every sound that the set utters, from time-signal to symphony concert, has to submit to being edited by the loud speaker. With some cheap speakers this editorial process is inclined to be drastic—whole bands of frequencies are ruthlessly blue-pencilled out of existence, while fresh frequencies, not present at all in the original music as played before the microphone, are quite irrelevantly inserted.

In view of these facts it is hardly an exaggeration to say that the pleasure derived from a set—regarding it, of course, as a source of music—is influenced far more by the choice of the loud speaker, and of the output valve that drives it, than by any other single factor.

Even at the risk of wearying those to whom it is an old story, it is worth while to underline the phrase "the output valve that drives it," and to expand a little the point of view that prompted its use. Newcomers to wireless are inclined to think that a four-valve set must necessarily be "more powerful" than a set using only two valves. With four valves to amplify the signals it would seem self-evident that much louder results would be obtained than if only two valves were in use.

There is a neatly concealed fallacy in this apparently straightforward reasoning—the fallacy lying in the tacit assumption that, however great the signals handed on to the last valve, it will deal with them faithfully and without distortion. In practice, a limit is set to the amplification that can profitably be used by the fact that the last valve cannot accept, without distortion, any signal greater than a certain definite amount. If the one preceding valve of the two-valve set can provide the last valve with all the signal it can handle, then the addition of extra stages of amplification cannot possibly do any good, for they will have to be "throttled down" to avoid overloading the last valve. The set may become more sensitive, there may be more stations that can load up the last valve to the limit of its capacity, but the maximum volume of noise that the receiver can deliver will not be increased in the slightest by anything that may be done to the preceding part of the receiver.

FAILURE to observe the simple rules which govern the linking of the last valve in a receiver to the loud speaker must inevitably result in disappointment. With the three-electrode power valve a certain degree of mis-matching is possible without audible loss of power and fidelity, but with the pentode the output coupling is somewhat critical and means must be provided for accurate matching. This article, couched in terms simple enough to be understood by the newcomer to wireless, explains how the greatest undistorted output is obtained from the last stage.

It will be seen from this that it is the last valve, and not the set as a whole, that determines the volume of sound that can be delivered before overloading sets in. Electrically this is accounted for by the fact that the loud speaker is connected in the anode circuit of the last valve, so that it is from this valve alone that it derives the power that operates it. If, therefore, it is desired to increase the available volume from a set, it is necessary either to exchange the output valve for one of greater power-handling ability, or alternatively to increase the anode voltage on the existing valve up to the point of the maximum recommended by its makers.

The decision as to the standard of volume required, then, will determine the choice of output valve and of the anode voltage at which it is to be operated; it will, in addition, have a considerable bearing on the selection of the loud speaker.

Very various ideas are current as to the most desirable level of volume, owing largely to different opinions as to the correct function of a wireless set. There are those who like to have a set running all the time as a background to conversation or other activities. In such a case the volume must not be too great or conversation will be made difficult, while the fact that

The Output Stage and the Loud Speaker.—no one pays any particular attention to the programme makes the quality of reproduction quite a secondary matter. On the other hand there are those who definitely put other occupations entirely on one side to listen to an item which interests them, and when it is over switch off the set until the next item that suits their taste is due. For such listeners as these a larger volume of sound is usually an advantage; apart from adding realism to the music, it enables them to enjoy the programme in spite of the efforts of even the most irrepressible conversationalist.

When High Quality Matters Most.

Since full attention is given to the receiver whenever it is in use, it is important that the quality of reproduction should reach the highest standard if the fullest enjoyment is to be had. And, even apart from those listeners who wish to talk through the programme, there are many who say they dislike loud reproduction. If this statement is analysed it will usually be found that those who make it have learnt to associate loud signals with the distortion that inevitably arises when a small output valve is overloaded, or when the faults of an imperfect speaker are brought into prominence by asking it to deal with heavier signals than its maker ever contemplated. The many listeners with a low-power set and a powerful gramophone belong to this very numerous class; they will all enjoy the loudest wireless signals if the quality remains good.

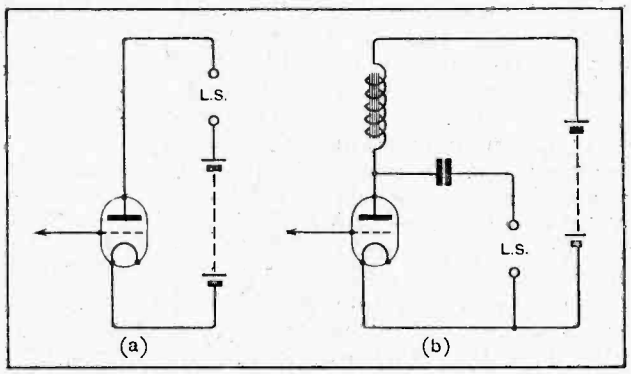


Fig. 1.—These two methods of coupling the speaker to the output valve are equivalent from the point of view of signals; they differ only in current through the speaker and stability.

If only a small volume of sound is required, or if the listener is forced to rely upon dry batteries which, for financial reasons, cannot be replaced very frequently, a small output valve of the P215 or P220 class may be found sufficient. The anode current will then be of the order of 8 to 10 milliamps. at about 120 volts. The speaker to accompany such a valve may well be one of the ordinary moving-armature cone type, and care should be taken in selecting it to obtain one that has a high sensitivity. With so little power available the very most has to be made of every milliwatt if disappointment is to be avoided; sensitivity in the speaker is often more important than fidelity in such a case.

A combination of this kind will provide music at a level comparable with that of the smaller portable sets, while the quality should be acceptable if the absence of bass, inseparable from so small an output, is not regarded as too serious an objection. Conversation, unless conducted in a very hushed tone, will probably make it impossible to follow the programme, and the rustling of the evening paper will drown it out completely.

A rather larger output than this will find favour with many listeners, especially those who have mains from which to draw their anode current. For example, a valve of the P240 class, taking about 15 to 20 milliamps. at 150 volts, will give some three times the output of the smaller valve just discussed. Where an accumulator is used for L.T. supply, and an eliminator for H.T., such a valve provides a very convenient compromise between generosity of volume on the one hand and economy, both in maintenance and in first cost, on the other. Power enough will be available for the reasonable reproduction of bass notes, and the music will be much more lifelike than with the smaller valve. A person talking in the room will no longer have it all his own way, but will have to raise his voice a little to make himself heard.

The speaker chosen to accompany such a valve must be picked with some care, for power enough is now available to show up any resonances that a cheap speaker may possess. Attention, too, should be given to the bass response, for at the volume to be expected music will sound very tinkly if the lower notes are not reproduced by the speaker.

The next level of output is that of the all-mains set in which an output valve consuming some 30 milliamps. or more at 200 or 250 volts is used. Such a valve will provide a volume of sound great enough to make conversation definitely difficult; music will be reproduced at somewhere round the level of that from a good acoustic gramophone. A speaker of moving-coil type will normally be preferred for an output of this magnitude, for there are very few cone speakers of the ordinary kind that do not have their resonances brought into very unkind prominence when called upon to handle so large an output as this. If the provision of the field current is difficult, then either a permanent magnet moving-coil speaker or one of the newer inductor types will probably be chosen.

Bigger Output Stages.

Still more ambitious output stages drawing up to 50 or 100 milliamps. at perhaps 400 volts are liked by some listeners. With an output stage of this size it is no longer possible to allow the speaker to remain close to the listener, but in a large room it is ideal, giving a far greater impression of realism than can be obtained with lower power. No speaker other than a moving coil can possibly be considered for such a set, and no moving-coil speaker save the very best will be found good enough.

From what has been said it will have been inferred that the excellence of a speaker is not an absolute thing measurable coldly in figures and expressible in curves,

The Output Stage and the Loud Speaker.—

but depends to a very great extent on the use to which it is to be put, and more particularly upon the strength of the signal which it will be called upon to reproduce. In a speaker that is intended to follow an output valve of small power, a pronounced resonance in the bass will often be a virtue; true bass simply cannot be had without a certain driving power, and a resonance bass will take its place very acceptably. Moreover, at low

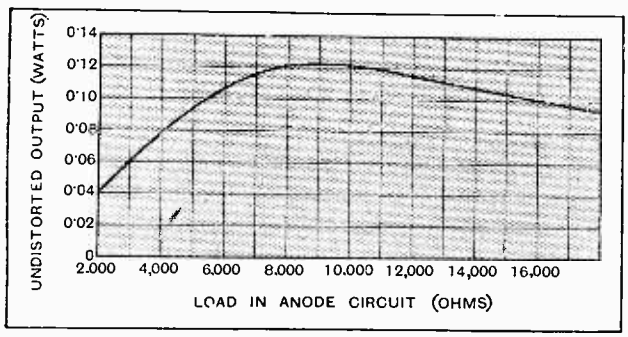


Fig. 2.—Variation of undistorted output with anode-circuit load for an American valve (CX 112-A). It is to be observed that quite wide deviations from the optimum load (9,000 ohms) do not make a great difference to the output available.

power this resonance will never become unpleasantly obtrusive. But if the same speaker is attached to a big radio-gramophone, the power supplied to the speaker will be such as to excite this bass resonance all the time, and reproduction will degenerate into a series of hollow booms. In choosing a speaker by the usual process of listening to it, considerable care should be taken to ensure that it is demonstrated with an output valve of about the same power-handling capabilities as that with which it is intended to be used in the home.

Output Valves in Relation to Speakers.

Besides the choice of speaker and of output valve there is the third factor, as yet undiscussed, of the coupling between them. The simplest and most usual method of coupling is to connect the speaker directly in the anode circuit of the valve, as in Fig. 1 (*a*), but the alternative choke-filter shown at (*b*) is even better. From the point of view of the signals the two are identical, but the choke circuit scores in that the choke will generally have a lower D.C. resistance than the speaker, so that fewer volts will be dropped across it. Where batteries are used as the source of anode current this point is often of considerable importance. In addition, the speech-currents are diverted away from the H.T. supply, so that motor-boating, in the case of sets deriving their anode current from the mains, is made much less likely.

The condition of maximum transference of power from valve to speaker is attained, with most valves, when the impedance of the speaker is approximately double the A.C. resistance of the valve. Either a higher or a lower impedance will permit a certain amount of power to run to waste. The accompanying curve, Fig. 2, which relates to an American valve, shows how the available power first rises, and then falls again, as the load imposed by the impedance of the speaker is raised.

It is a fortunate circumstance that quite wide divergence from the best possible value of load has but little effect, at all events with a triode, upon the audible volume obtained from the speaker, for it is quite unusual to take any pains in the matching of speaker to valve. Nor, in the case of an ordinary cone speaker, would such matching be at all easy to carry out, for the impedance of the speaker depends so greatly upon frequency, as Fig. 3 shows, that it is not possible to make the matching theoretically correct except for one selected frequency. The curve does at least suggest, however, some points of interest.

Tone Control by Choice of Valve.

In the first place the impedance of the ordinary cone speaker always rises with the frequency, being greatest for the highest notes. At middle C, or a little higher, the average speaker has an impedance somewhere about 5,000 ohms, and so is matched for that frequency with a valve of A.C. resistance about 2,500 to 3,000 ohms. With such a valve, power will therefore be most efficiently transferred to the speaker at about the middle of the musical range, there being a slow but steady falling-off towards both treble and bass.

If, on listening to a speaker, it is considered that there is too great a preponderance of treble, a valve of lower resistance may be substituted, or, if it is more convenient, the resistance of the existing output valve may in effect be halved by putting a second identical valve in parallel with it. The most efficient transference of power will now take place at a frequency for which the impedance of the speaker is lower; that is to say, at a frequency nearer to the bass end of the scale. The effect of the change will therefore be to accentuate a little the lower notes and diminish a little the proportion of power at the highest notes, while the total of available power will at the same time be doubled.

In thus discussing the relationship between the impedance of the speaker and the resistance of the

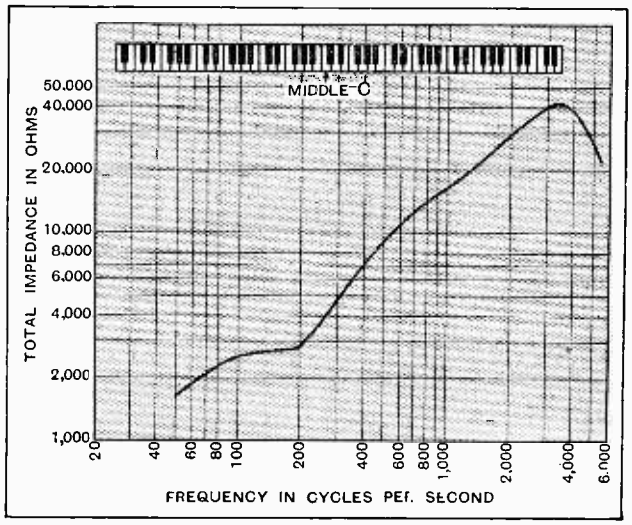


Fig. 3.—Showing variation of impedance of typical cone speaker with frequency. The piano scale at the top of the diagram enables the frequency-scale to be interpreted in musical terms.

The Output Stage and the Loud Speaker.—valve it has throughout been assumed that one of the arrangements of Fig. 1 will be used; for a triode and a moving-iron speaker no other circuit is likely to be employed. With the moving-coil speaker, especially with the smaller speakers that have come to the fore in the last few months, a transformer is generally required. The moving coil itself is generally wound with comparatively few turns of stout wire in order that it may be robust and free from breakdown; as a result, the impedance of the coil may be no more than 8 or 10 ohms. This will be at least roughly constant over the whole range of audible frequencies.

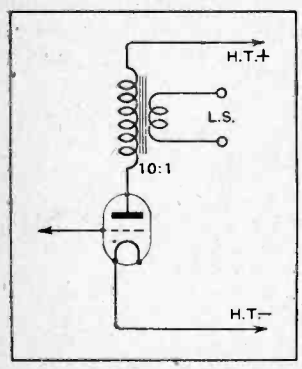


Fig. 4.—With a step-down output transformer the impedance of the speaker, as viewed from the valve, is stepped *up*. A 10-ohm speaker with a 10 : 1 transformer imposes the same load on the valve as a 1,000-ohm speaker directly coupled.

If this coil were connected directly in the anode circuit of a valve two things would happen. First, the direct current flowing through the coil would tend to force it out of the gap in the magnet, thereby tightening the suspension and making free movement impossible. Secondly, the impedance of the coil would be so low that almost no power would be transferred to the speaker and signal strength would be absurdly small. The first objection, were it the only one, could very easily be surmounted by using a choke filter; the second, however, would still remain.

By inserting a transformer between the valve and the speaker the effective load in the anode circuit of the valve may be brought to any desired value. If a transformer of ratio 10 to 1 is used, as in Fig. 4, the impedance of the speaker as a whole, including the transformer, is raised to 100 times (10 squared times) that of the coil alone; it becomes, therefore, equivalent to a speaker of impedance 800 to 1,000 ohms. If the valve has, say, a resistance of 2,000 ohms, that of the speaker should be about 3,500 ohms, the transformer ratio necessary for this, with a 10-ohm coil, is the square root of 3,500/10, which is about 18.7 to 1. It is therefore usual for a low-resistance speaker to be fitted with a transformer of about this ratio.

In using such a speaker, especially with an output valve of comparatively large size, it is necessary to make certain that the transformer provided will carry the steady anode current. If there is any doubt on this point, a choke-filter output should be used as well as the transformer, giving the circuit shown in Fig. 5. There is the additional advantage that motor-boating is rendered less likely than with the circuit of Fig. 4.

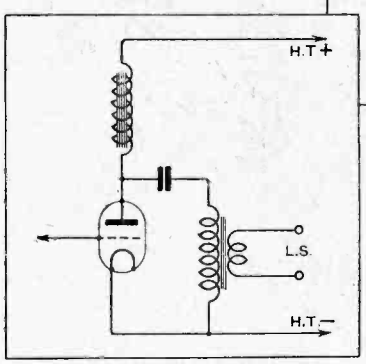


Fig. 6.—Where a transformer of small ratio is required, the advantages of Fig. 5 may be had by using a tapped choke. Above, a choke is shown used as a step-down transformer of ratio 2 : 1.

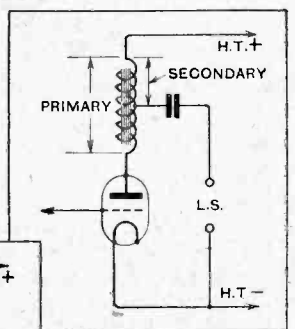


Fig. 5.—Where there is any doubt as to the ability of the transformer to carry the steady anode current of the valve, the transformer may be choke-fed as on the left.

There is no need to be very particular as to the exact transformer ratio; experiment with a low-resistance speaker and a multi-ratio transformer will very speedily show that the ear can hardly distinguish between ratios of 9, 15, and 22 to 1.

When using a pentode, whatever the type of speaker chosen, it will be found that correct choice of ratio is much more critical. In this case the A.C. resistance of the valve can no longer be used as a guide; instead, the figure for the optimum load, as published by a few of the makers or by *The Wireless World* in the supplementary valve data sheet, in the case of all pentodes must be taken, and the ratio of the transformer so chosen that this load is reached. If, for example, the correct load for the pentode is 10,000 ohms (a very usual figure), the ratio required for a moving-coil speaker of 10 ohms impedance will be the square root of 10,000/10, or about 32 to 1.

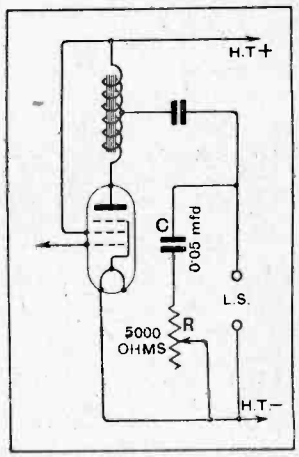


Fig. 7.—A very convenient and effective output arrangement for a pentode used with an ordinary cone speaker. The step-down ratio provided by the tapped choke ensures good bass, while the corrector circuit CR limits the load impedance at high frequencies.

The case of the moving-iron speaker following a pentode is more difficult, because the impedance of such a speaker varies so greatly with the frequency. The now well-known method of matching impedances in the bass by a step-down transformer of ratio about 2 to 1, and limiting the impedance reached by the speaker at higher frequencies by connecting in parallel with it a resistance of some 5,000 ohms and a condenser of about 0.05 mfd., remains the most satisfactory means of ensuring well-balanced reproduction. If the resistance is made variable it serves as a very useful tone-control. Omission of this corrector circuit will result in shrill and distorted reproduction, coupled with such early overloading of the pentode that the total volume obtainable is very small.

Such a corrector circuit should theoretically not be necessary when using a moving-coil speaker; in practice, since the speaker will most probably have been

The Output Stage and the Loud Speaker.—designed to follow a triode, it is not unlikely to be wanted. In this case a resistance of 20,000 ohms and a condenser of 0.02 mfd. should be connected across the primary of the transformer.

Matching the speaker to parallel or push-pull output stages follows exactly the same rules, provided we remember that in the case of parallel valves their impedance, and therefore the load that they require, is half that of one valve alone, i.e., where two valves are employed. In the push-pull output stage the valves are in series; they therefore require a load double that required by either valve by itself. If parallel push-pull is used with two valves each side, the load must then be brought back to the same value as that needed in the case of a single valve.

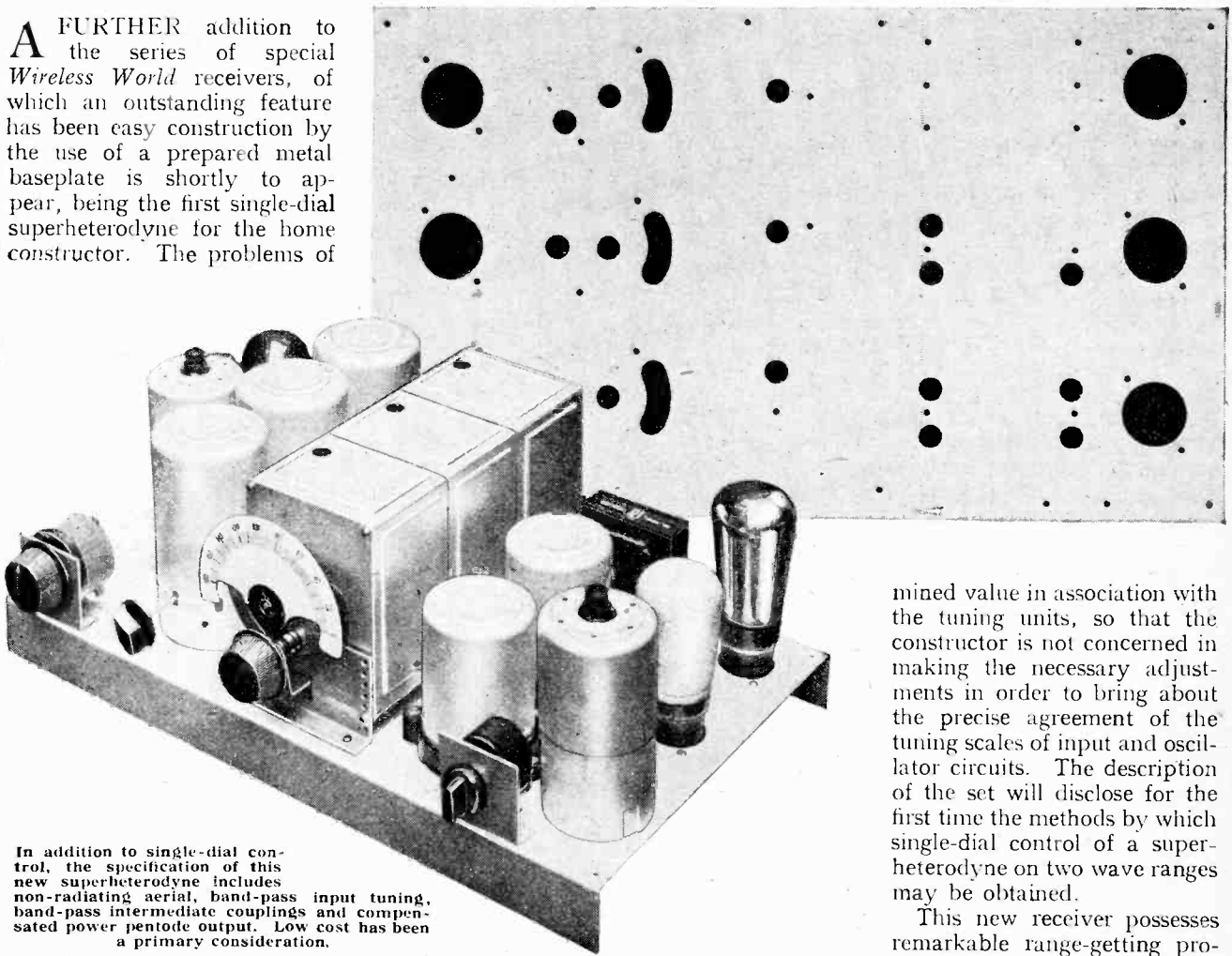
To Appear Shortly.—

"THE WIRELESS WORLD" SINGLE-DIAL SUPERHETERODYNE.

Designed by F. H. HAYNES and W. T. COCKING.

Metal Baseplate Assembly.

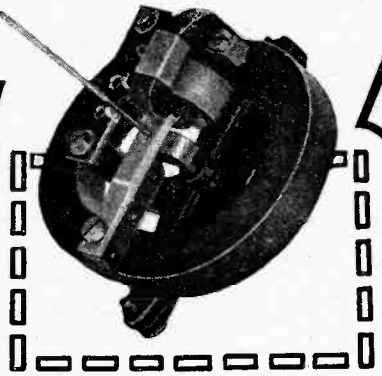
A FURTHER addition to the series of special *Wireless World* receivers, of which an outstanding feature has been easy construction by the use of a prepared metal baseplate is shortly to appear, being the first single-dial superheterodyne for the home constructor. The problems of single-dial control have been carefully investigated, so that no complication is encountered when abandoning the second dial. Ganging of the band-pass input circuit and oscillator holds in perfect unison over the entire tuning scales on both wave ranges. This is effected by the introduction of compensating condensers of predetermined value in association with the tuning units, so that the constructor is not concerned in making the necessary adjustments in order to bring about the precise agreement of the tuning scales of input and oscillator circuits. The description of the set will disclose for the first time the methods by which single-dial control of a superheterodyne on two wave ranges may be obtained.



In addition to single-dial control, the specification of this new superheterodyne includes non-radiating aerial, band-pass input tuning, band-pass intermediate couplings and compensated power pentode output. Low cost has been a primary consideration.

This new receiver possesses remarkable range-getting properties, stations being sharply tuned and occurring at close intervals around the dial. Current consumption from the H.T. battery has been brought down to the low value of some 12 mA., and the power output is generous. Every care has been taken to avoid superfluous equipment, so that the price of the necessary components may be as low as possible.

THE Moving Iron Loud Speaker



Factors Influencing Design.

Working Conditions under which it Scores over other Types.

By S. J. TYRRELL,
(Chief Research Engineer, Celestion, Ltd.).

COMMERCIAL loud speakers of to-day may be divided into two main classes—the moving coil and the moving iron. Each has its own sphere of usefulness, and while it is admitted that the moving coil under favourable conditions is capable of giving more faithful reproduction than the moving iron, yet under the conditions existing in the average receiver the moving-iron type is often found to give results equal, if not superior, to those of the moving coil.

The function of a speaker must be to convey to the listener a reproduction as near to the original as is possible *with the available amplifying equipment*. In other words, the response of the loud speaker should be chosen to compensate as far as possible for deficiencies in the response of the amplifier, both as regards frequency distortion and the general level of the power output. Were it possible, a census of the rated undistorted power outputs compared with the *actual* power outputs extracted from the last valve of broadcast sets would provide most instructive reading. Opinions as to the volume level required for an ordinary room in the average small house must vary considerably, but it appears to be generally accepted that an undistorted output of 250 milliwatts fed into a sensitive moving-iron speaker will prove sufficient volume for normal requirements and give a pleasing rendering of the original. This output assumes a maximum distortion of 5 per cent., which is scarcely discernible by the most critical ear, and in practice this percentage can be raised, and commonly is, to produce an output which, in the case of many portable receivers, is twice that of the rated output of the valve. In this latter case the distortion is readily apparent, and is a compromise with volume. A selective form of distortion may be produced by choosing a speaker whose reactance at the frequency of matching is less than the optimum load required by the output valve, when an increased power output is obtained with a higher distortion factor *at the lower frequencies*. Since the reactance of a moving-iron speaker rises rapidly with increase of frequency, this form of distortion does not affect the upper register. Speakers whose windings are tapped to produce different optional load impedances have advantages over the untapped types, in that a happy compromise of quality and volume can be readily realised.

THE rise in popularity of the moving-coil loud speaker has been accompanied by a tendency in some quarters to underrate the possibilities of the moving-iron type. As this article shows, there are circumstances—quite common in practice—in which the moving-iron loud speaker will give results which are superior to those obtainable with a moving-coil working under the same conditions.

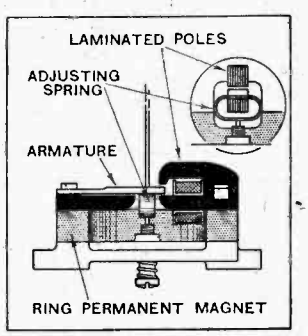


Fig. 1.—Constructional details of the Celestion type M moving-iron movement.

It is on power outputs up to 400 milliwatts that the moving-iron speaker has particular application. Whilst the progress in moving-coil design has been such that several types will now operate satisfactorily with 300 milliwatts, the volume level is generally less than that of a good moving-iron speaker; and unless the temptation to increase the volume by overloading the output valve is combated, the resulting distortion will mar the reproduction and render it less agreeable than a good moving iron giving equal volume for a lower and less distorted input. On outputs exceeding 400 milliwatts some classes of moving iron may still offer advantages over the smaller moving coils in the way of increased sensitivity, and also when the fidelity curve of the receiver is not all that could be desired. On 250 milliwatts, the power usually supplied by the majority of battery-operated sets, the moving iron is particularly happy; the power is such that the unit can be made for high sensitivity with good quality, and it is questionable whether any other class of speaker will meet the conditions equally well.

The moving-iron principle is such that it is as well fitted as any other to reproduce frequencies above seven or eight hundred cycles. Although its reactance rises rapidly with increase of frequency, and so reduces the current driving the speaker, this occurs also to a lesser extent with the majority of moving coils, and in practice the performance of both can be made identical in the reproduction of the upper register.

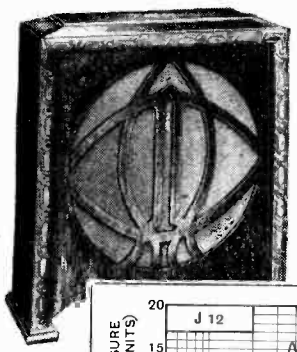
The Moving-Iron Loud Speaker.—

It has, however, been pointed out elsewhere[1] that satisfying quality is obtainable when the response begins to cut off at 3,500 cycles, and that in the present congested state of the ether the ability to reproduce frequencies above about 4,000 may be definitely undesirable.[2] Furthermore, in gramophone practice the response is usually made to tail off rapidly above this frequency to minimise surface noise. Accordingly, there seems little purpose in catering for frequencies the inclusion of which is not essential for good reproduction, and may be undesirable.

Sensitivity and Power-handling Capacity.

When, however, the frequency of the bass cut-off is approached, a different position arises, and it will be shown that although the bass response is a compromise with sensitivity good quality can still be secured. In order to examine this, reference will be made to the Celestion "M" type unit which is fitted into the "M" range of speakers, and is representative of modern practice. In Fig. 1 the unit is shown in cross-section. A ring-shaped permanent magnet of cobalt content steel is used to avoid unnecessary bulk and to conform to a "best shape" as regards magnetic leakage. A laminated C-shaped electro-magnet is clamped with the laminations edgewise on to one magnet pole; the particular shape provides a path of low magnetic reluctance to A.C. flux resulting from the speech currents applied to the coil. The other magnet pole carries the laminated extension piece, which serves to conduct the permanent magnetic flux along and into the armature. The latter is constructed of turbo-stalloy, which combines high elasticity with low reluctance. It has a slight downward set, and is adjustable in an upward direction by the screw bearing against the elliptical spring seen in side elevation. The application of speech currents to the coil produces a redistribution of the permanent magnetic flux, which otherwise would be equally divided between the two tips of the electro-magnets, and causes the armature to vibrate in sympathy with the current variations.

The greatest sensitivity is obtained when the air-gaps between the armature and the pole tips are at a minimum, but the maximum excursion which the reed can then make is correspondingly small, and the power-handling capacity of the unit reduced. As a first approximation,[3] the power a unit will handle is inversely proportional to the frequency, and the design of a speaker must be based on the required maximum power output at the lowest frequency it is considered necessary to reproduce. Similarly, as the lower cut-off frequency is raised, the gaps, for the same power output, may be reduced and the speaker sensitivity increased. This raises the extremely important problem of the frequency and form of the bass cut-off, in which connection the ability of the amplifier to feed the speaker with these lower frequencies must be raised. The fidelity curve of a very popular battery-operated kit set taken by way of example shows the highest power output level at 700 cycles, tailing off gradually above this to 50 per cent. of this output at 3,500 cycles, and 36, 20, and 9 per cent. at 200, 100, and 50 cycles respectively. In order to correct this curve a speaker would have to have a bass characteristic rising from 700 cycles to five times that level at 100 cycles, or, conversely, and more truly, *falling* at 700 to one-fifth that at 100 cycles. Such a speaker would be impracticable, and would of necessity be comparatively insensitive. Since the output of this set is limited to 270 milliwatts, and sensitivity is accordingly essential, the bass cut-off cannot be made to occur at a frequency much below 180 cycles. At first sight, and particularly when the band cut-off is viewed on a logarithmic basis, it would appear that the quality



Type J12 cabinet loud speaker.

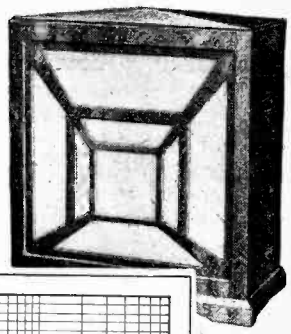
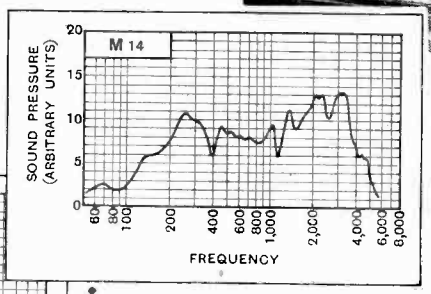
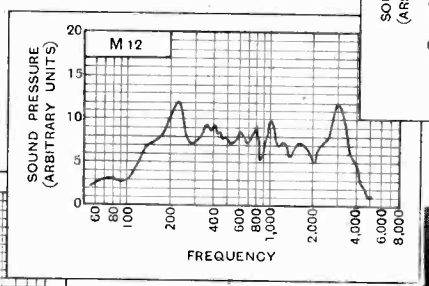
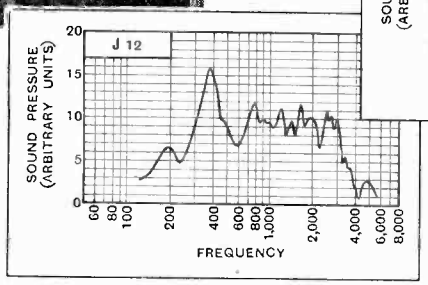


Fig. 2.



M14 loud speaker which employs the same unit as the M12 chassis.





Characteristic curve of M12 chassis with 2ft. baffle. The diaphragm is smaller than that of the M14 loud speaker.

[1] "Inexpensive Quality." *The Wireless World*, March 18th, 1931.

[2] "Where to Cut Off?" *The Wireless World*, Nov. 4th, 1931.

[3] This neglects, amongst other factors, the varying radiation resistance of the system with frequency, but is sufficiently true over a small band in the lower register.

would be seriously affected thereby. Fortunately, as was pointed out in the first of the two articles previously referred to, the accommodating human ear very conveniently reconstructs from harmonics the lower fundamental frequencies, and it is this fact which permits of a reproduction of limited power being termed good.

Choice of a Diaphragm.

The selection of a diaphragm for a moving-iron speaker is of particular importance, seeing that the largest diameter possible (without detriment to the upper register) must be used to maintain the output at the lower frequencies. In general, for a given diameter the smaller the cone angle and the stiffer the material, the more does the cone act as a piston in the lower register, and the higher the frequencies of diaphragm break-up which augment the upper register. The undesirability of an upper-frequency response extending far beyond 4,000 cycles has been shown, and accordingly a limit is fixed to the combination of cone angle and rigidity. Since, however, a sharp-angled cone has a pronounced forward focusing effect, increased rigidity with a shallower angle is a material advantage. In this connection it may be mentioned that a Celestion reinforced cone of 12in. diameter and apical angle of 130 degrees had its nearest approach in axial characteristics in a parchment paper cone 0.01in. thick and angle 100 degrees. The reinforced and paper cones weighed 25.5 and 31 grammes, and collapsed under weights applied to the apex of 28 and 11 lb. respectively. In an ordinary room, however, the reinforced shallow angle cone gave a better distribution of sound at a greater sound level, the latter being in part due to the lower mass of this cone.

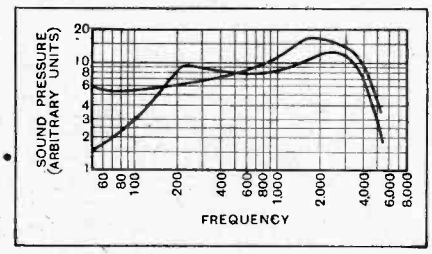


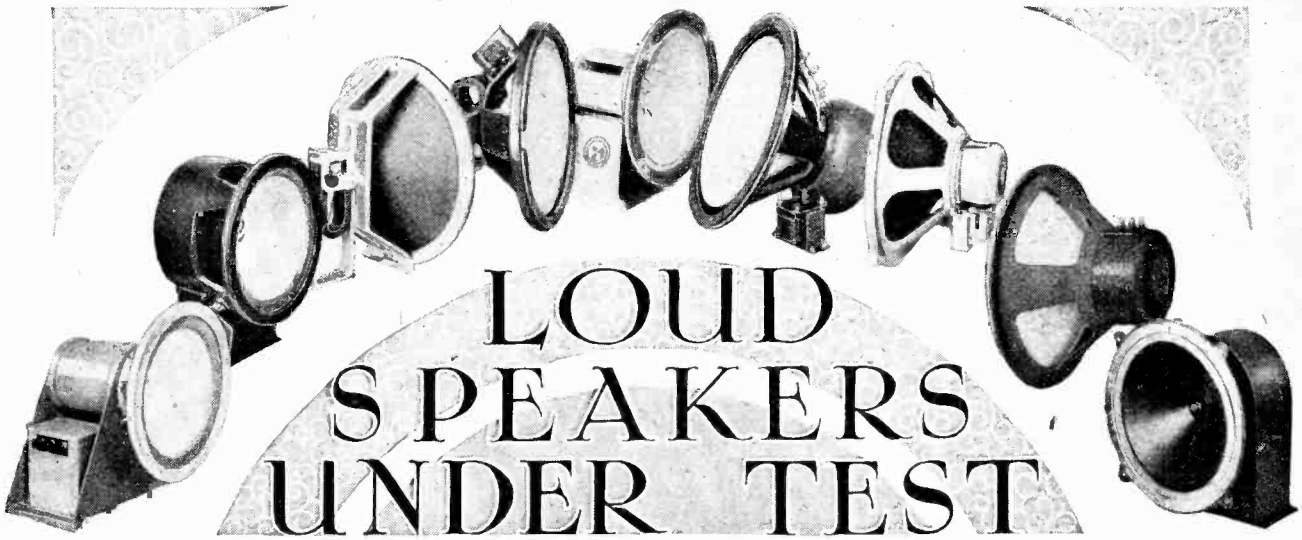
Fig. 3.—Comparison of response curves of the Celestion M14 loud speaker and a representative high-class moving-coil loud speaker.

It is unfortunate that whilst it is possible to measure the characteristics of individual components and secure overall fidelity curves of a complete receiving amplifier, it is with difficulty that the performance of speakers can be measured and expressed in forms which are readily interpretable. Speaker characteristics are necessarily taken under echoless conditions to avoid the interference of standing waves, and in circumstances very different from those in which the speaker will ultimately be employed. Such curves are, however, of considerable importance in the development of speaker design, and are of particular interest for purposes of comparison. Those reproduced, having been taken under identical conditions, give an indication of the comparative volume and tone balance to be expected.

All speaker characteristics show a succession of smaller or larger peaks and depressions caused by the many resonances which conspire, particularly in the upper register, to augment the output. Under normal conditions, in an ordinary room, standing waves produced by reflection from walls and objects interact in space, and, neutralising or assisting certain frequencies, produce fluctuations in output which may render those in the speaker relatively unimportant. In addition, every confined space has a certain dominant resonance which, in the case of a small room, may centre around 150 cycles, and colour the reproduction in that region. There is, therefore, every justification in drawing a mean line through the curve, and curves so drawn for a representative high-class moving-coil speaker and for the M14 Celestion moving iron have been superposed in Fig. 3 for purposes of shape comparison. In this instance logarithmic ordinates have been used since by some it is considered that these more truly represent the actual performance. Above 250 cycles there is little to choose between the curve shapes; below 150, however, the moving-iron response drops rapidly, whilst the moving-coil curve rises below 70 to a surround resonance at 40 cycles. In actual performance with an input of 250 milliwatts from an average instrument the moving iron gives greater volume with a quality, which, although perhaps technically inferior, may actually be preferred. Many of the smaller moving coils have a spring suspension or centring device and taut-stretched surround which produces a sharp resonance about 130 cycles and makes their characteristics little better than that of a good moving iron.

The three speaker characteristics in Fig. 2 make interesting comparisons. These curves combine the axial response and one taken 60 degrees to the axis. The input was a constant voltage to the grid of a triode of 2,000 ohms A.C. resistance delivering 400 milliwatts at 200 cycles. The J12 unit is the most inexpensive, and, having a rather greater sensitivity with a higher bass cut-off, is admirably suited to work from the kit set previously referred to, since its sensitivity is well maintained over a useful band, and cuts off at those frequencies which are already very attenuated. The M12 and M14 speakers have the same basic unit—that illustrated in Fig. 1—and show a somewhat similar general form. The 2ft. baffle of the M12 chassis has raised the general bass level, whilst the larger diaphragm of the M14 has increased the mean sound level for that speaker. It should be noted that, in order to produce as great a bass response as possible within the permissible limits of armature movement, the amplitude for all frequencies below the cut-off frequency should be the same. This has been nearly reached in the above speakers, and, in spite of the bass droop in their characteristics, the reproduction from a suitable input is full-bodied with a satisfactory impression of the presence of the lower fundamental notes.

No reference has as yet been made to price, and it is on grounds of first cost that the moving-iron speaker has the advantage over all other types. It is fortunate, too, that it operates most happily in conjunction with receivers, which, by reason of cost or circumstances, have outputs of small power. Yet, with the exception of the reproduction of the lowest fundamental notes, the performance can have a quality and volume level which will be completely satisfying to the ear.



LOUD SPEAKERS UNDER TEST

The number and variety of loud speakers at present on the market is so large and so wide that a comprehensive review would occupy far more space than is available in a single issue. It has been necessary, therefore, to confine attention to a few representative examples, which have been chosen as far as possible to illustrate features of design or performance associated with the class to which they belong. Readers are reminded that reviews of loud speakers are a regular feature of the "Laboratory Tests" section of this journal, and many leading makes not included in the present series will appear there in due course.

MOVING-COIL TYPES.

Amplion M.C.9.

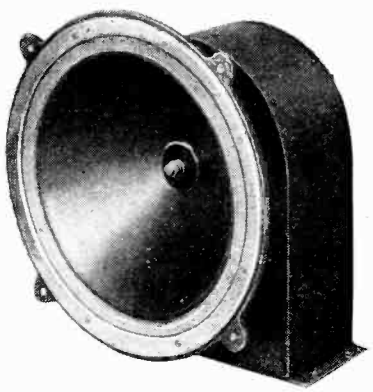
IN performance this chassis is second to none in the small group of leading moving-coil loud speakers. Starting at 50 cycles, the output rises slightly to 75 cycles, then drops to 200, and again rises steadily to 2,000 cycles. Between 2,500 and 5,000 cycles the output is maintained and then falls steadily to 8,000 cycles, at which frequency the output is equal to that in the region of the 500 cycles.

It is difficult to find any point of criticism in the reproduction of either speech or music, while the sensitivity is very much higher than that of the average permanent-magnet moving coil. It is interesting to note that this high standard of performance has been obtained with a corrugated diaphragm of a comparatively acute angle. Price, with transformer, £6.

Graham Amplion, Ltd., St. Andrew's Works, Slough, Bucks.

Baker's Selhurst Super-Power P.M.

THE performance of this chassis definitely places it in the best half-dozen units of its type at present on the market. The sensitivity is above the average, and the balance between high and low frequencies is just right. It was specially noticed that, while the reproduction of music is quite brilliant, the sibilants of speech are not over-emphasised. This is probably due to the fact that the high-

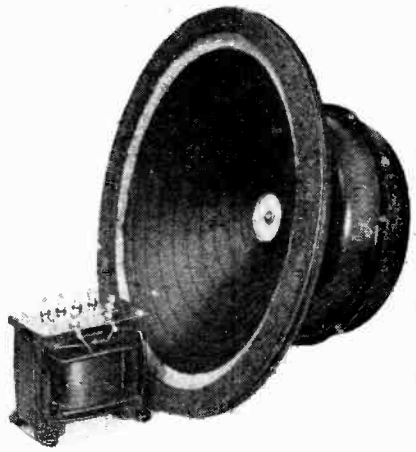


frequency cut-off commences at 4,500 cycles, and that the upper register between 1,500 and 3,500 cycles, although at a higher level, is remarkably uniform. Price, £6 6s., including output transformer.

Baker's Selhurst Radio, 89, Selhurst Road, S. Norwood, S.E.

Celestion R.P.M.12.

THIS unit employs the well-known Celestion shallow-angle reinforced diaphragm, and the reproduction is noticeably free from focusing of the



higher frequencies. The useful frequency response is from 50 to 4,500 cycles, and the reproduction of both speech and music is natural and free from undue shrillness in the upper register. A 6.5-ohm speech coil is employed, and an output transformer with alternative tappings is available.

Price, without transformer, £6.

Celestion, Ltd., London Road, Kingston-on-Thames.

Loud Speakers Under Test.—

Epoch, Type 99K.

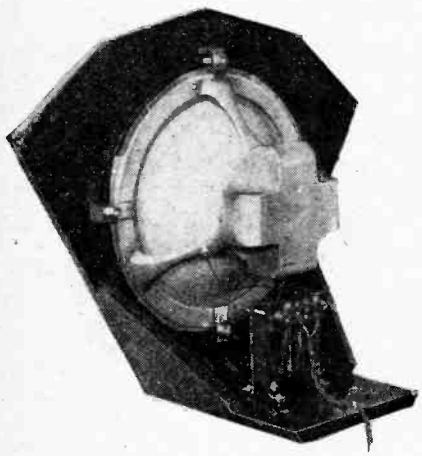
THIS permanent-magnet moving-coil chassis is an outstandingly good example of its class. It is extremely

sensitive and has a practically uniform frequency response from 50 to 1,000 cycles, after which it rises gradually to 3,500 cycles, and then falls slowly to 8,000 cycles, at which frequency the output is only about 5 db. lower than that in the middle register. The balance between bass and treble in the reproduction of music is excellent, while speech is notable for its good articulation. Incidentally, a 35 per cent. cobalt magnet is employed. Price, without transformer, £6 2s.

Epoch Radio Manufacturing Co., Ltd., Exmouth House, Exmouth Street, London, E.C.1.

Ericsson "Fan."

THE unusual cabinet contains a permanent-magnet moving-coil unit of sound design, together with a multiple-tapped output transformer, giving a wide



range of step-down ratios. The frequency response is good, both in the bass and upper register, the total useful range being from below 50 cycles up to 7,000 cycles. The curve is somewhat erratic in the middle register, but the effect of these subsidiary resonances is not distinguishable by the ear when listening either to speech or music, which are both well reproduced. The articulation of speech is especially good, while the sensitivity is normal for this size of permanent-magnet unit.

The cabinet is available in a variety of finishes; the price complete is £6 6s. (chassis only, £4 10s.).

Ericsson Telephones, Ltd., 67-73, Kingsway, London, W.C.2.

Ferranti, Type M.3.

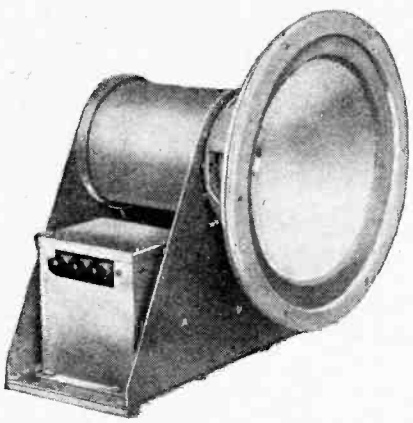
THIS chassis is the smallest of the Ferranti range of permanent-magnet moving coils. It has a 9in. buckram cone and a 20-ohm speech coil working in

a 0.050in. gap, with flux density of 7,300 lines per square centimetre. Sensitivity is very nearly equal to that of the more expensive type M.1, but the bass response below 150 cycles is, naturally, not so high. The middle and upper registers, however, are similar to that of the type M.1, and reproduction of both speech and music is good. A 9 per cent. cobalt-steel magnet is employed, and special precautions have been taken to ensure permanency. Price £3 15s., without transformer.

Ferranti, Ltd., Hollinwood, Lancs.

G.E.C.

THE model reviewed is designed for excitation from D.C. mains. It is sensitive and has frequency response of at least 50-8,000 cycles. The bass reproduction is full and is noticeable when reproducing orchestral music, but does



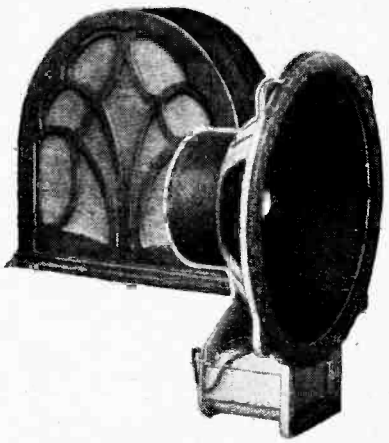
not obtrude itself in the reproduction of speech, which is free from hollowness. Good articulation is ensured by the excellent response in the upper register between 2,000 and 6,000 cycles. Incidentally, the output at 8,000 cycles is of the same order as that at 200 cycles.

The chassis bears all the marks of a sound engineering job and has an attractive grey enamel finish. The speech coil is a one-piece pressing from duralumin and carries a low-resistance speech coil. The tapped transformer gives two alternative primary impedances at 800 cycles, of 880 and 3,570 ohms respectively. The energy consumed in the field winding is 10 watts. Price £7.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

H.M.V., Type S.7.

IN spite of the small size of the permanent magnet this model is one of the most sensitive miniature moving coils so far tested, while its power-handling capacity is comparable with moving-coil units of twice its size. The useful frequency range is from below 50 cycles to well over

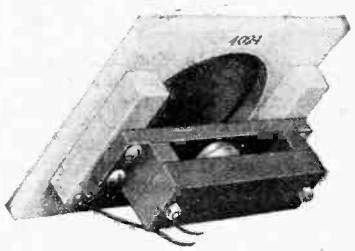


8,000 cycles, and the curve is remarkably free from resonances. As a result, reproduction of both speech and music is natural and unforced. A product which worthily upholds the reputation of this company. Price £5 5s.

The Gramophone Co., Ltd., Hayes, Middlesex.

Lanchester "Monitor."

THIS unit is of unconventional design and has a shallow-angle cone of only $4\frac{3}{4}$in. diameter. Nevertheless, in conjunction with a suitable baffle, the sound output is large in proportion to its size,



and the general sensitivity is comparable with permanent-magnet moving coils of

Loud Speakers Under Test.—

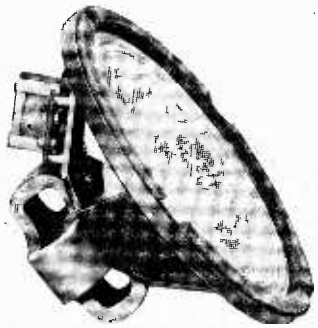
much larger diameter. The present models show a distinct improvement in the reproduction of the lower register, with the result that the general balance in the reproduction of music is good.

Lanchester loud speakers have always been noted for their excellent reproduction of speech, and in this respect the present model is not inferior to its predecessors. Price, without transformer, 48s.

Lanchester's Laboratories, Ltd., Spring Grove, Tyseley, Birmingham.

Igranic P.M.

THE 8in. buckram diaphragm is supported in a rigid cast aluminium frame, which also carries the output transformer. A claw-type permanent

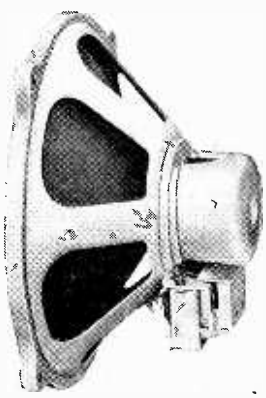


magnet is employed, and the sensitivity is good. The reproduction of speech is faultless and the balance between bass and treble in music is well maintained. The useful frequency response is from 75 to 6,000 cycles, and the level between 100 and 300 cycles and between 1,200 and 4,500 cycles is higher than in the middle register. Price £3 7s. 6d.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.4.

Magnavox D.C.143.

THE field magnet and speech coil in this model are similar to those of the smaller D.C.140 and D.C.142 models. The diaphragm, however, is 10¾in. in diameter,



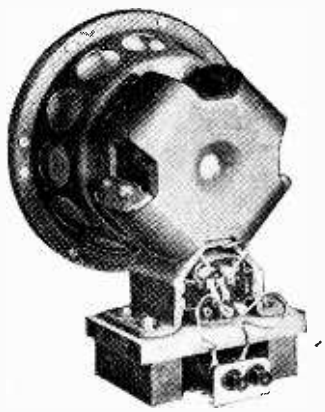
with the result that the sensitivity is increased. Unexpectedly, the large diameter does not over-emphasise the lower register, which is present in just the right proportion. The middle register is uniform, but there is an increase of level between 1,500 and 4,000 cycles. The output drops to normal between 5,000 and 6,000 cycles, and then falls rapidly to 8,000 cycles. The reproduction of both speech and music is natural and unforced, and there is no tendency towards hollowness or booming in the bass.

Considerable latitude is permissible in the current in the field winding, and the speaker operates satisfactorily with anything from 4.5 to 12 watts in the field. Price 60s.

Magnavox (Great Britain), Ltd., 89, Kingsway, London, W.C.2.

Marconiphone P.M.

A MASSIVE claw-type permanent magnet and small air gap are responsible for the high sensitivity of this unit. The diaphragm is a one-piece buckram pressing, and is provided with a low-resistance coil. An output transformer is included, which provides three alternative impedances for output valves of all types. The frequency response is aurally uniform from 50 to 1,500 cycles, after which it rises to a higher level at 2,000 cycles, which is maintained to 3,500 cycles. Above this the output falls gradually to 4,500 cycles, and then rapidly to a cut-off at 6,000 cycles. As a consequence, the



reproduction of music is not lacking in brilliance, yet the sibilants of speech and needle-scratch in gramophone reproduction are not over-emphasised.

Chassis price, £6 6s.

Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1.

Parmeko P.M.

THIS permanent-magnet moving-coil chassis is totally enclosed in a cast aluminium case, and is notable for the excellence of the workmanship throughout. Sensitivity is good, and the frequency response is excellent from 50 cycles to 8,000 cycles, with a maximum at 3,500 cycles. The suspension of the diaphragm is remarkably free, and, consequently, the bass resonance is well below 50 cycles. Thus the reproduction in the lower register is natural, and the general performance on both speech and music definitely places this speaker in the foremost class. A transformer is incorporated in the base, giving alternative working impedances of 2,000 and 8,000 ohms respectively. The

field magnet is of large dimensions, and has a total useful flux of 70,000 lines with a working flux density of 9,000 lines per square centimetre. The price, complete with base and transformer, is £8.

Partridge and Mee, Ltd., Dover Street, Leicester.

Ormond P.M.

IN the matter of quality and general balance of tone, the performance of this chassis is not inferior to that of the most expensive moving coils, whether of the permanent-magnet or energised type. The sensitivity is good, and the bass response is far better than that of the average small permanent-magnet moving-coil loud speaker. The useful frequency range is from below 50 to 7,000 cycles, and the bass response is balanced by an enhanced output between 1,200 and 6,000 cycles. Definitely a loud speaker in the

highest class. Price, including output transformer, 65s.

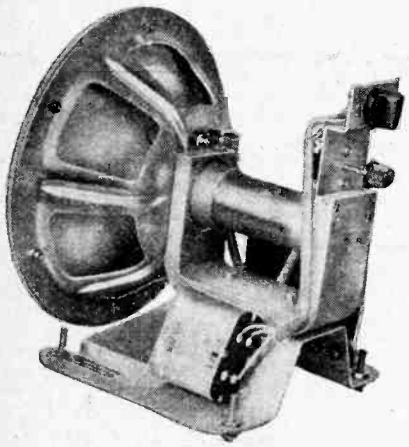
Ormond Engineering Co., Ltd., Rosebery Avenue, Clerkenwell Road, E.C.1.

Philips P.M. Chassis.

THE unusual shape of this unit is due to the employment of a special "U" type of permanent magnet. The diaphragm is of the doped buckram type, which eliminates the high-frequency resonances often associated with the ordinary paper cone. The sensitivity is

Loud Speakers Under Test.—

good, and a useful frequency response from 75 to 5,000 cycles is obtained. The diaphragm resonance is rather high (210 cycles), with the result that speech is somewhat low pitched; otherwise, the reproduction is beyond reproach.

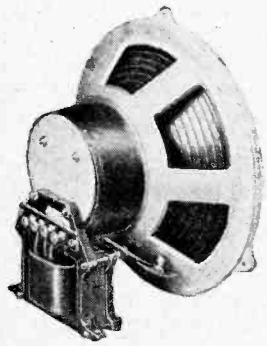


A tone control is fitted, which gives a sharp cut-off at approximately 4,000 cycles. This is useful when interference is experienced from heterodyne whistles. Price, complete with tone filter and output transformer, £4 4s.

Philips Lamps, Ltd., 145, *Charing Cross Road, London, W.C.2.*

Porter, Type P.F.2.

THIS permanent-magnet model has a sensitivity well up to the standard of its class, and is specially noteworthy for the brilliance of its response. An



increase in the output between 1,600 and 5,000 cycles is responsible for this, and the output is still well maintained up to 8,000 cycles. The middle register is uniform, but is of a lower level, while the bass response is maintained down to 75 cycles. The workmanship is of a high standard, and the diaphragm is supported in a machined aluminium casting.

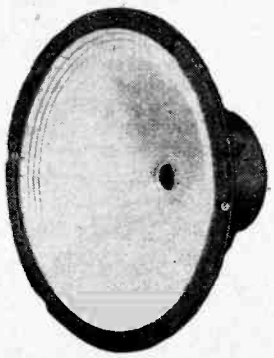
An output transformer is included in the unit, and gives three alternative impedance ranges suitable for low- and medium-impedance power valves and pentodes. Price 52s. 6d.

C. J. Porter, Wellowgate, Grimsby.

R. & A., Type 100.

UNLIKE the majority of miniature permanent-magnet moving coils, the output in the lower register from 150 cycles downwards does not fall away, but is maintained at the same level as in the middle register between 200 and 1,000 cycles. In the upper register the curve shows a general increase of level between 1,400 and 4,500 cycles, after which the output falls rapidly to 8,000 cycles. Incidentally, at 6,000 cycles the output is equal to that in the middle register.

Reproduction of music is good, with a well-maintained bass, while the reproduction of speech is even better. It is noticeable that the 120° cone gives appreciably less focusing of the high frequencies. An exceedingly small air gap is employed, and special methods of centring the diaphragm have been adopted in the assembly. The overall sensitivity, however, is normal, and the small air gap has been used to give improved response in the bass rather than



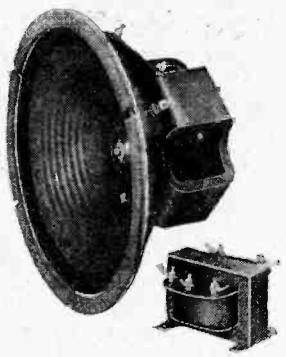
in the middle and upper registers, which generally influence the *apparent* sensitivity of a unit.

Price, without transformer, 45s.

Reproducers and Amplifiers, Ltd., Frederick Street, Wolverhampton.

R.K. Minor P.M.

THIS loud speaker is one of the most sensitive of the miniature permanent-magnet moving coils, and has an excellent frequency response, particularly in



the upper register between 1,000 and 6,000 cycles. Above 6,000 cycles there is a sharp cut-off, though there is still a perceptible response at 8,000 cycles. In the lower register the output is strengthened by a resonance at 200 cycles, which, to some extent, compensates for a tendency to cut off from 100 cycles downwards.

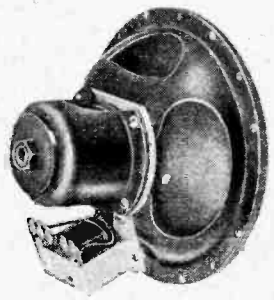
The reproduction of speech is, to all intents and purposes, perfect, while music is characterised by brilliance rather than a preponderance of the lower register.

Price, without output transformer, 50s.

Edison Swan Electric Co., Ltd., 123-5, *Queen Victoria Street, London, E.C.4.*

Rola, Type F.

THE response in this loud speaker is excellent from 100 to 6,000 cycles, with an increase in output between 1,500 and 4,000 cycles, which serves to give brilliance to the general effect. Although



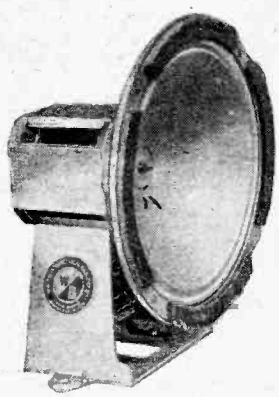
there is a tendency to fall off below 100 cycles, the response in the lower register is strengthened by a resonance at 175 cycles. Reproduction of speech and music are alike excellent, and the sensitivity is well up to the standard of its class.

The unit is made in a wide variety of specifications with transformers to suit all types of output valves. The specimen tested was designed for 200-250 D.C. mains, with the "single" output transformer, and the price is 35s.

British Rola Co., Ltd., 1*a*, *Willesden Lane, London, N.W.6.*

"W.B.," Type P.M.3.

THE sensitivity of this unit is quite definitely higher than the average of its class, while the reproduction of both



speech and music is of a very high standard. The response is excellent from

Loud Speakers Under Test.—50 to 5,000 cycles, and the greatest output is between 1,400 and 4,000 cycles, with a subsidiary resonance at 130 cycles.

The sensitivity and general performance is an excellent tribute to the special type of built-up permanent magnet adopted. At 52s. 6d. complete with output transformer, it represents excellent value for money.

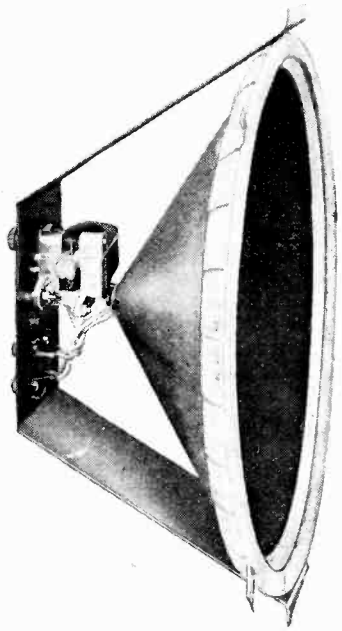
Whiteley Electrical Radio Co., Ltd., Nottingham Road, Mansfield, Notts.

MOVING-IRON TYPES.

Amplion A.B. 14.

THIS cone assembly, which is intended for incorporation in cabinets of special design, is a worthy representative of the moving-iron type of movement. In the photograph the unit is shown removed from the wooden framework with which it is normally supplied. This takes the form of a rigid baffle box open at the back. From 200 cycles upwards the response is comparable with that of a good moving-coil loud speaker, and although below 200 cycles the output falls off there is still a measurable response at 70 cycles.

The reproduction of speech is entirely without hollowness, and in the reproduction of music the performance differs from that of the moving coil only at

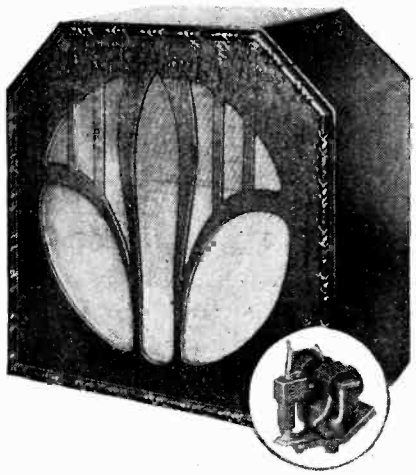


frequencies below 100 cycles. The sensitivity, of course, is superior to that of the majority of moving coils, and the power-handling capacity is more than adequate for domestic requirements. Two tappings are provided, giving impedances at 200 cycles of 1,430 ohms and 5,430 ohms respectively. Price 50s.

Graham Amplion, Ltd., St. Andrews Works, Slough, Bucks.

Artavian.

THE design of the movement in this loud speaker is notable for its rigidity and the accuracy with which the air gap can be adjusted. This accounts for the



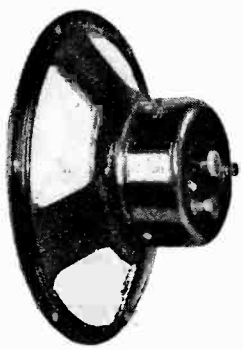
high sensitivity of the unit to small inputs; consequently the speaker is particularly well suited for use with sets employing small output valves.

The useful frequency response is from 80 to 5,000 cycles, and the quality of reproduction of speech and music are specially creditable for a moving-iron type unit. The power-handling capacity is limited by the reed resonance, which is between 75 and 90 cycles, but the volume available is more than sufficient for domestic use. Price 32s. 6d. in oak.

Barnstaple Loud Speaker Co., Ltd., Artavian Works, Barnstaple, Devon.

R. & A., Type 59.

THIS model is a development of the well-known R. & A. type 40 unit, and has a smaller diaphragm (chassis dia-

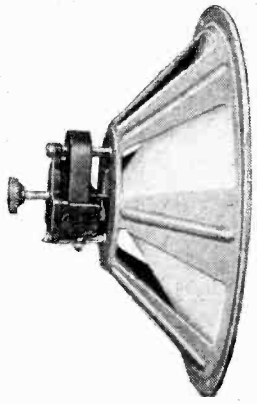


meter 10in.) for fitting to standard 12in. cabinets. Between 200 and 4,000 cycles the characteristic would do credit to a moving-coil loud speaker, and although there is, naturally, a falling off below 200, there is still a perceptible response as low as 75 cycles. The high-frequency cut-off is at 4,500 cycles. The reproduction of speech is comparable with that of a moving coil, and there is quite a fair proportion of bass in the reproduction of music, which is beyond reproach in the middle and upper registers. Price 16s. 6d.

Reproducers and Amplifiers, Ltd., Frederick Street, Wolverhampton.

Ormond No. 3 Unit and Small Cone Chassis.

THIS assembly gives conclusive proof that pleasing quality need not necessarily be prohibitive in cost. The response between 200 and 4,500 cycles is better than many moving coils, and the same may be said of the quality of reproduction of speech. Naturally there is a cut-off in the bass below 100 cycles, and there is also a decrease of output from 200 down to 100 cycles. Nevertheless, with

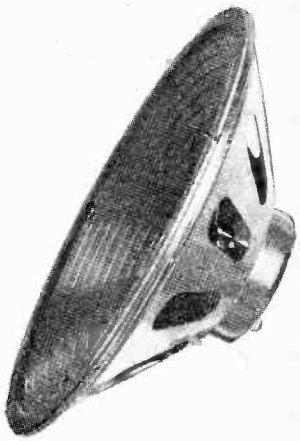


a baffle or well-designed cabinet reproduction of music is not unduly lacking in body of tone. Price 15s. complete.

Ormond Engineering Co., Ltd., Rosebery Avenue, Clerkenwell Road, E.C.1.

Celestion M.12 Chassis.

THIS chassis employs the well-known Celestion reinforced diaphragm, which is driven by a massively constructed unit of original design. A continuous ring-type permanent magnet is employed and the reed is of special high-elasticity



Stalloy steel. Tappings are provided on the speech coil for valves of high or low impedance.

Loud Speakers Under Test.—

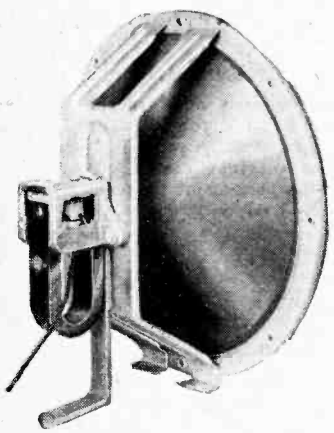
The response above 400 cycles is comparable with that of a moving coil and the high-frequency cut-off is at about 4,000 cycles. The bass response is strengthened by a resonance at about 220 cycles, and the reproduction of music is well balanced. Speech is natural and free from hollowness, and the general sensitivity of the unit renders it specially applicable for use with receivers giving an undistorted output of from 250-400 milliwatts. Price 35s.

Celestion, Ltd., London Road, Kingston-on-Thames.

INDUCTOR TYPES.

Blue Spot, Type 100U.

LIKE most inductors, this unit is characterised by exceptionally good reproduction in the bass, and an important consequence is that the bass is well maintained at very low volume levels. Taking into account the good sensitivity of the unit, this renders it specially applicable to receivers with small output valves. The output is well maintained through the middle registers, but begins to fall above 2,500 cycles, reaching its lowest level at 6,000 cycles, after which there is a sharp rise again at 8,000 cycles. However, the fall in output in the region of 3,000-5,000 cycles is noticeable when reproducing the sibilants of speech, and it would appear that the speaker would give best results

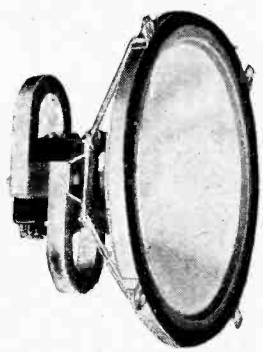


with a pentode, which would tend to improve the output in the upper register. Price 39s. 6d.

The British Blue Spot Co., Ltd., 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

Ferranti Inductor.

ALTHOUGH this unit does not develop the large amplitudes below 100 cycles usually associated with an inductor, the response between 100 and 400 cycles is well above the average, with the result that both speech and music are somewhat deep in tone. The output is maintained up to 6,000 cycles, but does not show any marked increase in the upper register to

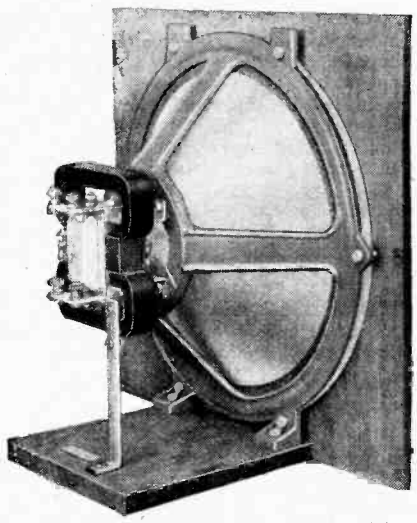


balance the output between 100 and 400 cycles. It would appear, therefore, that this unit would give best results in conjunction with a pentode output valve. Price 70s.

Ferranti, Ltd., Hollinwood, Lancs.

G.E.C. Inductor.

A DETAILED description of this chassis appears on another page in this issue. The principal characteristic curve there reproduced was taken with constant cur-



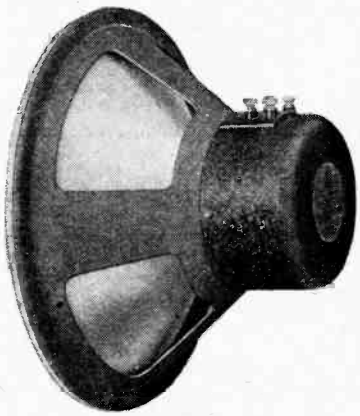
rent in the speech coil, a condition equivalent to the use of a pentode output valve.

With a three-electrode power valve, the bass becomes more prominent relative to the upper register. Nevertheless, the response up to 4,000 cycles is good, and the level between 1,500-4,000 is still sufficiently strong to give good articulation in speech and to balance the rather heavy bass response. Price £3 10s.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

Lamplugh Inductor.

THIS chassis has been redesigned, and is now produced in an attractive green and black crystalline enamelled case. True to type, the bass response is prominent, the output at 50 cycles being about 10 db. higher than the general level of the curve. In the upper register the highest output is to be found between 2,000 and 3,500 cycles, after which there is a steady decline to 6,000 cycles, which is the highest useful frequency reproduced.

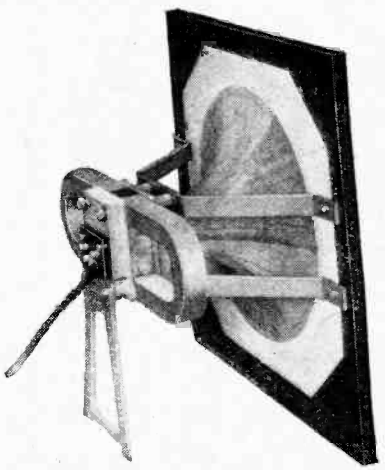


The speech coil is centre-tapped for use with push-pull circuits, and is provided with alternative sections for high- or low-impedance output valve. Price £3 10s.

S. A. Lamplugh, Ltd., Little Park Street, Coventry.

Realistic Inductor.

THIS chassis is notable on account of the special construction of the diaphragm, which is built up of veneer wood sections, joined together to form an approximately logarithmic flare. The frequency response is remarkably uniform between 50 and 5,000 cycles, after which there is a slight drop to 6,000 and then a sharp cut-off to 8,000 cycles. The unit is sensitive, and, in common with most inductor movements, gives a well-sustained



output in the bass. There is, however, no suggestion of hollowness in the reproduction of speech, and articulation is above the average for its class. Price £3 12s. 6d.

Realistic Speakers, 72, Penton Street, Islington, London, N.1.

UNBIASED
BY FREE GRID

Are Relays a "Menace"?

IT is only natural that radio traders —under which heading I include manufacturers, wholesalers, and retailers—should feel a little apprehensive lest the radio relay systems springing up on all sides should become so popular as to conflict with the sale of wireless receivers and components. In my opinion, however, radio dealers are taking the same short-sighted view of the so-called relay "menace" as did gramophone dealers of the radio "menace" in 1922; eventually they will find that the relay services tend to whet the appetite of people for an independent radio receiver. Relay subscribers will soon tire of receiving only one programme, and will come to their local dealer to buy a multi-valve set capable of dragging in foreign stations.

Wireless dealers are fully entitled to form their own opinions on this matter, but what they are not entitled to do is to adopt the dog-in-the-manger attitude about it which, according to a highly reputable journal which I have just been reading, they are intending to assume.

Fighting the radio menace.

To attempt to keep the business "in the family," so to speak, is highly sensible, but unfortunately their actual intentions are not so praiseworthy, for it seems that they intend to apply to the various local councils for *a monopoly* in connection with the establishment and operation of relay services, and, having obtained it, simply sit back and do nothing. The general public will, I think, be entirely out of sympathy with them in such a course, and I think also that when their intention becomes generally known they will find that the various town councils will begin issuing the necessary licence only on the condition that an actual service is put into operation within a reasonable time—say, one month—from the date of the granting of the licence.

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Erroneous Description.

BY the way, it always annoys me to see the expression "wired wireless" applied to the relay services. I believe that one of these relay companies has actually had the temerity to adopt this expression, as part of its title. "Wired wireless," of course, consists of the transmission of a number of different telephone conversations—or broadcasting programmes, for that matter—over one land line, interference being obviated by the fact that, to put it very loosely, the various conversations are electrically tuned and thus pass over the line at different frequencies.

Old readers of this journal will remember that an excellent description of this system appeared in the issue of *The Wireless World* dated May 6th, 1922. It is, of course, not at all necessary that the line be one which is reserved for telephony, as use can be made, for instance, of the various high-tension power transmission lines, this particular arrangement being referred to in the issue of this journal for January 2nd, 1924. The ordinary electric light wiring can be used for distributing programmes and the writer himself was an interested spectator—or is auditor the more correct word?—of experiments of this nature which were carried out in Staten Island some while back.

The system worked very well, and, of course, there was no hum because the programme was taken off the lines at radio frequency and not at audio frequency, as in the case of the ordinary relay system. The latter, of course, is nothing more or less than a loud speaker extension system on a large scale.

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Those Continuous Gramophones.

THE type of gramophone which, loaded up with a large number of records, plays continuously for an hour or more, is coming on the market in an increasing number of types, and what is better still, at prices which would have been undreamt of a year or so ago. Considerable ingenuity is being displayed in the design of these, but, personally, I would like to be the owner of one which plays both sides of a record before passing on to the next, and which carefully deposits the "used" record into a well-padded compartment of its own, instead of dumping it on to a pile of other records, with the probability of scratching it.

My continuous gramophone.

I am afraid that these luxury articles are beyond my means, but the one that appeals to me most is an instrument that was demonstrated to me by a firm situated somewhere up in the gallery at last year's Olympia exhibition.

I cannot remember the name of the firm—probably the fact that they wanted nearly one hundred and fifty pounds for their product has contributed largely to my forgetfulness—but I do remember that the instrument possessed the good points which I have just mentioned.

The gramophone record makers are meeting the situation in an easier way by arranging to supply us with two one-sided records at about the price of one, as they contend that apparatus which actually turns a double-sided record is apt to be cumbersome. *My* contention is, however, that the storage of twice the number of records is apt to be even more cumbersome, and I hope that research departments will do something about it.

Empire Broadcasting —at Last!

By THE EDITOR.

IN April, 1926, *The Wireless World* published an article entitled "England in the Colonies," pointing out what a boon to the lonely settler wireless could become as a means of keeping him in touch with the Mother Country. In May of the same year *The Wireless World* published the first appeal for a short-wave transmitting station of world-wide range, introducing as the title of the leader "Empire Broadcasting." So opened a campaign which, in spite of postponements, objections, both general and technical, and even deliberate obstruction, has eventually led to the pronouncement by the British Broadcasting Corporation which we publish on this page.

Now, at long last, we have the assurance that an Empire broadcasting station, designed on adequate lines to provide a satisfactory service, is to be proceeded with. Every recommendation made by *The Wireless World* appears to have been taken into consideration in planning the Empire station. The station is to radiate on a number of wavelengths in order to ensure that there will be available in every part of the world a wavelength best suited for reception. A twenty-four-hour programme is promised, so that no part of the world need be deprived of a daily transmission.

At how early a date *The Wireless World* appreciated the possibilities of Empire broadcasting is indicated by the statements contained in a leader which appeared in the issue of July 14th, 1926, which, in view of the importance attaching to the subject at the present time, we think it is of interest to quote in full:—

"Broadcasting provides a means, such as has never existed before, for linking up large areas and even bringing different nations into mutual touch with some central point. We, in Britain, are often being accused of insularity in our outlook, and, despite the fact that the British Empire extends to every corner of the globe, our broadcasting organisation has been set up to serve this country alone, with really no consideration for the possibilities of broadcast reception farther afield.

"An article which we published some time ago on the subject of the possibilities of reception in the Colonies of transmissions from home has provoked considerable interest, and we have received communications from different parts of the Empire appealing to us to stimulate interest and consideration for the requirements of our fellow-countrymen overseas. We get used to the advantages of broadcasting at home through familiarity, and even if we were deprived of broadcasting here we still have other sources from which to obtain our news and entertainment. But it is not so in the Colonies, where the possibilities of being able one day to listen-in with a wireless set to the transmissions of the Mother Country are looked forward to with an eagerness which should stir us to a sympathetic response.

"The present B.B.C. stations are scarcely suited to very-long-distance broadcasting, but if a transmitter were erected to operate on short wavelengths it could, no doubt, be made possible to broadcast programmes to many parts of the Empire under favourable conditions. In comparatively few cases would it be possible for individual listeners to pick up the transmissions direct, but central receiving stations of high efficiency would have to be put up which would supply the programmes from the Mother Country for re-broadcast-

THE B.B.C. AND EMPIRE BROADCASTING

THE B.B.C. announces its intention to proceed immediately with plans for the erection of a short-wave Empire Broadcasting Station.

For some time the Corporation has been in consultation with Government Departments concerned and the subject was discussed with the last Imperial and Colonial Conferences. Difficulties of financing such a service on a permanent basis have so far postponed the development of the experimental service from Chelmsford (G5SW), but the need in the Imperial sense and the strong desire expressed from all parts of the Empire, in particular from the Crown Colonies, have determined the Corporation to proceed without further delay.

The object will be to give as many listeners as possible in all parts of the Empire a programme from the home country at hours when it is most convenient for them to listen, but details of the times of operation will depend upon the results of experiment and upon the demand.

Technical arrangements include the use of several wavelengths which will be chosen so as to provide the best reception under the varying conditions which obtain in the Dominions and Colonies. The station will be at Daventry and construction will begin shortly.

6th November, 1931.

Empire Broadcasting—At Last!—

ing from local transmitters. Those who listened-in would not expect too much all at once, and would be well pleased if they could receive only portions of a programme with success at first, not, of course, as we receive them in the shadow of our stations, but, nevertheless, sufficiently well to give tremendous pleasure, especially to listeners in isolated districts.

"We are not sure that such a project would best be carried out as a part of the programme and organisation of the present broadcasting service. It would seem to us that it is a matter requiring the consideration and co-operation of the Colonial Office and the India Office, and we feel that steps should be taken without delay to arrive at some solution which would meet the present demands of the Colonies for a broadcasting service from the home country in which they could participate.

"It would take some time for satisfactory broadcasting to the Colonies to be organised and launched, and if we delay we shall find that, instead of broadcasting becoming a means of uniting the peoples of the Empire, it may become rather a menace to the Empire for the reason that the Colonies will be dependent upon the high-power broadcasting stations of their neighbours, and thereby become subject to the influence of a national spirit which is not their own."

The Wireless World is naturally proud of the part which it has played in furthering the development of Empire broadcasting which it launched with this article. Holland set an example to this country by being first with a short-wave broadcasting station capable of almost world-wide transmission on short waves. We congratulated Holland on the achievement in our issue of April 27th, 1927, and referred to British broadcasting as follows:—

"It is a matter for regret that we should so far have neglected to take advantage of the wonderful opportunity which broadcasting provides for communication with the outlying sections of the Empire. When we know that wireless sets are being bought in places as far distant as India and Iraq, in the hope of being able to pick up the transmissions from Daventry once in a while for, perhaps, no more than a few minutes, we can form some idea of the enthusiasm which would be created if a short-wave British station were established in this country of sufficient power to be heard more or less consistently."

The cartoon which we reproduce on this page was published in our issue of 8th June, 1927, to commemorate the achievement of Holland.

In our issue of May 4th, 1927, we published a letter from a correspondent in Western Australia, who asked: "When are the Englishmen going to broadcast on short waves?" and he reported good reception of American programmes. In comment we said:—

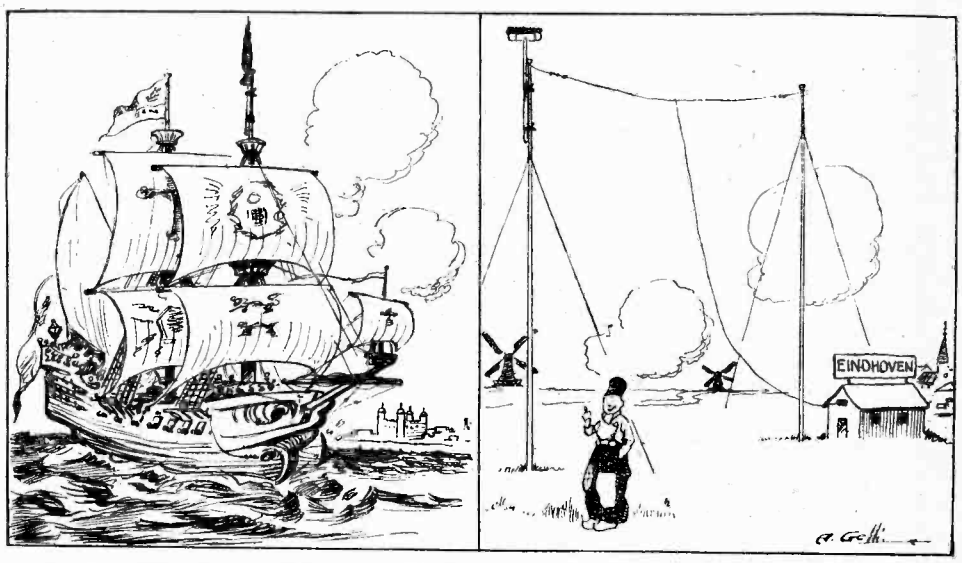
"This will no doubt express the opinions of almost every representative of the British Empire abroad, who must feel very strongly that we, in the Mother Country, are neglecting a wonderful opportunity which short-wave broadcasting offers for strengthening the bonds of Empire unity."

It was following upon our recommendation that the Marconi Company were invited to undertake the technical development of an Empire short-wave station, and 5SW, at the Marconi Works at Chelmsford, has been the result of that initiation. We stated then:—

"We sympathise with the attitude of the B.B.C. that it is not justified in incurring heavy expenditure on experimental work; but such experimental work, we believe, would readily be incurred by one of the big commercial companies if the station, when established in going order, and after having passed specified tests, could be handed over to the British Broadcasting Corporation at an agreed price."

Persistent Effort Rewarded.

From that time onwards we have watched the attitude of the various authorities towards Empire broadcasting with the closest interest, have made recommendations or criticised when we felt it necessary, and have applauded whenever a step, however small, has been taken to further the cause. Now that the decision has been taken and there is every reason to feel assured of the establishment, ultimately, of a short-wave Empire station which will be worthy of the Empire which it is to serve, we offer our heartiest congratulations to the B.B.C. We will forget the procrastinations of the past and will wait, with impatience, the early fulfilment of the promises contained in the B.B.C.'s recent pronouncement. No living person, we believe, can foretell the extent of influence for good which this step is to have on the future not only of the British Empire, but upon the world as a whole.



In 1652 Admiral Tromp, the courageous Dutch commander, defeated the British fleet under Admiral Blake at Dover, and, according to tradition, sailed up the Channel with a broom hoisted to his masthead to denote that he had "swept the seas." In 1927 the Dutch station of the Philips Company at Eindhoven "sweeps the ether" on short waves and again scores off Britain, but this time in the friendliest spirit of rivalry.

[From "The Wireless World" of June 8th, 1927.

Broadcast Brevities

By Our Special Correspondent.

The Empire Broadcasting Surprise.

Mr. Whitley, Chairman of the Governing Board, and Sir John Reith, Director-General, were jointly responsible for the rapid decision that the B.B.C. should take the bull by the horns and start an Empire broadcasting service. The decision was well timed, but I believe that it took Whitehall by surprise.

Paid for by "Pirates."

In a sense, the new station will be the wireless pirates' contribution to Empire unity. During the past few weeks the Post Office anti-pirate campaign has netted nearly £200,000, of which approximately £100,000 will reach the coffers of the B.B.C. The new transmitter will cost £40,000, and the first year's expenses will reach the same figure.

So the pirates have done their bit and a little more!

When No News Is Bad News.

A news service is to be regarded as an essential item in the Empire service. The story is told of a Colonial with a new set who listened to Chamber Music from 5SW for two hours in expectation of picking up the news bulletin. When the news period arrived and the transmitter was switched off, he said . . . . (That's enough. — EDITOR, *Wireless World*.)

Why Not a Governor for Empire Broadcasting?

The Press pundits are getting busy on the choice of new B.B.C. Governors to succeed the four who automatically retire on December 31st. The four Governors in question are Lord Gainford (vice-chairman), Mrs. Philip Snowden, Dr. Montague Rendall, and Sir Gordon Nairne, and it will surprise me if they are not all re-elected.

This is not to suggest that there will be no newcomers, for the constitution permits an unlimited number. There might be fifty, which—at £700 per annum each—Heaven forbid! But why not at least one new Governor to watch the interests of Empire broadcasting?

Sir Robert Donald.

For such a post I can imagine no one more fitted by experience and attainments than Sir Robert Donald, G.B.E., whose untiring work in the cause of Empire wireless unity places him in a class by himself.

Sir Robert took a leading part in the foundation of the Empire Press Union in 1910, and is as popular in the Dominions as he is over here. As Chairman of the Imperial Wireless Telegraphy Committee in 1924 and as a Press champion for the extension of world wireless he has won international esteem. His appointment as a B.B.C. Governor would be hailed with satisfaction

The Man with the Purse.

Savoy Hill is handling the economy campaign very adroitly. In spite of definite financial retrenchments in practically every direction, there is as yet no visible sign of any cutting down of expense.

The financial genius at Savoy Hill is that shrewd Scotsman, Mr. T. Lochhead, the accountant whose methods of guarding the Corporation's purse have saved the Governors from many sleepless nights.

Cheaper "O.B.s."

But the cuts are taking effect, noticeably in the "O.B." department. It will be observed more and more that the B.B.C. chooses nearby events for broadcasting in preference to those involving long land-lines and "big money."

A Cornish Exception?

For instance, Northern listeners may soon expect the end of the relays from Blackpool, which have been so popular during the last few months.

An exception may be the annual relay of the Christmas service from Marazion, Cornwall, which requires 300 miles of land-line. This quaint Yuletide feature will probably be relayed as usual.

Jack Payne and His Boys.

I am making an incursion into the realms of prophecy to say that Savoy Hill which now knows Jack Payne will continue to know him for a long time ahead. His contract comes up for reconstruction in March next, and, despite an astonishingly persistent rumour to the contrary, I will say that the contract—to adopt the parlance of the Sunday Press—will be duly "reconstructed" to the satisfaction of listeners in general, and Jack Payne and the B.B.C. in particular.

THE NEW P.M.G. Sir Kingsley Wood, who now has "the last word" in matters affecting broadcasting and wireless generally.

Wish Wynne.

When a broadcast artiste dies, one becomes aware of the peculiarly intimate type of popularity which only the broadcast microphone can give. The news of the sudden passing of Wish Wynne must have been received with a sense of almost personal loss by the many listeners who have felt that the inimitable Cockney comedienne had entered into their homes.

Wish Wynne, who has been called a queen of Cockayne, first broadcast in April, 1924, and between then and her last appearance at Savoy Hill on October 8th she had broadcast seventy-four times.

Power to Order.

The other day WHAM, Rochester, N.Y., had a telephone call from a young lady who explained that she was "upstairs—some distance from the radio," and would be glad if the station would "turn on more power" so that she could hear a favourite item.

Let Them All Come.

Women's interest in broadcasting from the inside has hitherto been confined mainly to an inspection of the studios, where the mystery box which houses the microphone is viewed with awe and some veneration. But recently a lecture on wireless apparatus was given by Mr. J. Cooper, the engineer in charge of the Birmingham studios, and as a result two hundred members of the Birmingham Branch of the Electrical Association for Women made application to be shown the engineering section of the studios.

This is the first experience that the B.B.C. engineers have had of feminine interest on such a scale in the technicalities of broadcasting, and they are hoping that the movement will spread.

A Programme from Brussels.

Another of the series of international relays takes place on December 17th, when a Brussels programme is to be heard through the London Regional station.

Stooping to Conquer?

Having noted with misgiving that Dr. Adrian Boult was to step into the background to manage the musical "effects" for "Resurgam" last Wednesday, I did hope that the young gentlemen in the Dramatic Department would rise to the occasion. But did they?

Making Milton "Effective."

It seemed to me that they jumbled up the two arts—music and poetry—into an indigestible conglomeration which did justice neither to Milton and Wordsworth nor to the "effects" of Dr. Boult. The poetry was well chosen, but why was it half sung? And why did the speakers' voices tremble? Was the studio cold?

READERS' PROBLEMS.

Readers' technical enquiries are not replied to through the post, but in these pages replies to questions of general interest are dealt with week by week.

Loud Speaker as Smoothing Choke.

IT is often asked whether the practice of using the loud speaker field winding as a smoothing choke is applicable when the instrument is mounted at a considerable distance from the receiver. The answer is, that to adopt this plan in such circumstances is extremely risky, as hum will probably be introduced, due to the necessary proximity of the speech current and field current wires.

The scheme is most successful when the loud speaker forms part of the receiver itself, or at any rate when it is mounted in close proximity to it.

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Hopelessly Unselective.

ONE or two readers living in remote localities, where severe interference is not normally experienced, have asked whether it would be permissible to simplify the latest "Wireless World" superheterodynes, such as the "Super-Selective Five" (battery model), by employing a simple single-tuned input circuit in place of a band-pass filter.

In our opinion this modification is quite inadmissible. The receiver is highly sensitive, and even at a great distance from any transmitting station it is quite certain that if the selectivity of the input circuit were reduced, serious second-channel interference would become evident, and the receiver would lose most of its attractiveness.

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The "Wireless World Two."

CORRESPONDENTS have asked whether it would be an easy matter to modify the "Wireless World Two" for operation on D.C. mains.

This receiver is essentially a highly economical set for battery feed, and although it lends itself as readily as any other to conversion for D.C. mains working, considerable alteration would be necessary.

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Eliminator or Built-in Power Equipment?

THOSE who propose to build the "Wireless World Three," and who already have an H.T. eliminator, seem to be uncertain as to whether to make up the model designed for batteries, or to modify the A.C. mains version so that it may be fed from their existing eliminators.

These problems are rather difficult to discuss in general terms, but it is sound advice to offer that if the eliminator be of the comparatively unambitious type, with an output of some 150 volts or less, at about 20 milliamperes, it is best to follow the circuit arrangement of the battery-driven set exactly as described; its anode circuits may be fed with complete satisfaction from any reasonably good eliminator.

Although anode current for the A.C. "Wireless World Three" can be obtained from a standard type of eliminator with a fairly generous output, a number of modifications would be required, and it would probably be necessary to forego the advantages of free field current for the loud speaker.

In particular, it should be emphasised that anything approaching a drastic alteration is bound to upset the distribution of voltages. Suitable changes in bias and feed resistance values should be made.

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Semi-electrified.

AS an output valve generally consumes more filament current than any of the others in a receiver, it is worth while, where possible, to reduce consumption of L.T. battery current by feeding the filament of this valve from the mains. Fortunately, it is quite permissible to do this, although it is well known that the valves in the earlier stages cannot normally be heated with unsmoothed D.C. or raw A.C. unless they are of special type.

Those readers with A.C. supplies who have asked for details of the alterations necessary to make this step towards the complete "electrification" of their receivers will be able to gather sufficient information from the accompanying diagram, Fig. 1, which also shows the

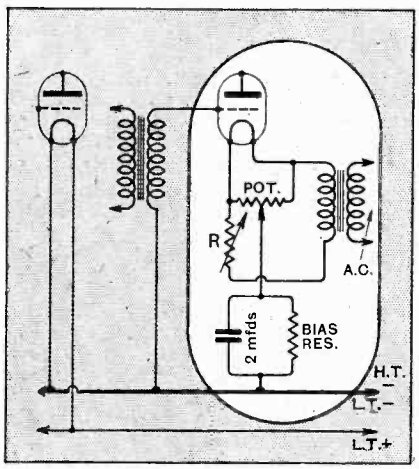

Fig. 1.—The output valve of a receiver with ordinary battery valves may safely be heated, through a step-down transformer, from A.C. mains.

connection of an optional "free" grid bias resistance. If it be preferred to retain battery bias, this resistance is omitted, and the potentiometer slider is joined directly to the common H.T.-L.T. negative bus-bar.

A rheostat R is shown as being connected in series with the filament; this will only be necessary if the transformer cannot be depended upon to deliver the exact voltage required by the valve. Inexpensive bell transformers can be used for this purpose, but properly designed instruments are so cheap nowadays that there is little need to put up with an improvisation.

The potentiometer through which an artificial centre point on the filament is located may have a resistance of some 40 or 50 ohms.

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Long-wave Parasitic Oscillations.

WHEN reports are received regarding relatively poor performance of a receiver on long waves as compared with its reception on the medium waveband, we always suspect the presence of parasitic oscillations at some frequency other than that to which the circuits are tuned. This effect is more common than is usually suspected, and is generally found in "H.F." sets with highly efficient modern valves, and with an up-to-date tuning system. The presence of these spurious oscillations is easily proved by inserting a meter in the detector anode circuit; if anode current falls on switching over to long waves, it may almost invariably be assumed that this form of self-oscillation is taking place, and that the operation of the detector valve in particular will be adversely affected.

It will hardly be necessary to add that when making this test, the receiver circuits should not be tuned to a strong transmission on either medium or long wavebands, as otherwise a misleading meter reading may be obtained, due to the normal depression of anode current by an incoming signal.

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Air *versus* Bakelite.

IT has been noticed that differential condensers with both air and bakelite dielectric have been specified in recent *Wireless World* receivers, and correspondents wish to know whether these different components can be regarded as interchangeable, provided their capacity is as recommended.

Bakelite dielectric condensers are quite satisfactory for use in reaction circuits, and in some cases even for tuning or volume control, but the use of an air-dielectric component is generally preferable for the latter purposes. In some designs, a noticeable falling-off in signal strength can be observed as a result of using a condenser with unnecessarily high losses.

The D.C. Mains Super-heterodyne.

SEVERAL contructors of the D.C. "Super-selective Five" have asked for information as to how a gramophone pick-up should be connected to this receiver.

To avoid all risk of accidental short-circuits, it is desirable, in dealing with any D.C. set, to isolate the pick-up completely from the mains. This can most conveniently be done by means of two large condensers (of 1 mfd. or over), as shown in Fig. 2.

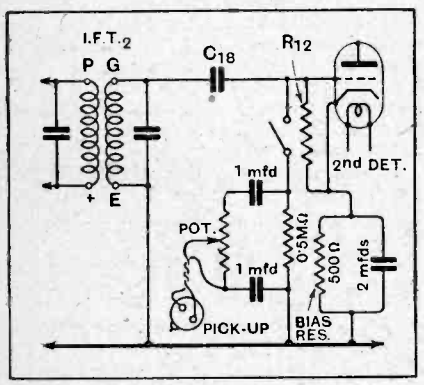

Fig. 2.—Adding a gramophone pick-up to the "Super-Selective Five" (D.C. model). Original components bear original reference lettering.

Other additions are a bias resistance and by-pass condenser in the cathode lead; negative grid voltage is applied through a resistance of about 0.5 megohm, which is shunted across the feed condensers.

It will be necessary to change over the grid-leak connections as shown, in order that the valve may work with a "zero" grid when performing its normal function of detection.

❖ ❖ ❖

Winding Filter Coils.

A READER who is making his own screened coils for use in a band-pass filter asks whether it is necessary that both the windings of each component coil should be in the same direction.

As a general rule it may be assumed that sense of winding is quite immaterial, but, of course, the medium- and long-wave section of each individual coil must be wound in the same direction. This applies to all types of filter circuits, except where coupling is partly effected by means of negative inductance.

❖ ❖ ❖

With an Eliminator.

IT is asked whether the "Band-Pass Pentode Three," described in *The Wireless World* of October 28th, may be operated with simple eliminators providing a maximum voltage of from 120 to 150 volts. As this set is basically of the simple H.F.-det.-L.F. type, it is not greatly affected by extraneous sources of inter-circuit coupling, and there is no reason why its anode current should not be derived from the type of instrument in question, especially if provision is already made—or can be improvised—for fairly accurate control of screening grid voltage.

When an eliminator is used, there is seldom any need to exercise any great economy in anode current, and it will simplify matters if the H.F. anode, pentode anode, and pentode screen are all supplied from the "maximum" output terminal.

❖ ❖ ❖

Unsuitable for a Frame Aerial.

IT is asked whether any of the three-valve sets recently described in this journal could easily be modified for use with a frame aerial. The answer is that they could, but it is generally agreed that for anything but short- or medium-range work at least two H.F. stages are necessary when this type of collector is employed. In any case, all the latest sets have a band-pass input filter, and it is a matter of undoubted difficulty to modify this type of circuit so that it may work satisfactorily with a frame.

Put another way, the input circuits would have to be redesigned, and this alteration might well involve sweeping alterations in the design of the H.F. couplings; the modified set would have little in common with its prototype.

❖ ❖ ❖

Rising Anode Current.

IT has sometimes been noticed that, as a result of inserting an H.F. stopping resistance in series with the grid of an output valve, the anode current of this valve tends to rise. Readers who have observed this effect may always conclude that it is an indication that the output valve is "soft." A rise of a few per cent. does not indicate any very serious degree of softness, but if the increase is considerable it is certainly desirable, in the interest of good reproduction, that the valve should be changed.

Of course, the effect is due to the flow of reversed grid current, which, by developing a bias voltage, across the added resistance, which is in opposition to that derived from the ordinary source, reduces the normal negative working potential of the grid.

❖ ❖ ❖

A Risky Procedure.

FOR the reason that they wish to obtain rather more L.F. amplification than is given by a conventional L.F. stage, readers have asked whether it is permissible to use a high ratio (1 : 7) L.F. transformer as a coupling between the detector and an output pentode.

A high step-up ratio transformer can be used—and, indeed, has often been used—in conjunction with a pentode, but it should be made quite clear that there is a very real risk of introducing L.F. instability by doing so.

It is usually found that this plan is only made possible by the fact that H.T. voltage is so high that unusually generous decoupling may be included in the detector anode circuit.

Condensers: Inductive and Non-inductive.

AS a result of reading a recent note in this section of *The Wireless World*, regarding the possible danger of using inductive condensers in a band-pass filter circuit, readers have asked whether it is possible that motor-boating might be due to the use of inductive by-pass condensers.

Briefly, the position is that inductance in a condenser is highly undesirable in a filter circuit, and is distinctly dangerous in an H.F. circuit. But with regard to the L.F. amplifier, its existence is unlikely to have any very serious result.

❖ ❖ ❖

Incomplete Grid Circuit.

IT would appear that quite a number of readers who have added band-pass tuning to an existing receiver have failed to appreciate the fact that, by interposing the coupling condenser that is a part of the most popular type of filter, they have interrupted the continuity of the grid circuit. As a result of doing this, it is usually found that the primary filter circuit behaves normally, but the tuning of the secondary circuit is flat and indefinite, and altogether the whole filter is anything but satisfactory.

In such cases care should be taken to see that there is a conductive metallic path from grid to cathode of the H.F. valve, in order that grid bias may be applied. It should be pointed out that, if necessary to realise this condition, no harm will be done if a non-inductive resistance of a few thousand ohms is shunted across the coupling condenser.

FOREIGN BROADCAST GUIDE.

LODZ

(Poland).

Geographical position: 51° 45′ N., 19° 26′ E.

Approximate air line from London: 848 miles.

Wavelength: 233.8 m. Frequency: 1,283 kc. Power: 2.2 kW.

Time: Central European (one hour in advance of G.M.T.).

Standard Daily Transmissions.

G.M.T. 09.15 (Sun.), sacred service from Poznan Cathedral; 11.15, concert (Sun.), then throughout day until 16.45, afternoon concert; 18.25, gramophone records; 19.15, main evening entertainment; 21.30, weather, news, etc.; 22.00, dance music (daily, exc. Sun. and Mon.).

Relays Warsaw, Poznan and Cracow.

Man and woman announcers.

Call: (Phon.): *Har-low! Har-low! Raadjo Pols-kej Woodsh.*

Interval signal: Metronome; when relaying Warsaw W in Morse (. – –). Announcements are also frequently made in the French language.

Closes down with Polish National Anthem (Dombrowski Mazurka).

The Wireless World AND RADIO REVIEW

(19th Year of Publication)

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THE LIST OF PARTS.

READERS are familiar with the fact that when we publish a constructional article we give a list of parts detailing the components which can be used. Many new readers who have, no doubt, graduated to *The Wireless World* in recent weeks from more elementary journals have written to ask why it is that *The Wireless World* does not publish with every constructional set an extensive list of alternative components of every item, and in view of these enquiries we have been giving the subject our special attention.

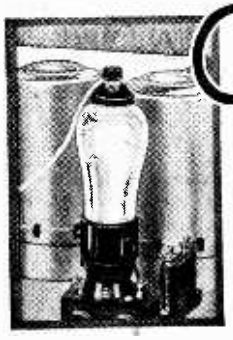
Our first aim must always be to give the reader a good set, and, therefore, good components must be chosen. The possibility of a wide choice may exist in some instances, where the performance is the same and the only factor which the constructor has to take into account is whether or not the alternative component will fit into the space available in the set design.

We have examined the lists of parts published elsewhere to which our readers have drawn our attention, and we are frankly puzzled over the position which these lists reveal. The photographs of the sets and the detailed drawings published obviously cannot show alternatives, and all the dimensions given in the plans are for the accommodation of the particular components which the designer has used. Now, if alternatives are permissible in a number of instances, one would expect to find some such comment as that an alternative of any good make can be used, but, instead of this, we find a string of manufacturers' names included on the list of parts—yet it is by no means an exhaustive list.

If alternatives are to be named, why omit from the list any manufacturer who produces a component of equal quality and equally as suitable for the purpose as other components which are listed? Again, we have checked up alternative components listed in certain of these sets, and have found that if the constructor happened to pick on certain particular selections of the alternatives given, the components would overflow beyond the baseboard provided for the set!

Again, sets which *The Wireless World* has described employing an all-metal chassis have proved extraordinarily popular, and this is, we believe, quite largely due to the attractive appearance of the finished product and the fact that we have, by giving the details of the metal chassis to manufacturers in advance, made it possible for readers to obtain this chassis ready drilled and cut out where necessary to accommodate components, thus making the assembly extremely straightforward. Since our designs have appeared the idea has been introduced elsewhere, but still adhering to the policy of listing many alternatives, and the explanation given as to how these alternatives are to be fitted is what we regard as a very crude one, namely, that the reader shall make fresh holes in the metal chassis, to accommodate alternatives, with a "bradawl and a file." *The Wireless World* has hitherto left it to the reader to make an alternative selection of components where he cared to do so, and in our designs we have made it clear what particular key components we did not recommend should be replaced.

An article discussing the question of the choice of alternatives is included in this issue, and in the future it will be our endeavour to meet the wishes of readers by indicating a little more latitude in certain instances, but the suggestions for alternatives will be given only after actual test of the products in the set, the designer taking into consideration the question both of electrical suitability and physical dimensions. The purpose of these remarks is to indicate that this must be done very carefully if we are to avoid leading the reader into troubles, for all the time our aim should be to save him from them.



Controlling Volume with the Variable-mu Valve

Keeping Screen Volts Constant Under Varying Conditions.

By N. R. BLIGH, B.Sc., and E. D. WHITEHEAD, B.Sc.
(The Research Laboratories of the General Electric Company, Wembley, England.)

CONSIDERABLE attention has lately been paid to the variable-mu valve, and a number of articles[1] concerning its merits have appeared in this journal. It has been shown that a new type of volume control by variation of bias becomes possible and that considerable simplification of equipment is the result. As a bias variation from 2 to 40 volts is possible, the voltage distribution between the electrodes of the valve has to be carefully considered when designing a receiver. It is essential, in order to maintain the "tailing" characteristic of the variable-mu valve, that the screen volts be kept constant throughout, and it is intended in these notes to give the actual resistance values for the necessary potentiometer, together with a simple formula for approximate calculation.

Balanced Feed.

Fig. 1 shows the circuit as previously given for the control potentiometer. The principle is that when the resistance, and therefore the potential, between the points E and X is increased, the effective H.T. on the valve drops by this potential EX. At the same time, the effective screen voltage tends to decrease. However, the screen current decreases (due to the increase in grid bias), and therefore the potential drop from S to A decreases, thus tending to counteract the previous effect. If the decrease in drop from S to A can be made equal to the increase in drop from X to E, then the screen voltage, S to X, remains unchanged.

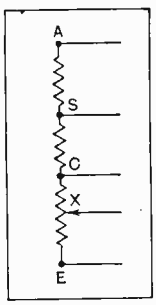


Fig. 1.—The screen and bias-feed potentiometer for the variable-mu valve. AS and SC are fixed resistances, whilst CE is a potentiometer having a slider X.

In this particular case the screen voltage is arranged to be the same at −30 volts bias as at a small initial bias of about −1.5 volts. Values of the various resistances to achieve this end are given in Table I for one and two VMS.4 valves. The resistances AS and SC are fixed, whilst the resistance CE is a potentiometer, of the total resistance stated, arranged so that the cathode may be moved from E to C by means of the slider X.

TABLE I.

Resistance.	A S.	S C.	C E.
One VMS.4 valve.	21,000	16,500	8,000
Two VMS.4 valves.	10,500	7,500	4,000

[1] See *The Wireless World* of September 9th and 16th, and November 11th and 18th, 1931.

These values of resistance give a maximum bias of about −40 volts. The greatest bias for use in any particular case depends chiefly upon the maximum input voltage with which it is desired to deal. The value of −40 is considered to be ample for all but the most exceptional cases, as the first valve will then handle an input of about 8 volts R.M.S. of radio frequency to its grid without undue distortion.

Should it be desired to use a different maximum bias under these conditions, the resistance CE should be altered as required, and the resistance SC also altered so that the total resistance SE remains unchanged. The above figures assume 200 volts from E to A, and 80 volts screen voltage at minimum bias and −30-volt bias.

In order to ensure the maintenance of the minimum bias, automatic or self-biasing resistances must be inserted separately between the cathode of each valve and the slider X. These resistances can be made 200 ohms each and give 1.6 volts bias on the particular valves used, with the slider X at E. They are also useful as decoupling resistances for decoupling the cathodes by means of condensers from each cathode to earth. In order to decouple the screens, further resistances of about 600 ohms may be inserted between the screens and the point S. The effect of these on the voltage distribution is negligible, dropping the screen voltage at minimum bias by about 2 volts. A constructional receiver designed with this feed scheme was described in last week's issue.

Control and Voltage Variation.

Using two variable-mu valves, the actual screen voltage was measured for various values of grid bias as X is moved from E to C, and this is shown in Fig. 2. It will be seen that the screen voltage varies only ±10 volts from minimum bias to −40 volts bias.

As the input handling capacity of the valves is increased with increasing screen voltage and vice versa, it would be better if the screen voltage could rise slightly with increasing grid bias. In this way the valves would be enabled to handle the larger inputs used with the reduced gain. It is, however, difficult to bring this about simply and with economy in H.T. current, and the values have therefore been arranged so that the handling capacity of the valve is not decreased over the

Controlling Volume with the Variable-mu Valve.—

most useful range of grid bias; in fact, there is a useful increase of screen volts at −10 volts bias.

The mutual conductance of the VMS.4 valve was measured at various values of grid bias under working conditions. This curve of mutual conductance against grid bias is shown in Fig. 3 compared with a similar curve on the same valve, taken with constant screen and anode voltages of 80 volts and 200 volts respectively. When two valves are used they each behave in the manner indicated above for one valve.

It will be seen that the actual variation of the screen and anode voltages makes little difference to the shape of the control curve—if anything, it improves its linearity of volume control with bias. The total loss with two VMS.4 valves arranged in this way (−40 volts bias) would be something like 90 decibels, or about 30,000 to 1. This great range of control should be ample for all purposes, including the case of reception of a powerful station close by.

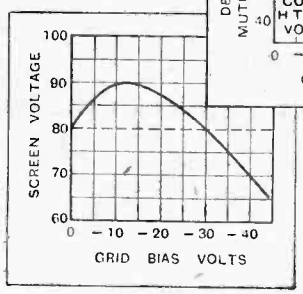


Fig. 2.—Screen voltage variation with change in bias.

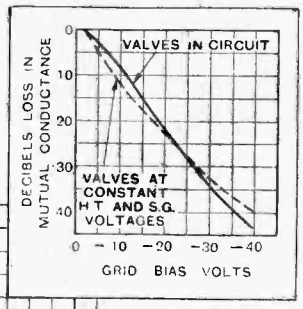


Fig. 3.—The relation between mutual conductance and grid bias. One curve shows the values when the valve is used in circuit; the other is taken with constant screen and anode voltages.

A Simple Calculation of Resistances.

In many cases the values of the resistances can be easily calculated, the only measurement required being that of the screen current, I_s, at the minimum bias that will be used. For the valves used for these tests, this current proved to be 2.7 milliamperes at −1.5 volts. If we now have a supply voltage of E volts and wish to arrange the screen voltage to be V_s volts at −1.5 volts and at a large bias V_g, then the resistance AS is given by—

$$AS = 1/(n \times I_s) \times E \times V_g/(V_s + V_g),$$

where n is the number of valves to be controlled, and the total resistance AE is given by—

$$AE = AS \times E/(E - V_s - V_g).$$

The portion of the resistance ES which is included between E and C depends upon the total bias range required. Generally this will be greater than the bias V_g, so that we actually work slightly into the region where the screen voltage is falling. If this voltage is V_c, the resistance EC is given by $EC = AE \times V_c/E$. For example, if we wish to maintain the screen voltage on two valves at 80 volts for a bias of −1.5 and −30 volts with a supply voltage of 200 volts,

$$AS = \frac{1 \times 200 \times 30}{2 \times 2.7 \times 110} = 10{,}100.$$

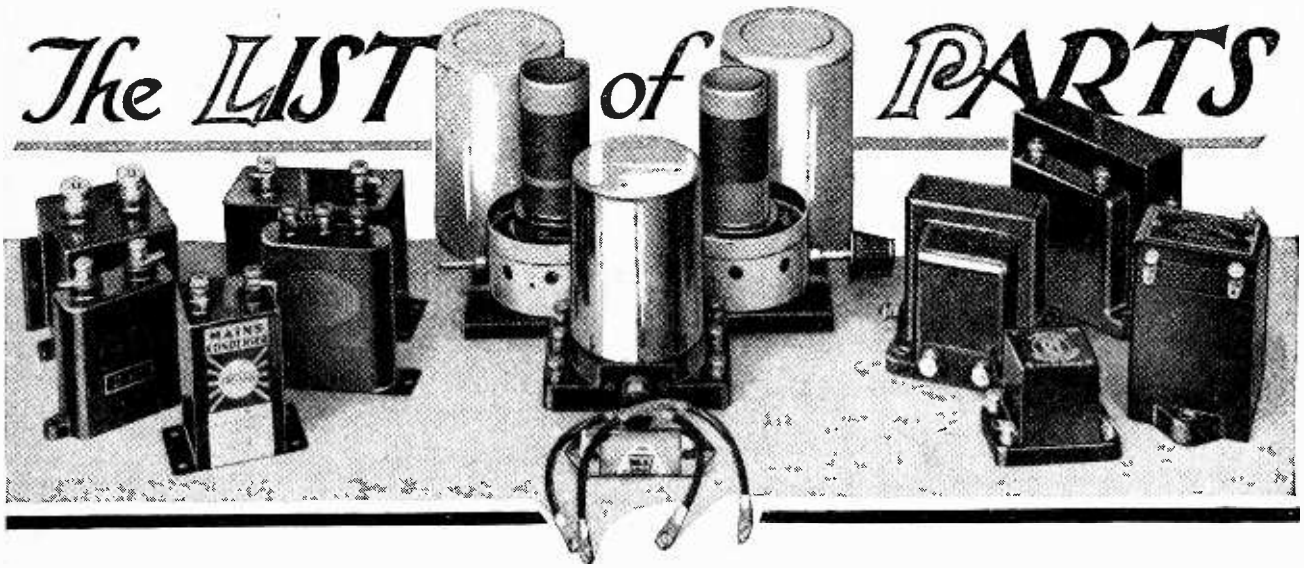
The total resistance $AE = 10{,}100 \times 200/90 = 22{,}400$ ohms, and hence, if we wish to give a control bias of 40 volts maximum, $EC = 22{,}400 \times 40/200 = 4{,}500$ ohms.

In practice there is a small correction due to the combined anode and screen currents flowing through the resistance EC. With these valves this proved to be about 0.55 milliampere per valve, and hence the voltage drop across AE is increased by about $2 \times 0.55 \times 4{,}500$, or 4 volts, giving an actual grid bias of 44 volts.

We see that this analysis gives figures which agree closely with the experimental ones and are near enough for all practical purposes, and we also see that the resistance values are inversely proportional to the number of valves used, e.g., for one valve the resistances would have exactly twice the resistances given above.

Although with the foregoing arrangement the volume control is very linear with grid-bias voltage, this voltage would not be quite linear with rotation of a straight potentiometer due to the change in screen current through it. For this reason a graded potentiometer might be used, giving a larger change of resistance per degree of rotation at large bias values than at small.

The LIST of PARTS



Where Alternative Components May Safely be Substituted.

IN every constructional article published in *The Wireless World* there appears a "List of Parts," in which are enumerated the types and makes of components used by the designer of the receiver in building his original model. A widely accepted belief, amounting almost to a tradition, has grown up, to the effect that it would be courting failure to use, say, a grid condenser of different manufacture to that specified; this in spite of the fact that authoritative statements to the contrary have often been made in the most unequivocal terms.

With the obvious limitations of physical size, there are, in reality, comparatively few components in any receiver that have not their counterparts among the products of other manufacturers; it should hardly be necessary to say this, but the fact should be put on record for the benefit of new readers and those who have not given much thought to the matter. Obvious exceptions to this rule exist in the design of highly specialised receivers, but in such cases the designer, in the descriptive article, will naturally take pains to emphasise the need for special apparatus whenever he makes a radical departure from conventional practice.

IT is hardly ever essential to success that a published specification should be followed slavishly with regard to every component; this article, written mainly for the benefit of new readers, shows where substitutions can be made when desired.

In *The Wireless World* designs it can be assumed that the designer has had a free hand to choose components which by experience he has found to be satisfactory. The matter of cost, however, is sure to be considered, consciously or subconsciously, by every designer, so it may happen that components used are not always the very best, although satisfactory. If, for instance, he sets out to produce an inexpensive and simple set, he will probably use a cheap variable condenser with drive mechanism to match; such a component, though it may be efficient enough electrically, will lack the silky smoothness in operation of the most expensive kind of condenser, and will certainly not be such a joy to manipulate. Although it *is* possible to go wrong in an attempt to better the designer's selection, there is comparatively little risk of doing so; it is when we try to cheapen the original model that troubles usually begin. The well-informed amateur is sometimes able to exercise sufficient discrimination to employ unbranded parts made by unknown manufacturers successfully, but the beginner should certainly not try to do so.

If, in his search after economy, he is unfortunate enough to obtain even one defective component, he may find it impossible to trace the real cause of his failure to get the results anticipated, whereas the more knowledgeable constructor would know at once what to suspect. Indeed, it is a wise plan for everyone to confine their custom to those manufacturers who have built up a reputation in their own particular field, and who have enough confidence in their own products to let the world know all about them. Apart altogether from the question of the quality, such firms consider their reputation to be a most valuable business asset; they will go to almost any lengths to safeguard it, and if a defective part should escape the vigilance of the test-room staff, the ultimate purchaser may rest assured that the matter will promptly be put right.

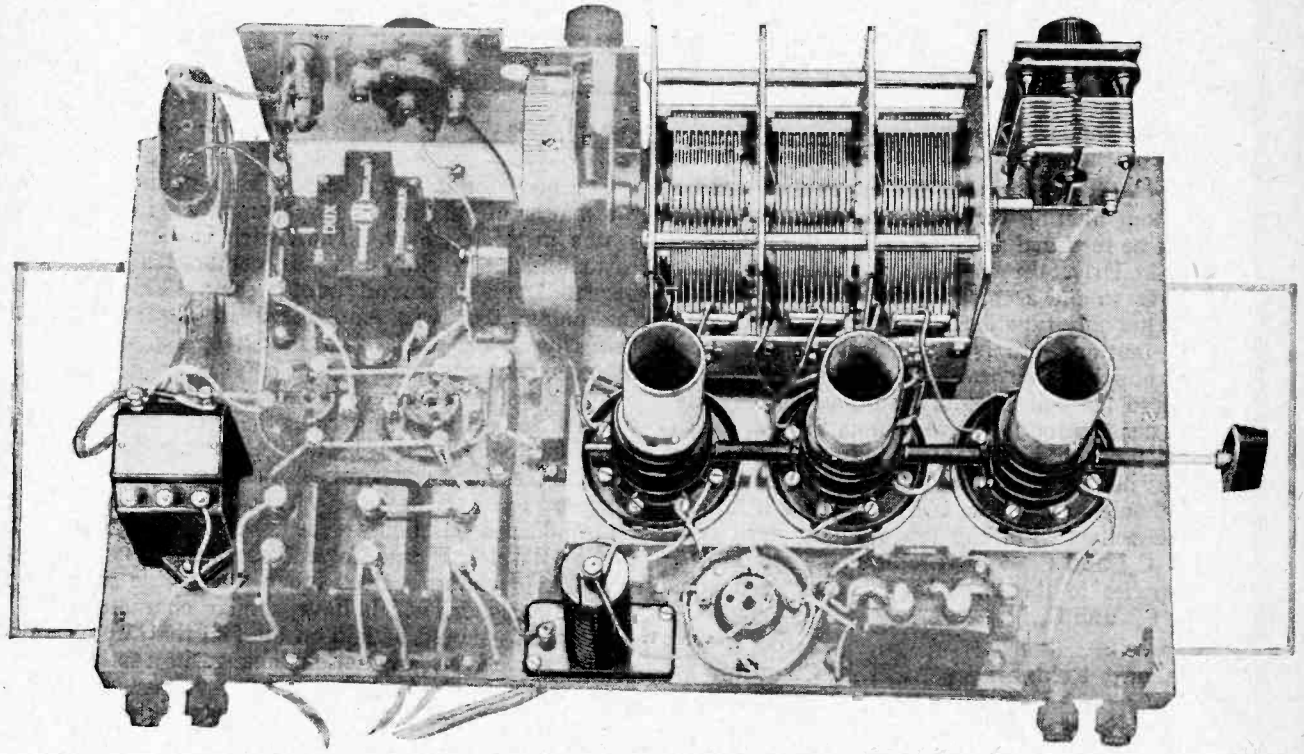
Before attempting to discuss the instances where injudicious substitutions might be risky, it would be well to enumerate those parts that, always provided they are of good manufacture, can be regarded as interchangeable. First come fixed condensers, both of the mica dielectric and paper types. These are produced by many manufacturers, and almost all are surprisingly good, especially considering the low price for which they are sold nowadays. Of course, care must be taken to

The List of Parts.—

see that the condenser is designed to stand up to the working voltages that exist in the receiver. Practically the only need to exercise especial care is in the choice of by-pass condensers in certain H.F. circuits, and particularly in conjunction with band-pass filters; non-inductive, low-resistance condensers may be either essential or merely desirable for these purposes.

Requirements for Single-knob Tuning.

Variable condensers can generally be depended upon to have substantially their rated capacity, to be soundly designed mechanically, and to have no greater dielectric losses than can comfortably be tolerated, and which in any case are negligible in comparison with other losses in the circuit. But multiple-ganged condensers are another matter; one could almost count on the fingers of one hand those manufacturers who turn out a really first-rate article, in which each unit can be relied upon to have the same capacity at any given angular setting of the vanes. One could go so far as to say that, unless ganged condensers that are definitely guaranteed as to matching are employed, it is infinitely better to legislate for separate tuning of each circuit in the receiver. The adaptability of the component chosen for the particular type of drive that is called for in the design must also be borne in mind.



A three-valve battery-operated receiver—the "Band-Pass Pentode Three." Components shown "in relief" were chosen with regard to special technical considerations; elsewhere there are many opportunities for exercising an option.

Coils are vitally important in an "H.F." set, but in a receiver having a detector unassisted except by reaction there is little point in striving after the last degree of efficiency, and so one's choice can be governed almost as much by convenience as anything else. Clearly, it would hardly be wise to purchase coils that are not sold as matched with regard to their inductance values if tuning controls are to be ganged; in this respect the coils are as important as the variable condensers, with the exception that errors in matching can be remedied by a skilful amateur.

There is always a fair amount of latitude in the windings of a "straight" aerial-grid coupling, or even in an intervalve coupling coil with reaction, but it is fatally easy to go wrong with regard to coils for a "mixed" band-pass filter, and here the greatest discrimination must be used before making a change.

Although a few manufacturers now produce composition resistances that are capable of carrying quite considerable currents, it is perhaps safest to use wire-wound elements if they are specified, and moreover, the current-carrying capacity of those chosen should be watched carefully. With these reservations—and, of course, that of space available—any of the products of responsible makers will prove satisfactory. Sometimes it should be noted that entirely non-inductive resistances are necessary; as, for instance, in decoupling the grid circuit of a valve associated with a band-pass filter; this condition is seldom satisfied by a wire-wound resistance, and one of the "grid-leak" type is likely to be a safer choice. Most grid leaks are satisfactory enough for a time, but only those of good manufacture can be relied upon to retain their rated values indefinitely.

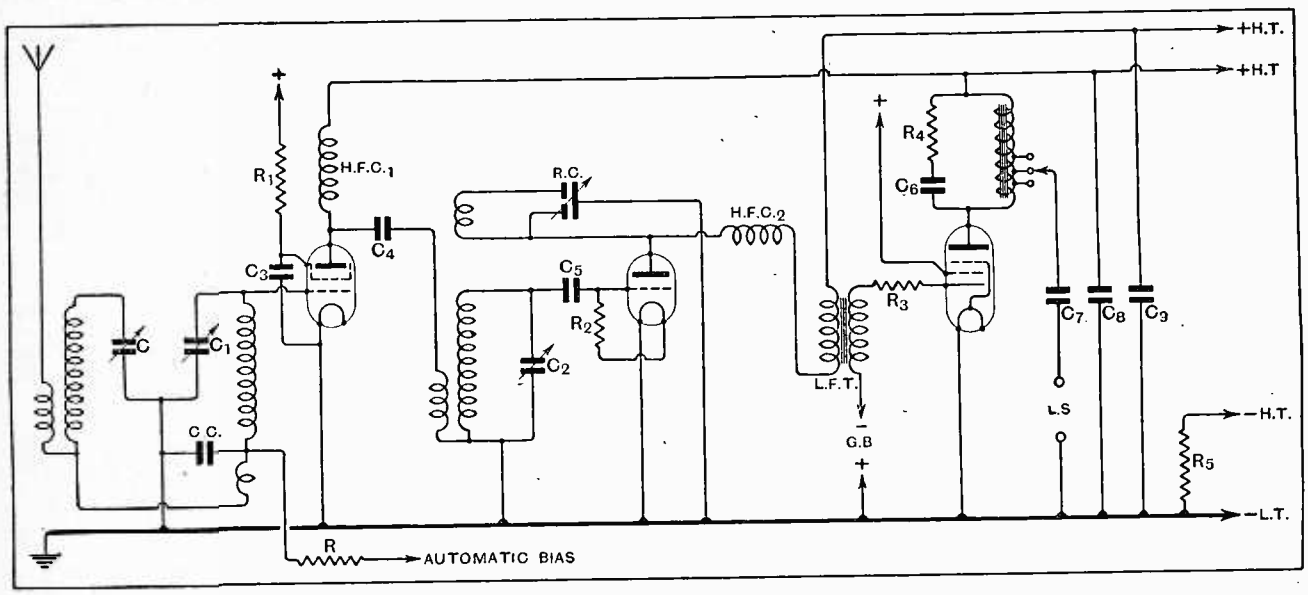
There are now a number of L.F. transformers that can fairly be classed as good, if not super-excellent, and a number of even the cheapest sort are practically as good

The List of Parts.—

as need be if they are used in the popular resistance parallel-feed circuit, where no current is passed through the primary windings.

Specific recommendations as to where substitutions may and may not be made can best be illustrated by taking as an example a receiver recently described in this journal. The "Band-Pass Pentode Three" (October 28th) will serve this purpose well, as, except for its output stage, it is of fairly conventional design.

On analysing the circuit, it will be found that the decoupling resistance R, is effectively in parallel with the coupling condenser, CC, and so this resistance must be non-inductive; in practice, a "composition" component is preferable to one of the wire-wound type. The same sort of resistance is practically essential for R_3, the "H.F. stopper," as high self-capacity would render this component ineffective. Reliability and reasonable accuracy in value are the main considerations in the choice of the resistances, R_1, R_2, R_4, and R_5.



Simplified circuit diagram of the "Band-Pass Pentode Three"; reasons for the choice of components are given, and it is shown that alternative selections are generally permissible.

The particular coils used in this receiver cannot well be changed without altering the circuit arrangement, and so these must be regarded as being among the key components. Similarly, the multiple variable condenser (C, C_1, and C_2 in the accompanying circuit diagram), although not the only type that could be used, is among the very few that are entirely satisfactory for their purpose. It so happens that the filter coupling condenser CC is built into the coil assembly, so does not directly concern the constructor; if it were not, this is a case where a condenser that is guaranteed to be non-inductive should be insisted upon. Also the H.F. by-pass condenser, C_3, should have a low H.F. resistance if it is to be entirely effective. For the low-capacity mica condensers, C_4, C_5, and C_6, any reliable make would do; the same applies to the large by-pass and feed condensers, C_7, C_8, and C_9.

Chokes and Resistances in H.F. Circuits.

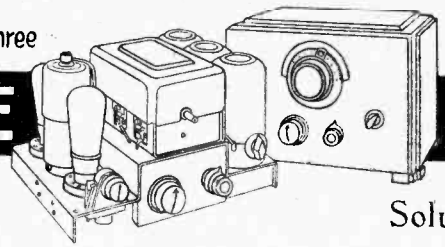
With regard to the H.F. chokes, the most ambitious type—which practically means the most expensive, as we generally get what we pay for—is to be recommended as H.F.C_1; any lack of efficiency here will be reflected in impaired performance of the H.F. stage. The requirements of H.F.C_2 are less critical, as it is merely required to act as a deflector of H.F. energy in the detector anode circuit.

The need for taking a reasonable amount of care in the matter of substitutions is exemplified in the on-off switch in this receiver. The switch is mounted on an earthed metal bracket, and if its contact blade were not insulated, a short-circuit would result. This is one of the points that was emphasised in the article, and similarly it was made clear that a specialised type of output choke was needed.

The question of valves is rather beyond the scope of this article, but is so important that brief reference to it must be made. In a battery set there is, generally speaking, a much wider range of choice than in a mains-operated receiver, or, at any rate, the result of making an injudicious selection will be less serious. With the help of *The Wireless World* Valve Data Sheet, it is generally possible to choose valves other than those mentioned by the designer, which have similar characteristics.

Emphasis should be laid on the fact that, in a mains-operated receiver, any serious change in anode-current consumption will affect the working voltages of all the valves, and in all probability will also upset grid-bias voltages as well, if they are obtained automatically in the usual way. It is therefore necessary to see that the valves used have not only the same general characteristics, but also that they operate with substantially the same working voltages, and also consume about the same current. If any important change be made, the constructor may have to redesign the feed circuits.

Wireless World Three



SOME READERS' QUERIES

Solutions to a Few Practical Difficulties.

Alternative Valves.

ENQUIRIES have been received suggesting the use of valves other than those specified, and which are to hand, as well as drawing attention to certain new types which readers consider might improve performance. In the battery set the Mazda equivalent of the Osram or Marconi valves shown are the S.G.215, the H.L.2, and the P.220A. In the mains receiver no change can be made from the types of valves given. In the first place, the progressive arrangement of the stages which provides for fully loading the output valve and giving maximum power output becomes completely lost by the use of alternatives. More important, however, is the fact that the feed circuits and voltage-adjusting resistances suit only the valves mentioned, and if any change is made not only will anode and screen voltages be incorrect but the biasing potentials will be unsuitable. In order to determine typical faults, specimen sets built by readers have been examined, and the outstanding difficulty has been the use of unsuitable valves.

Failure of Reaction.

Failure to obtain reaction effects has occurred in a number of instances. This was primarily due to the omission of the insulating bush used in the mounting of the reaction condenser. It has now been appreciated that the reaction condenser can be rotated through half a turn, so that when the wires are brought to the respective outside terminals in the manner shown in the practical wiring diagram increased reaction effect will result when the control knob is rotated in an anti-clockwise direction. This difficulty is overcome either by swinging the condenser about or reversing the connections to the pair of outside terminals.

Readers interested in the construction of a three-valve battery- or mains-operated set will find complete design details in the following recent issues—

Battery Model September 16th.

Notes on the Battery Model October 23rd.

A.C. Model September 30th.

Queries of General Interest October 28th.

Connections Omitted.

Attention has been drawn to what appears to be the omission of an earth connection on two of the terminals of the coil L_3 in the battery-operated model. This coil is shown on the top right-hand side of the practical wiring diagram on page 276, and it will be appreciated by reference to the theoretical circuit diagram on page 273 that terminals 2 and 3 must be earth connected. This lead was omitted, however, as it was the original intention for the coil to be provided with an internal earth connection from these two terminals.

"High-pitched Whistle."

Oscillation in the form of a high-pitched whistle has been met with in the battery model, while an erratic change of output when the volume control is operated has been reported in respect of the A.C.-operated set. This trouble is entirely due to a damaged volume-control potentiometer. In use this potentiometer is entirely robust, but owing to the position in which it is fitted the possibility of damage to the winding is not unlikely during construction of the set. A break in the winding cannot always be seen, and one must test with battery and milliammeter. There is a danger also of the feed resistances in the A.C. model having been damaged during assembly. In certain instances a faulty resistance may not cause complete failure, and in the event of a set behaving badly tests should be applied across all resistances.

Loud Speaker Extensions.

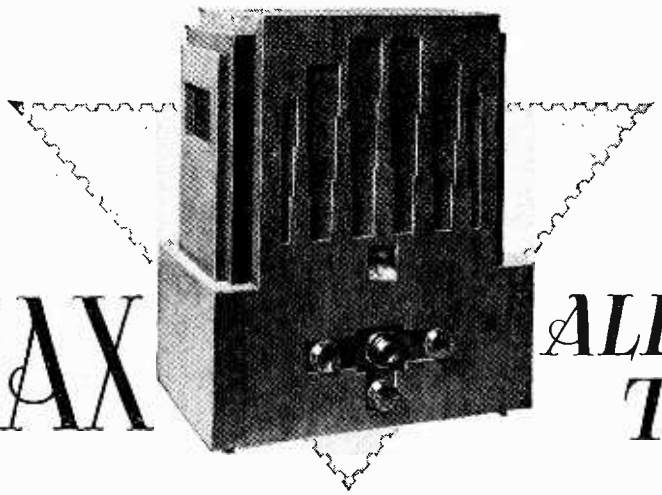
The introduction of permanent-magnet moving-coil loud speakers into the circuit arrangement of the A.C. model has been proposed by several readers, their aim being to dispense with the particular cabinet design and to use the set with a loud speaker operated on an extension line. While the obvious way of effecting the change is that of introducing a smoothing choke in place of the loud speaker field winding, and adding a series resistance in order to bring the value up to 2,500 ohms, an alternative process is the substitution of the field coil by a normal low-resistance choke, at the same time using a mains transformer having a secondary output of 250 + 250 volts.

Field Connections.

In the case of the Amplion loud speaker the field connections are, perhaps, not obvious. Reference should be made to the view of the loud speaker on page 378. It will be noticed that the terminal board associated with the field winding has been entirely removed and the leads taken directly on to the tags of the coil.

Used with an Eliminator.

In many instances the battery model is being used in conjunction with an A.C. or D.C. battery eliminator. Trouble has been met with by way of inadequate range and inability to make the receiver oscillate. While the set was designed essentially for use with H.T. batteries, there is no report of L.F. oscillation being experienced when current is drawn from an eliminator. Poor sensitiveness when used with an eliminator is entirely a matter of obtaining the correct potentials, and, in particular, one is reminded that the behaviour of a screen-grid valve is impaired when the screen voltage is inadequate.



CLIMAX ALL MAINS THREE

A Reasonably Priced A.C. Mains Set with Built-in Moving-coil Loud Speaker.

NO matter how excellent a receiver may be from the point of view of range and selectivity, it has little chance of attracting the attention it deserves unless it can also show the less technical but more obvious virtues of a dignified and pleasing appearance, reasonable price, and, most important of all, good quality of reproduction from the local station. Most people appreciate the ability to explore the ether, from time to time, for interesting foreign programmes, but the fact remains that, for the greater part of its working life, a set is tuned to the B.B.C. transmissions.

In the Climax Model 33A, the built-in Rola moving-coil loud speaker, working in conjunction with a power pentode output valve, is an adequate guaranteee of natural and well-balanced quality with ample reserve of volume. The cabinet is designed on the modern lines of simplicity and good proportion, with the minimum of ornamentation, and the general appearance may be judged from the illustration in the title of this article. The photograph, however, does not convey an adequate idea of the highly polished finish of the walnut, nor of the unusual compactness of the set as a whole. This must surely be one of the smallest self-contained three-valve mains sets so far produced, for it measures only 16in. in height, 12¾in. in width, and 9in. in depth, and is unusually light in weight in spite of the fact that an energised moving coil is included. Incidentally, the recesses provided in the panelled sides of the cabinet enable the set to be carried from room to room with the greatest ease, a facility of which full use can be made, since good reception from the local station is possible with the mains aerial provided.

Many will consider that the very reasonable price of fifteen guineas is fully justified by the merits already mentioned, but to these must be added the possibility of receiving—even under the most adverse conditions as regards proximity to the local station—a minimum of ten or fifteen foreign stations at good loud speaker strength. The circuit includes a high-frequency stage using one of the latest metallised screen-grid valves, and the sensitivity, and to a certain extent the selectivity, can be varied by means of a separate control to give just the right performance for any given set of conditions. Thus, when working the set at a distance of five miles from Brookmans Park it was possible to reduce the band occupied by each of the local transmitters to ten or fifteen metres, though the corresponding reduction of range did not favour the reception of foreign stations in the intervening clear space. As the tuning control was advanced above 356 metres, however, the range could be progressively increased until, above about 450 metres, unrestricted use could be made of the full range of the set. In these circumstances eleven medium-wave foreign stations were received in the space of a few minutes. Subsequently a test was made in North London, at a distance of twelve miles from Brookmans Park, and it was there found possible to tune in Hilversum (298 metres) clear of either station. Incidentally, this station was well received in the mornings during the period of the test.

The long-wave performance is quite equal to that on short waves in the matter of range, and seven stations other than Daventry were tuned in without any difficulty. If anything, the control of selectivity is slightly better than on short waves, and, with the switch at minimum, Königswusterhausen could be tuned in clear of Daventry and Radio Paris, though these stations began to encroach as the volume was increased. At maximum volume, however,

SPECIFICATION.

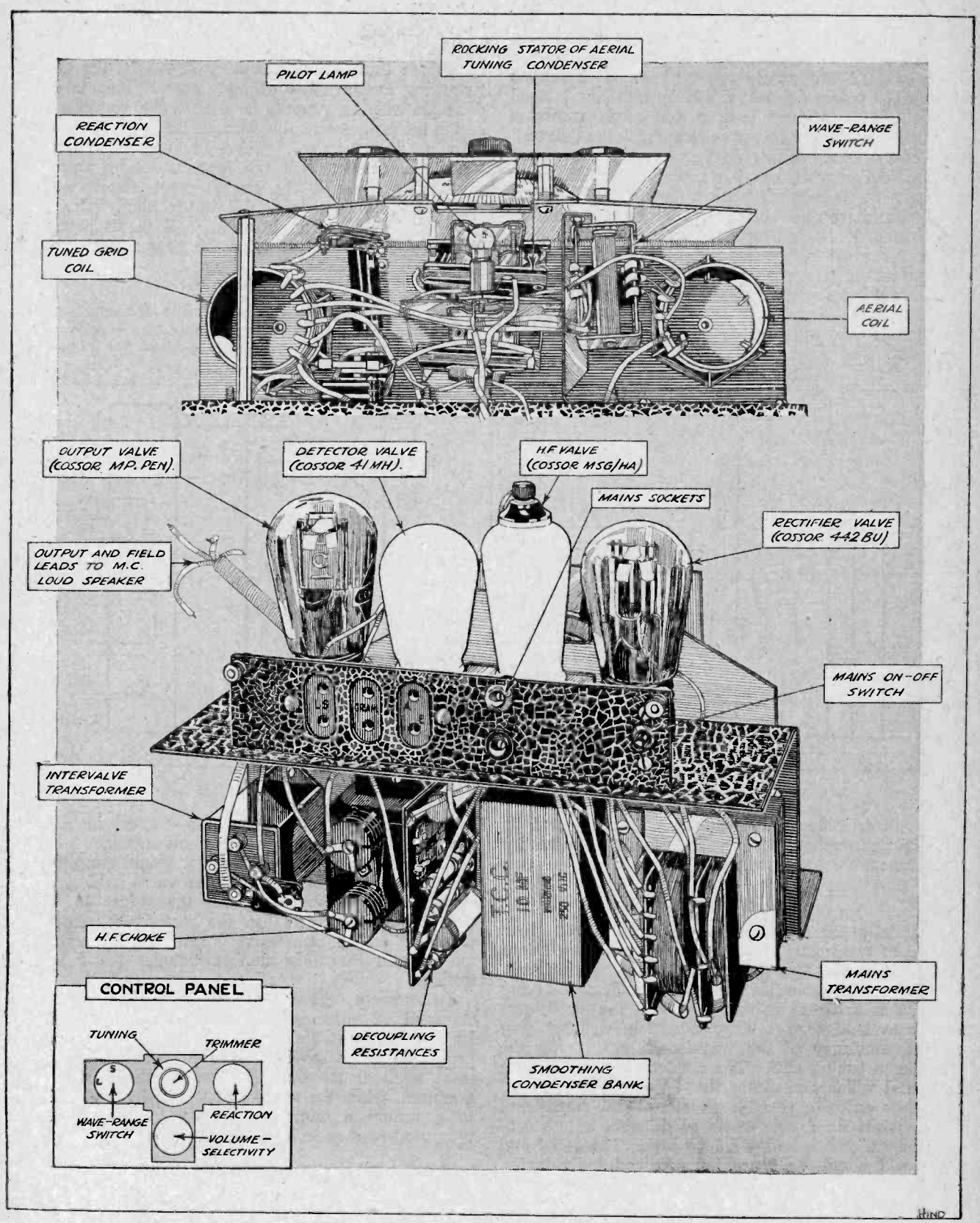
CIRCUIT: Three stages with indirectly-heated valves. (1) Screen grid H.F. (2) Power grid detector. (3) Power pentode output valve. Full-wave valve rectifier.

CONTROLS: (1) Single-dial tuning (with trimmer). (2) Reaction. (3) "Volume-Selectivity." (4) Wave-range switch.

GENERAL: Moving-coil loud speaker standard. Overall dimensions of cabinet, 16in. × 12¾in. × 9in.

PRICE: 15 guineas.

MAKERS: Climax Radio Electric, Ltd., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.



Constructional details of chassis and layout of controls in the Climax Model 33A receiver.

Climax All Mains Three.—

no mutual interference was experienced when fully tuned in to either station.

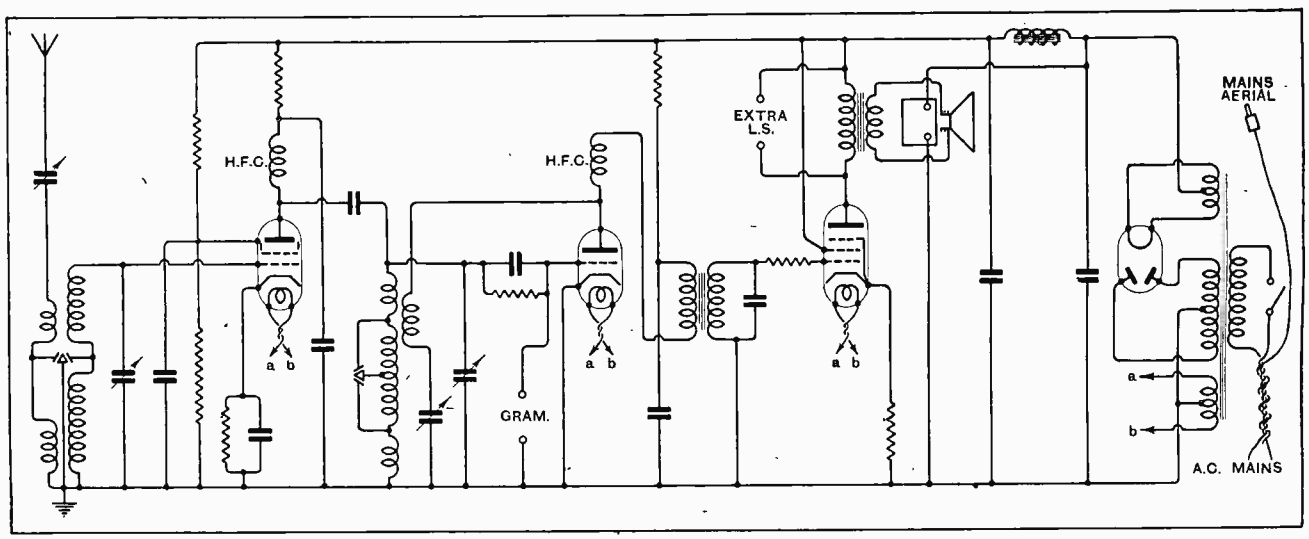
The controls are neatly arranged in a T-shaped recess. The centre control, which operates the ganged condensers, is provided with a concentric trimming knob which imparts a limited movement to the "fixed" vanes of the aerial tuning condenser. By this means accurate ganging at all parts of the dial is easily obtained. In practice very little attention need be given to this subsidiary control, for, like the reaction control, it maintains its setting over the greater part of the dial.

A push switch with alternate on and off positions is fitted in the terminal panel at the back of the set for interrupting the mains supply. The same panel carries terminal sockets for an external loud speaker, gramophone pick-up, and the usual aerial and earth terminals.

It will be observed that unusual precautions have been taken to prevent stray H.F. currents reaching the pentode. The series grid resistance and the condenser across the transformer secondary also limit the audio-frequency amplification of high notes. This is often desirable where a pentode is used in the output stage, and in the present case the compromise has been effected with good judgment. There is no suggestion of "pentode whistle," yet the reproduction of some of the special effects in the cinema organ clearly proves that high-note reproduction is not lacking. The bass is full, without being obtrusive, and mains hum can be heard only in intervals in the programme.

Mains Adjustment.

The mains transformer is suitable for supply frequencies from 40 to 100 cycles, and the primary can be easily adjusted to the mains voltage by a flexible



Complete circuit diagram of the Climax Model 33A.

The construction of the chassis is rugged, and its behaviour throughout the tests indicated that reliability may reasonably be expected.

Circuit Details.

Essentially the circuit is straightforward, but there are one or two points of interest which are not obvious in the diagram. The tuning condensers, for instance, are of the solid dielectric type. A considerable saving of space is achieved in this way, and the condensers appear to hold their settings extremely well, judging by the constancy of the wavelength settings on the illuminated tuning dial. The condenser in series with the aerial which constitutes the "Volume-Selectivity" control is actually variable in steps, and consists of five separate fixed condensers of different values controlled by a switch on the front panel. The aerial and tuned-grid circuit coils are not screened individually, but are spaced well apart and do not interact sufficiently to cause instability at any point in the tuning range.

lead and wander plug fitting into sockets in a neat terminal panel near the mains on-off switch.

There is one minor criticism: it would simplify the initial installation of the set if the valve holders could be marked to correspond with the valves to which they belong. Incidentally, the receiver is sometimes described as a "four-valve" set, but it should be remembered that this number includes the full-wave rectifier.

To sum up, the Climax Model 33A sets a new standard of value in self-contained mains receivers. Its compact portable design and the excellent quality provided by the moving-coil loud speaker make it an ideal medium for the reception of the B.B.C. programmes, while the range and selectivity are sufficient to guarantee a minimum of ten to fifteen foreign programmes at good loud speaker strength.

Next Week's Set Review:—

REGENTONE TWO-VALVE MAINS SET.

Current Topics

News of the Week in Brief Review.

PARIS CALLING!

The new Radio Paris at St. Remy l'Honore shook the ether with an official flourish on November 13th, when M. Guernier, described as France's "most radio-minded Postmaster-General," performed the opening ceremony. The station is understood to be using a power of between 85 and 120 kilowatts, and already it is making its presence known to British listeners, particularly those on the south coast where the signal strength is comparable to that of Daventry.

The first illustrated description of the station in this country appeared in *The Wireless World* of November 11th.

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A BRITISH PROGRAMME FROM PARIS.

Listeners to Radio Paris between 1 and 2 p.m. on Sunday next will find it difficult to imagine that they are not listening to a British station. A concert of the newest "His Master's Voice" records will be broadcast, and a feature will be the introductory comments by Mr. Rex Palmer, who is still remembered as one of the best-known announcers of the B.B.C. in earlier days.

Further "H.M.V." concerts will be given from Radio Paris on the three following Sundays, from 3 to 4 p.m.

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PORTABLES ON THE 8.30.

Our congratulations to the L.N.E.R. for the decision that portable wireless sets may be carried as personal luggage, and for the further concession that they may be operated in the compartments "as long as other passengers do not object."

With the increasing popularity of the portable it seems quite likely that, in days to come, special "radio" compartments will be included in each train, which will be quite pleasant so long as every person in one compartment tunes in the same transmission!

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I.W.T.: NEW OFFICES.

On and after December 1st the offices of the Institute of Wireless Technology will be situated in more commodious premises at 72, Oxford Street, London, W.1. Telephone No.: Museum 0582.

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£102,000 FOR £650.

This title is not a summary of a sweepstake transaction. It merely represents the financial aspect of the recent anti-"pirate" campaign of the Post Office in the London area. Sir Kingsley Wood, Postmaster-General, stated in the House of Commons recently that the number of prosecutions arising out of the campaign was 117. Excluding renewals, and deducting also, as representing normal growth, the number of new licences issued during the corresponding period last year, the number of additional licences issued during the period of the campaign was 204,000, and the estimated cost of the operations was £650.

We learn that the P.O. mystery vans, which are now in the Bristol area, will soon proceed northwards, calling at Birmingham on the way to Yorkshire.

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SPONSORED PROGRAMMES FOR INDIA?

There is still hope of a continuance of Indian broadcasting despite the decision of the Indian Government to suspend the present service. We understand that the Indian radio trade is making strenuous efforts to gain support for a scheme which would maintain the existing transmitters at Bombay and Calcutta. Probably something in the nature of broadcasting sponsored by advertisers will be arranged. We are glad to learn that the Government is continuing the service for a few weeks to allow the trade to complete its negotiations.

THE "LIVE WIRE." A snapshot taken at St. Remy l'Honore at the opening of the new Radio Paris transmitter showing (centre) M. Guernier, the French Postmaster-General, who has done more than any of his predecessors to establish his country's broadcasting service on a firm basis. He is popularly known as the "live wire."

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THE WIRELESS LEAGUE.

Members of the Wireless League are cordially invited to attend the annual general meeting, to be held at 12, Grosvenor Crescent, Hyde Park Corner, London, S.W.1, on Friday, December 4th, at 3.15 p.m. The business will be the annual report and accounts and the election of committee. Sir Arthur Stanley will be in the chair.

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BROADCASTING FROM FRENCH LAW COURTS.

A microphone is to be installed in the Palais de Justice, Paris, on December 5th, for broadcasting the traditional opening discourse of the session, given by the leading advocate.

French listeners are hoping that this represents "the thin end of the wedge," and that they will soon be able to listen from their armchairs to the more important murder trials.

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THE PIRATES' HOUR.

From time to time the Bucharest station now broadcasts a list of names of those persons who are caught listening without a licence.

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THOSE OLD HEADPHONES.

Thousands of unused headphones are lying hidden in cupboards, where they were thrown when loud speakers first became popular. The *Daily Herald*, which has instituted a "Hospital Earphones Campaign," appeals for help to listeners with discarded phones, and asks that those who are ready to respond should communicate by postcard with Hospital Earphones, The "Daily Herald," 68, Long Acre, London, W.C.2, stating how many pairs of phones they could give.

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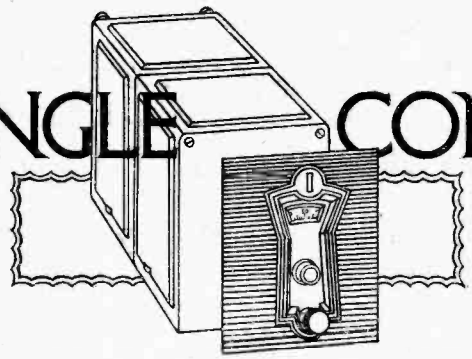
"PHYSICS IN SOUND RECORDING."

At the Royal Institution, 21, Albemarle Street, W.1, to-morrow (Thursday) at 5 p.m., a lecture on "Physics in Sound Recording" will be given by Mr. A. Whitaker, M.A., F.Inst.P., under the auspices of the Institute of Physics. The public will be admitted without ticket.



SINGLE CONTROL SUPERHETERODYNES

The Problem of Ganging the Oscillator.

By H. ANDREWES, B.Sc., A.M.I.E.E.

THE complicating factor in the design of superheterodyne receivers having only one tuning control is that the frequency band covered by the oscillator differs from that of the other high-frequency circuits. Yet the ganging of the tuned circuits in this form of receiver is just as important as in other types; in the opinion of the author it is essential if the receiver is to be operated by the "man in the street," the selectivity being higher and calibration otherwise often complicated by the two tuning positions of the oscillator condenser. It should be the aim of the designer to reduce the controls to a tuning dial calibrated in metres or kilocycles (preferably the latter), a wavechange switch, and a volume control.

THE problem of single dial control in the straightforward receiver with H.F. stages was readily solved involving only matching of inductances and capacities. In the case of the superheterodyne, tuned circuits are used following different wavelength scales and separated by a constant frequency difference. Such a requirement is beset with complication which becomes all the more difficult of solution when applied to single dial control arranged to be effective on both the medium and long wave ranges.

For some time now commercially designed superheterodynes in America have been of the single-control type. Naturally, the intermediate frequency which is chosen materially affects the design. In the U.S. a frequency of 175 kc. has been standardised, as this reduces to a minimum second channel interference from the fundamental and harmonics of the oscillator. Unfortunately, this frequency is unsuitable for European conditions, as it falls within the lower frequency band of signals to be received. It is, however, perfectly simple to adapt the ganging systems which have been developed for 175 kc. to an I.F. frequency of 100-150 kc., such as is used in this country. In considering the design of our superheterodyne we will assume that it follows the usual practice, in which case it will consist essentially of the following sections:—

(*a*) Signal frequency amplifier.
(*b*) First detector or frequency changer.
(*c*) Oscillator.
(*d*) Intermediate frequency amplifier.
(*e*) Second detector.
(*f*) Low-frequency amplifier.

The controls to be ganged together are therefore the H.F. amplifier, first detector, and oscillator tuned circuits. In the first design to be considered it will be assumed that the variable condensers will all have the same maximum and minimum capacities and follow a similar "law." It has been found that the oscillator should always have a higher frequency than the incoming signal; that is to say, it will have a frequency range from, say, 725 to 1,625 kc. if the signal frequency range is from 550 to 1,500 kc. This conclusion is the result of actual experience rather than theoretical consideration. It seems obvious, therefore, that the oscillator should have a lower inductance than the H.F. and first detector circuits. A brief calculation will, however, show that more than this is necessary if similar variable condensers are used. If the correct frequency difference is obtained at, say, 500 kc., there will be a wide discrepancy at 1,500 kc. A compromise must therefore be effected, and this may be done by placing the correct capacity in series with the oscillator condenser so as to reduce its maximum capacity without affecting the minimum. Such an arrangement is shown in Fig. 1.

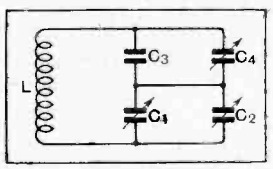


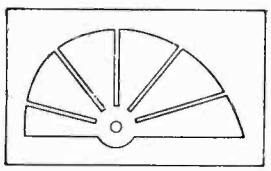
Fig. 1.—The tracking scheme advocated, using series and parallel condensers.

C_1 is the main oscillator tuning condenser, C_2 a small trimming condenser mounted on the same chassis and connected in parallel with C_1. C_3 is a fixed condenser of about 750 mmfd. in series with C_1, while C_4 is another trimming condenser of about 250 mmfd. The H.F. and first detector tuned circuits will be tuned by variable condensers exactly similar to C_1, also fitted with trimming condensers.

To "gang" the receiver over the required range the main tuning condensers are set so that with inductances used in the H.F. circuits a signal of approximately 1,500 kc. would be received. The value of the oscillator inductance is then chosen, so that correct frequency difference will be obtained. All the circuits may now be brought into gang by adjustment of the small trimming

Single Control Superheterodynes.—

condensers. It should be noted that the adjustment of the condenser C_4 is immaterial in this case as it will not appreciably affect the minimum capacity of C_1. The main tuning condensers are now set for a frequency of about 600 kc., that is to say, at practically their maximum capacity position. Under these conditions the small trimming condensers, having very little effect, are left untouched, but oscillator capacity may now be trimmed by adjustment of the condenser C_4, thereby altering the maximum capacity of C_1. This adjustment is made by simultaneously varying the capacity of C_4 and the position of the main tuning control for the position of maximum sensitivity.

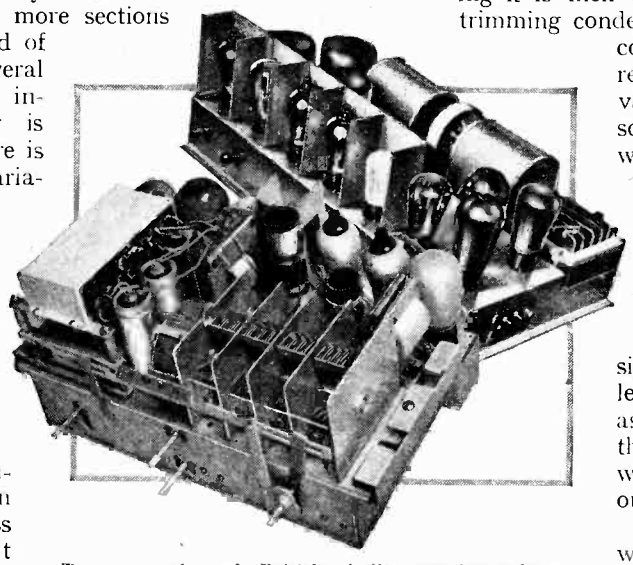


Fine adjustment of capacity ca i be effected by the use of split end vanes.

Split End Vanes in a Condenser.

The ganging is now checked at various intermediate positions. It has been standard practice for some time now to slot the end rotor vanes on variable condensers so that they consist of a number of segments. A sketch of one vane split into six parts is shown in Fig. 2.

The vanes are made of fairly stout aluminium; by bending one or more sections of the end vanes at each end of a section the capacity at several points on the scale may be increased while the receiver is actually on test. The feature is extremely useful, as such variations naturally do not affect the maximum or minimum of the condenser section in question. Such an adjustment will, of course, have to be made with a rod of some insulating material. This adjustment is most easily made if a signal generator is available which can be modulated at some constant audio frequency with an output meter connected across the loud speaker terminals. It cannot be too greatly emphasised that such a method is highly preferable to the much cruder system of relying on actual broadcast signals, which inevitably vary during adjustments.



Two examples of British-built superheterodynes employing single control for the tuning stages. Above is the R.G.D. chassis and below the Marconiphone.

The method of ganging described above is necessarily a compromise, for it is obvious that if the sections of the gang condenser have similar curves the insertion of a capacity in series with one section not only alters the maximum capacity of that section but also affects the general shape of its curve. The extent of the compromise will naturally depend on the I.F. frequency, and there is no doubt that, using 175 kc., it is practically impossible to obtain the same sensitivity throughout the whole scale. Up till recently, however, this method has been universally adopted in American design.

The 175 kc. I.F. frequency having now been universally adopted in America, where only the medium- or high-frequency bands are catered for, the ganging problem has been tackled by the leading condenser manufacturers, and as a result special superheterodyne gang condensers have been evolved. A typical example of a four-gang model consists of three standard sections for the pre-selector, H.F., and first detector circuits, and a specially designed section for the oscillator. To ensure that the tracking will not be disturbed by variations in the effective minimum capacity which may occur in various designs, it has been found necessary to design the oscillator condenser so that some capacity has to be added to a certain assumed value by means of the trimming condenser. This capacity is about 50 micromicrofarads, and once a suitable value of inductance has been determined, the shape of the rotor vanes may be calculated from the curve of the H.F. sections which are already known. Naturally, such a design is only satisfactory for particular values of the H.F. and oscillator inductances, but reasonable variations may be corrected by adjustment of the trimming condensers on each section, which usually have a value of about thirty to fifty micromicrofarads. With such a system of ganging it is then only necessary to adjust the trimming condensers at about 1,500 kc. for correct ganging, and then, if required, to bend the rotor vanes at other points on the scale as a final adjustment when all the others have been made. Such a design should be a boon in the mass-production of receivers by relatively unskilled labour.

As already explained, we in Britain have to design our superheterodyne for at least two frequency bands, and as one of these bands includes that mystic frequency 175 kc., we must sit down and work out a design for ourselves.

An I.F. frequency of somewhere between 100 and 150 kc. is usually chosen in this country, and this is quite satisfactory for our purpose. If we assume that the H.F. tuning condenser sections have a capacity variation of from 45 mmfd. to 500 mmfd., then the inductance required will be 250 microhenrys for the medium frequency band. This will give us a frequency range of 1,500 kc. to 550 kc., or a wavelength range from 200 m. to 660 m. On the lower frequency band we shall require approximately 2,200 microhenrys. Now, if the I.F. frequency is taken as 145 kc., which is just outside the lower band to be covered, and the oscillator condenser is assumed to have the same minimum capacity of 45 mmfd., allowing for stray valve capacities, trimming condensers, etc., the medium fre-

Single Control Superheterodynes.—

quency inductance will work out at about 206 microhenrys. To obtain the same frequency range on the oscillator, and therefore the required tracking, the maximum capacity of its variable condenser will therefore have to be 400 mmfd. unless the inductance value is reduced and the rotor vanes are shaped to give the required tracking. As, however, the difference in frequency between H.F. and oscillator circuits is less than in the case of the American design, it is probable that satisfactory tracking can be obtained without recourse to this method, and that, by putting a condenser of 1,500 mmfd. in series with the oscillator 500 mmfd. variable, its capacity at maximum may be reduced to 400 mmfd., when satisfactory tracking will be obtained. On the lower frequency band, if the oscillator maximum capacity is 400 mmfd., the required inductance will be 2,750 microhenrys. As the band to be covered in this case is rather small (150-300 kc.) a fixed capacity may be required in parallel with the lower frequency windings to spread out the band over the scale.

We now have the basis of our design. If a rather lower I.F. frequency is used, corresponding alterations must be made in the values of the oscillator inductances. Such a course seems desirable as, if 145 kc. is used at the lower end of the "long-wave" band, the signal frequency is almost equal to the I.F., and there may be difficulty in obtaining stability in the H.F. and first-detector circuits, especially in the latter. At, say, 120 kc., however, this difficulty should not arise. The above figures are, however, taken merely as examples to show the simplicity of the arrangement.

With the execution of such a design a receiver will be produced in which it will be possible to calibrate the single tuning scale in either metres or kilocycles. Such a feature is of enormous value.

Reducing Radiation.

In considering the various circuits only one tuned circuit in front of the H.F. stage has been dealt with. It is desirable, however, that some form of pre-selection should be used. This means that there will be three tuned circuits at the signal frequency requiring a four-gang condenser. This pre-selection is necessary in order to reduce the second channel or "image frequency" interference to a negligible value. It is not always appreciated that, without a fairly sharply tuned circuit or series of circuits in the H.F. portion of a superheterodyne, it is impossible to obtain the very high degree of selectivity which such a receiver can give. Such an arrangement will also reduce the radiation—another bugbear of the superheterodyne—to a negligible value, provided that the tuning coils are adequately screened. This extra circuit does not, however, affect or complicate the question of single control, as the first three circuits are exactly the same, the first two being loosely coupled either capacitatively or inductively.

There are no very serious difficulties in the design of single-control superheterodyne. It should be as easy to handle as the simple crystal set of days gone by.

IMPROVEMENTS IN THE "TRAUTONIUM."

New Method of Controlling Loudness.

DR. TRAUTWEIN, the inventor of an electro-musical instrument described in *The Wireless World* for December 10th, 1930, informs the author of the article that improvements were made in the actual instrument presented at the Radio Music "Tagung" at Munich this year.

At the keyboard of the "Trautonium." The inventor is standing behind the player.

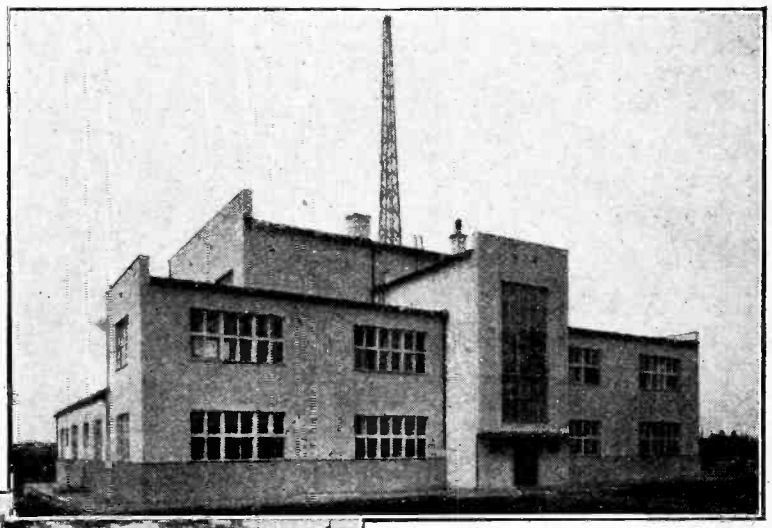
More especially, a considerable change has been made in the volume control, the foot-pedal having been abandoned in favour of a carbon resistance below the "keyboard." As the wire is depressed by the player's finger it comes first into contact with the resistance controlling the pitch, and this in turn presses on the carbon below it: hence a light pressure gives *piano* and a heavier one *forte*. At the same time, this system gives a perfectly smooth "attack," since the oscillations have already commenced before the carbon takes any pressure, and hence before there is any sound in the loud speaker. Of course, the earlier harsh, trumpet-like attack can be obtained when desired by cutting out the carbon resistance. As a further improvement, the smoother attack allows of deeper "tone formers" being used, giving notes resembling the lower register of the flute.

Dr. Trautwein also states that one source of trouble as regards purity of tone has been found to be an imperfect vacuum in the first valve (that used as a variable resistance), many commercial valves being insufficiently hard for this purpose.

R. R.-H.

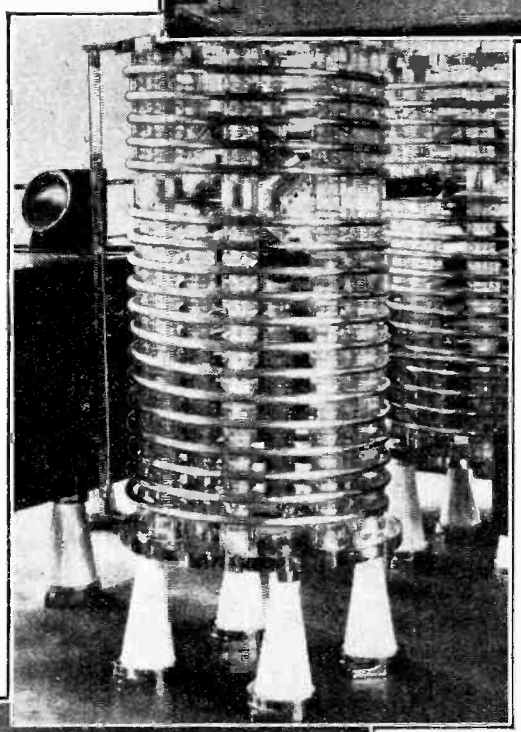
Broadcasting on 200 Kilowatts.

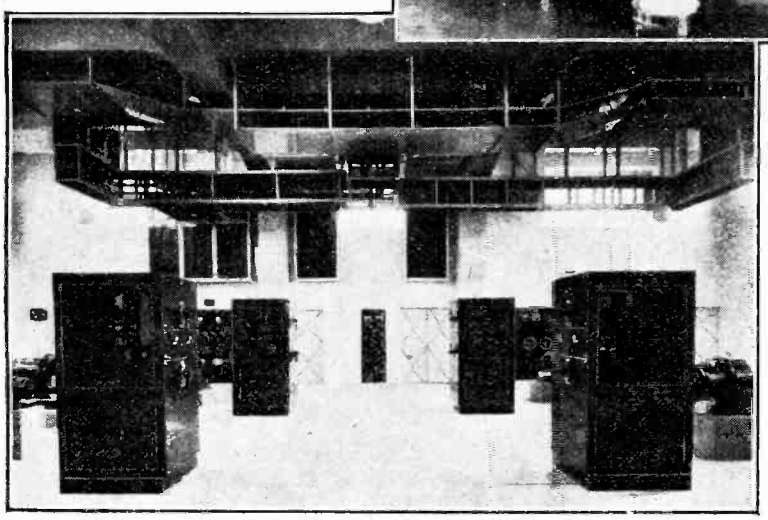
The New Prague Transmitter at Cesky Brod.



CZECHO-SLOVAKIA—one of the smallest countries in Europe—now owns what is, at the moment, the most powerful broadcasting station in the world. According to the latest official rating, the new transmitter at Cesky Brod, some twenty-one miles east of Prague, has a power of 200 kW., which places it "head and shoulders" above its nearest European rival, the 158-kW. Warsaw.

The equipment has been designed by the International Telephone and Telegraph Laboratories and installed by the Standard Electric Co., of Prague. The design virtually consists of two main parts, viz., the oscillator-modulator and the power amplifier. The former, which contains all the audio and radio-frequency circuits up to a strength sufficient to drive the power amplifier, really constitutes a complete broadcaster in itself, with a carrier output of 250 watts. The "power amplifier" includes radio-frequency amplifiers and the associated interstage and output circuits, and its valves carry a plate voltage of 20,000.





Silver-plated copper tubes compose the interstage tuning coils, seen on the right. The lower picture shows the large machinery hall on the ground floor.

The transmission system is one of modulation at low power, with subsequent H.F. amplification. Balanced push-pull circuits are used throughout, giving practically complete freedom from reaction, and thus avoiding amplifier distortion.

Power is derived from a 15,000-volt three-phase 50-cycle high-tension line. The rectifier system, which is of the Hewittic twelve-phase type, employing rectifier valves in oil-filled tanks, is duplicated to guard against breakdowns.

The two self-supporting aerial towers are 492 feet high, and are fed by a transmission line from the main station building, which is distinguished by its modern architectural design. All the radio equipment is located on the first floor, while the heavy power plant is at ground-floor level. Actually the entire radio equipment is in a metal screen, for the building has a copper screen roof connected by copper bus bars running down all four walls to the ground. There is also a copper mesh screen on the floor of the radio room.

November 21st was the date chosen for the official opening of this giant station. We understand that the power is temporarily restricted to 100 kW. The wavelength is 488 metres.

The VARIABLE-MU THREE

By W. I. G. PAGE, B.Sc., and W. T. COCKING.

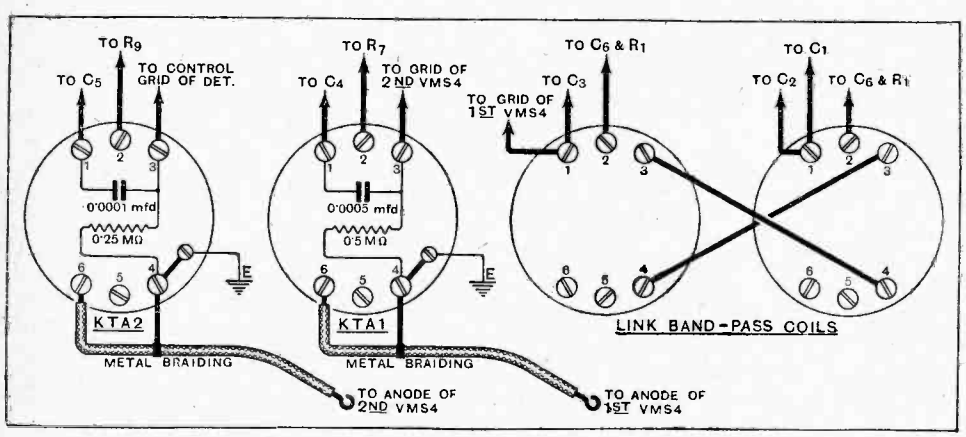
Constructional Notes and Performance.

IN last week's instalment the advantages of using the detector as the output valve feeding the loud speaker direct were explained, and reference was made to a somewhat unsuspected effect akin to automatic volume control. The four tuned circuits must be carefully adjusted to resonate simultaneously over the wavebands if the high selectivity of which the set is capable is to be obtained. The method of ganging in which the aerial series condenser C_1, rather than the trimmer built into the first condenser of the ganged assembly, is used to trim the first tuned circuit has already been considered. By this means the maximum capacity for the aerial connection is used, and thus the greatest efficiency is secured. It may be remarked that, in the case of a very small aerial, perfect ganging may not be attainable by this adjustment alone, and in this case the usual trimmer on the variable condenser must be employed.

On test, the performance was extremely good. The majority of the stronger Continental stations were available to provide a programme of entertainment value, and the volume control had to be employed to reduce their strength. The selectivity was well above the average for a two-H.F. receiver, and this is due to many factors. First, of course, there is the improvement due to the absence of rectification effects (cross-modulation) in the H.F. valves, and, secondly, there is the increased apparent selectivity due solely to the low value of L.F. amplification. The chief reason for the high selectivity, however, is due to the large input given to the detector by the two H.F. stages. At large input levels detection is truly linear and the demodulation of a weak signal on a nearby wavelength is very apparent. Due to this, the local-station spread is less than usual.

Interesting Experiments with an Oscillator.

Further details of the experimental work carried out with an oscillator, discussed briefly in the first instalment, may be of interest. The receiver was tuned to a wavelength different from that of the London Regional transmitter; as this station was only nine miles away it could still be heard, although weakly. A local oscillator was then switched on and tuned to the wavelength of the set to represent the carrier of a distant station. All trace of the London programme immediately disappeared. This test showed also the absence of cross-modulation in the H.F. stages, for had such been present the interference would have been increased, instead of reduced. It is chiefly owing to this demodulation effect that as many as ten stations could be received between the two London transmitters at a distance of only nine miles, for the blanketing effect of the local station is largely eliminated.



Schematic diagram of coil connections. Terminals 4 on coils KTA1 and KTA2 serve to earth the grid leaks and the metal braiding of the H.F. anode leads.

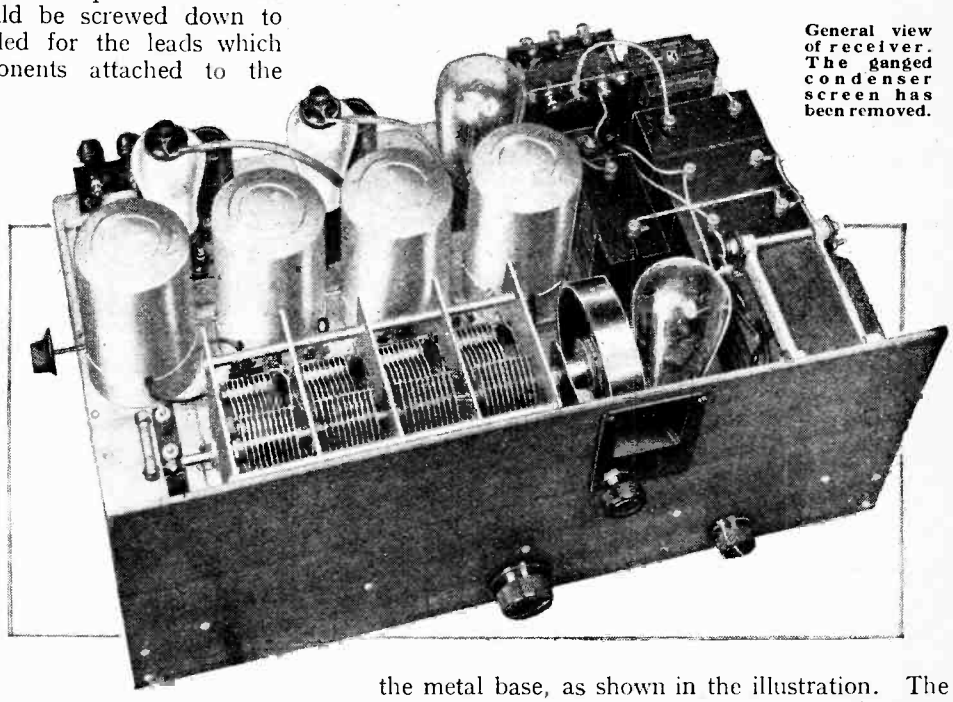
Hum was entirely absent on a good moving-coil loud speaker capable of responding to ripple frequencies, in spite of the very minimum of smoothing equipment employed. This can be attributed to absence of rectification in both H.F. stages and to the fact that there is no separate L.F. stage.

Other than the wooden baseboard and panel there are no parts which have to

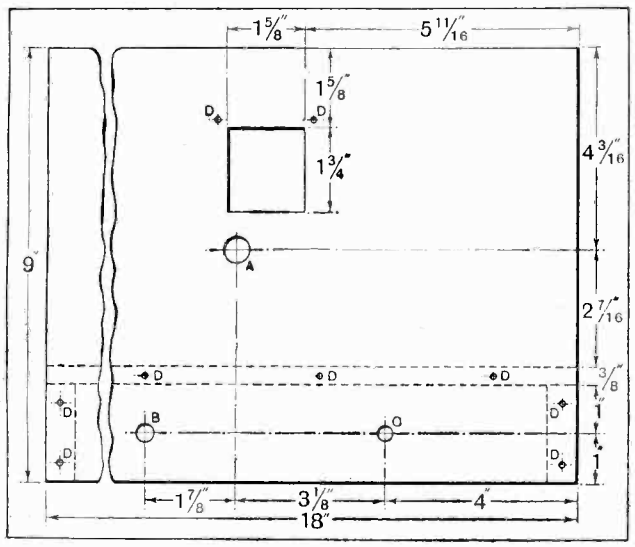
The Variable-mu Three.—

be constructed. The set is very simple to build, and after the wooden chassis is completed the ganged condenser assembly should be the first component mounted. After this the coil base should be screwed down to the baseboard and holes drilled for the leads which pass to the decoupling components attached to the under-baseboard. The wave-band switch rod should not be removed when the set is taken in and out of the cabinet; it is necessary only to remove the control knob by releasing the grub screw and to push the rod home so that it does not project beyond the left-hand edge of the baseboard. The hole in the side of the cabinet is sufficiently large to allow the switch rod to be pulled out an inch or so by means of a pair of pliers for attaching the knob after the set is permanently installed. Care should be taken to see that the two earthed spring contacts bear against the rod, otherwise the set may be noisy.

To facilitate the wiring of the four coils the accompanying diagram should be helpful. All the leads passing out through the screens are connected to components on the baseboard except those from terminals No. 2 on coils KTA1 and KTA2, which are taken through the baseboard to the two anode decoupling resistances (600 ohms) R_7 and R_9. Terminals No. 5 are not used on any of the coils, neither is No. 6 on the two band-pass coils. The metal braiding slipped over both anode leads of the H.F. valves must be earthed at terminal No. 4 on coils KTA1 and KTA2. These two terminals should be connected to the bolts which hold the coils down to the metal base, as shown in the illustration. The tuned-anode coils are supplied with grid condensers and leaks fitted in the base—their connections and values being given. A batten on the under-baseboard measuring 7½in. × 1¾in. × ½in. serves to hold the condensers C_7, C_8, C_{11}, and and C_{12}, and the resistance R_5.



General view of receiver. The ganged condenser screen has been removed.



Panel dimensions and drilling data. A = 9/16in. dia.; B = 3/8in. dia.; C = 5/16in. dia.; D = 1/8in. dia.

The Bias Potentiometer.

Owing to the simplification of circuit made possible by the use of variable-mu valves, the number of controls is reduced to the minimum. There are three on the panel—the right-hand knob controls the mains on-off switch (clockwise rotation makes contact); the left-hand control alters volume (clockwise rotation increases signal strength); whilst the upper control gives a reduction drive of the drum dial attached to the ganged condenser rotors (clockwise rotation increases wavelength). A word of warning is necessary when choosing the potentiometer R_4. There are some of these components on the market in which the slider is stopped at either end of its travel while there is still a resistance of, say, 250 ohms in circuit between the slider and the end terminals. This means that the initial bias is produced by a resistance greater than 400 ohms and the sensitivity of the set on weak stations may suffer. The cathode resistances R_2 and R_3 can be reduced, but it is better to obtain the type of potentiometer in which no residual resistance is left.

Owing to the small L.F. amplification, no provision has been made for connecting a gramophone pick-up.

This receiver is available for inspection by readers at the Editorial Offices, 116, Fleet Street, London, E.C.4.

PRACTICAL HINTS AND TIPS.

SIMPLIFIED AIDS TO BETTER RECEPTION.

MEASURING VOLTS— with a foot rule.

WITH ordinary equipment it is, practically speaking, impossible accurately to measure the voltage developed across a bias resistance. As a rule, a reliable estimation of the actual voltage existing can be obtained by an indirect method. We first measure—or assume—the ohmic value of the resistor, and then measure the current passing through it. Voltage is then ascertained by multiplying resistance by current, the latter being expressed as a fraction of an ampere.

This procedure will obviously need some modification if different values of bias voltage for two or more valves are taken from the same resistor, as they often are, for example when automatic bias is included in a battery-operated set. It is a fortunate circumstance that no current is consumed in a grid circuit, and consequently the bias resistance may be regarded as a true potentiometer, the voltages existing at various tapping points along it being strictly proportional to length. Length in this case, of course, means length of wire, but as the "strip" type of resistor that is often used for this purpose nowadays is evenly wound, one can rest assured that, knowing the total voltage existing across the resistor, any desired proportion of that total can be obtained by making connection to a point determined by linear measurement.

The accompanying illustration (Fig. 1) and an example will serve to make the whole matter clear. Imagine an output valve biased to 9 volts by means of a resistor in the H.T. negative supply lead, and that it is desired to obtain 1 volt, which is to be impressed on the grid of an H.F. amplifying valve. The resistor shown in the example has a total length of 2¼in., and so one volt will be developed across one-ninth of this length—i.e., ¼in.

When making tappings on resistances wound with very fine wire, care must be taken to avoid doing any damage, and if the joint is soldered an effort should be made to avoid short-circuiting more turns of wire than is necessary.

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LONG-WAVE GANGING.

WHEN a receiver with single-dial tuning works satisfactorily on the medium waveband, but when tuning is flat and indefinite on switching over to the long waves, it may almost invariably be concluded that the long-wave coils are not perfectly matched with regard to their inductance values.

Even if the usual symptoms of imperfect ganging are not present, it is worth while making a test as to whether tuning adjustments hold over the long waveband by observing whether it is possible to improve signal strength by experimental adjustments of the trimming condensers. If it is, then it must generally be concluded that a little time spent in re-matching long-wave inductance values will not be wasted.

There is, of course, the possibility that on switching over from the medium band a different proportion of the incidental stray capacities due to the aerial, etc., are transferred to one or more of the tuned circuits. If so, ganging will appear to be inaccurate even if the inductances are all of the correct value.

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GANGED CONDENSER SPINDLES.

MOST of the latest types of ganged condensers have separate connections led out from the rotor of each section — in spite of the fact that a single and continuous metal spindle is common to all the moving vanes.

This is a good point, and it is wise to regard these "earthed" terminals as being for use and not merely for show. Where possible, the low-potential end of the tuned circuit should be joined directly to the condenser terminal, and not to the nearest earth point, even though these alternative forms of connection may seem to amount to the same thing.

Although precautions of this kind can often be neglected with impunity it is distinctly risky to omit them when high-magnification H.F. stages are included in the receiver. High-frequency potentials can be transferred in rather a mysterious way, *via* the condenser spindle, from one circuit to another, and in a case that the writer has in mind it was found that partial instability could be completely cured by putting extemporised earth connections on the condenser spindle between each rotor.

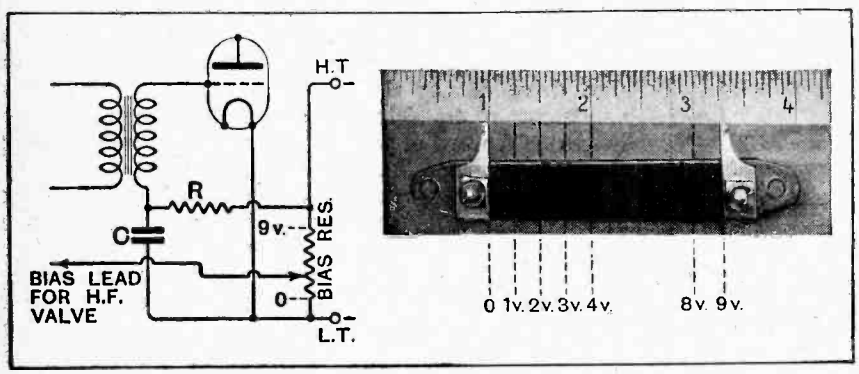

Fig. 1.—As the voltage drop along a bias resistor is uniform, tapping points for intermediate bias voltages are easily determined by linear measurement. The circuit diagram shows a practical application. R and C: Decoupling resistance and condenser.

TESTING CIRCUIT "GOODNESS."

THERE is no royal road to superlatively good reception; those lucky amateurs who, without taking any trouble, get results that leave nothing to be desired are either abnormally favoured by fortune or, more probably, are very easily satisfied.

Although somewhat limited in its application and comparatively laborious in execution, the method of testing to be described in this note will trace down those minor sources of inefficiency that are not usually revealed by simpler tests. It will also show up major faults, some of them of a type that are not definitely located without elaborate apparatus. A valve oscillator of almost any type is all that is needed; this can be improvised from some of the "scrap" apparatus that most home constructors have accumulated; it can be run with one of the valves, and also from the batteries or eliminator, of the set under test. Control of the oscillator frequency is not essential, provided that it resonates within the medium broadcast band, and preferably at a fairly low wavelength; for this reason a fixed tuning condenser is suggested for the circuit given in the accompanying circuit diagram (Fig. 2).

Comparative Measurements.

A milliammeter must be interposed in the oscillator anode circuit; this instrument should be reasonably sensitive, and its maximum reading should hardly be greater than five milliamps—preferably less. At a pinch, a voltmeter can be used, as the instrument is not required to give more than an indication of changes in current.

All other things being equal, the "better" a tuned circuit, the greater the amount of energy that it will absorb from an oscillator circuit to which it is coupled. This, in a nutshell, is the principle on which the "absorption tester" does its work.

Luckily—for our present purpose—each of the H.F. circuits in a modern "straight" receiver are designedly of the same characteristics—the same coils and the same inductance-capacity ratio. Consequently, each circuit, when coupled to the same extent to an oscillator, should absorb exactly the same amount of energy. At any rate, this is true if external sources of unequal damping are removed, and so the set should be tested with the valves "off" and the aerial disconnected.

Milliammeter Indications.

When energy is absorbed from an oscillating valve circuit there is a change—generally in an upward direction—of anode current. Hence the reason for the milliammeter, which enables the magnitude of these changes to be observed.

In order that full benefit may be derived from the test, it is essential that the circuits shall be tested *in situ*, so that they may be affected by any leaky insulation, poor-quality dielectric, or other defect that may exist elsewhere than in the actual coil-condenser combination. It is generally convenient to break the circuit at the lower end—electrically, and generally physically as well—of the tuning coils, and to wire across the break a coupling coil of half a dozen turns or so, which is placed in inductive relationship with the oscillator coil. When a suitable coupling has been determined, it should be fixed for the whole series of tests, and, moreover, the connecting leads should always be of the same length.

The actual test is made, of course, by varying the circuit tuning until exact resonance, as indicated by a sharp change in anode current, is reached. Coupling must not be so close that self-oscillation is stopped; this will be indicated by the fact that the meter reads the same current as when the oscillator reaction coil is short-circuited. Neither must it be so loose that an infinitesimal current change is produced, or it will be impossible to obtain a definite reading. Apart from the question of magnitude of current change, it should be noted that a good circuit of high dynamic resistance will produce a sharp "kick" of the meter needle as it is tuned through resonance. When a bad circuit—or one with a leak resistance in parallel or a resistance in series, which amounts to the same thing—is tested, the needle movement will be comparatively sluggish. For rough-and-ready tests, this sluggishness is often quite enough to show that something is wrong, without any reference to the amplitude of the movement.

The outstanding advantage of this semi-quantitative method of testing is that, when a faulty circuit has been found, the effects of experimental alterations or substitutions are so readily observable. Other applications of the principle will probably suggest themselves.

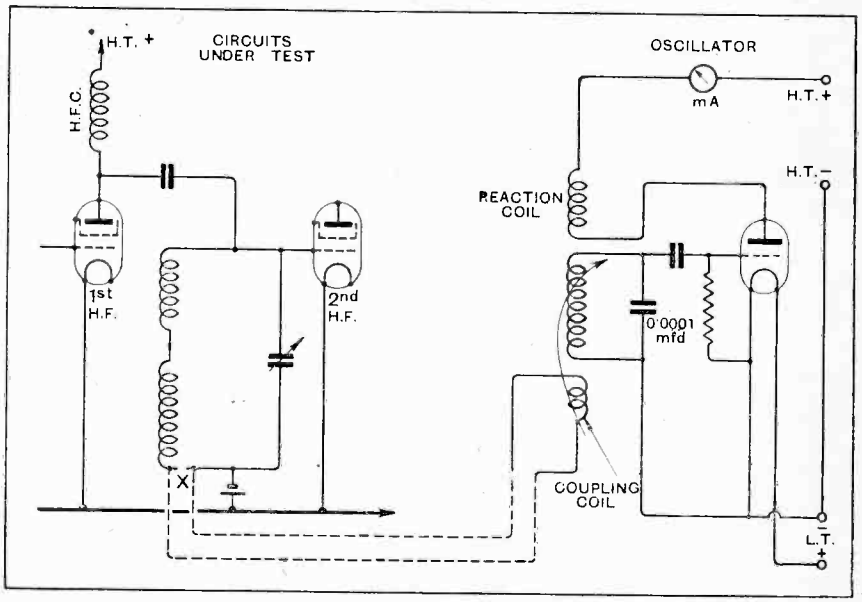

Fig. 2.—Testing H.F. circuits by absorption. The tuned circuit under test is broken at point X for insertion of a small coupling coil.

BROADCAST BREVITIES

The Austrian "Wandering Microphone" in a broadcast from the Hapsburg dynasty vault in the Capuchin Church, Vienna on all Soul's Day.

By Our Special Correspondent.

Savoy Hill and the Films.

Swiftly following the publication of my hint a fortnight ago of an early "understanding" being arrived at between Savoy Hill and the film industry, comes the interesting news that Holt Marvell's broadcast play, "Goodnight, Vienna," is to be filmed at the Elstree Studios of British and Dominions Films. The significance of this lies in the fact that the film will probably be released *just after* the broadcast.

Preparing the Ground.

It was the original intention that "Goodnight, Vienna," should be the first dramatic production at "Broadcasting House." Now the event is to be postponed. Time will show whether I am wrong in suggesting that the broadcast version will be used to heighten public interest in the film play.

Good Propaganda.

No one will deny that there are great possibilities in this idea. A broadcast of the play *after* the showing of the film would probably fall flat. On the other hand, the prospect of seeing a play which has already gripped attention over the microphone should send many people to the cinema—people who, perhaps, never see a film from January to December.

A Dangerous Precedent?

So far, so good. I believe that the play in question is excellent, as Holt Marvell's efforts usually are. But the fact remains that the B.B.C. may be creating a dangerous precedent.

Going Ahead with the Empire Station.

The B.B.C. engineers are already busy on the design of the multi-wave Empire broadcasting station at Daventry, and I am told that "the preliminary work is already completed."

Two Transmitters: 20 kW.

I am able to state that two, and only two, separate short-wave transmitters will be used, but each will be able to make frequent changes in wavelength to ensure reliable reception at all times in different parts of the Empire.

Tales that a colossal power will be used are untrue. The power will certainly not exceed 20 kW.

Encore!

I am glad to see that my plea for the revival of the B.B.C. Surprise Items is gaining support. Two days after the suggestion appeared in *The Wireless World*, it was eloquently echoed in one of our leading "dailies," whose readers have since responded with enthusiasm.

No Surprises.

The truth is that we all like occasionally to hover on the verge of a mystery. The present programmes are trumpeted weeks ahead and scheduled in print with the virtuous precision of Mr. Bradshaw; like the tourist at Mugby Junction, we know pretty well what is coming and we sit in our waiting rooms awaiting the inevitable.

Bang Went . . .

Occupying the usual programme period, surprise items need not add a penny to the expenses of the B.B.C. Yet I learn that it was the question of cost that led to their discontinuance. And what was that cost? About £5 per week!

"Effects" in an Operetta.

Two main studios, one with three microphones, besides the "effects" studios, will be required for a complicated broadcast to-morrow evening (Thursday) of Cyril Scott's operetta, "Janet and Felix."

The music introduces some subtle burlesques, both of musical comedy and grand opera.

Three National Lectures.

Sir William Rothenstein's National lecture entitled "Whither Painting" has been postponed from November 20th to December 18th.

The other National lecturers during the present season will be Sir Frederick Hopkins, President of the Royal Society, who will deal with "Vitamins as Necessities of Life" on January 22nd, and Professor George Gordon, President of Magdalen College, Oxford, whose lecture on March 18th will be entitled "The Art and Ethics of Modern Biography."

"Broadcasting House".

Mr. Val Myer, the architect of "Broadcasting House," is now disclosing the fact that the famous central tower in the new building was included as an afterthought. The original intention was to group all the studios on one or two floors. Then came the reflection that no windows would be necessary, and this led to the final conception of a central block of studios in perpendicular array, surrounded by the administrative offices.

Critics Confounded.

These and other revelations are made in the forthcoming "B.B.C. Yearbook."

Mr. Val Myer gives a severely simple reply to critics who have drawn attention to the "lopped off" appearance of the building on the east side. It was merely a question of "ancient lights." If the back of "Broadcasting House" had reared up to the same height as the portion fronting on Portland Place, the tenants of the flats in Langham Street would have been deprived of light.

Too Small?

It is frankly admitted that "Broadcasting House" appears to be considerably larger than its actual size, but I am not sure that Mr. Val Myer has any regrets on this score. It is one of the blessed triumphs of a good design that a pint pot should seem to hold a quart.

Expressive.

It is said—and I got the story nearly a year ago from a man on the spot—that Mr. Val Myer insisted on designing the big concert studio himself. "I don't mind who designs the others," the architect is reported to have said, "but the big studio will be seen by the general public!"

READERS' PROBLEMS.

Readers' technical enquiries are not replied to through the post, but in these pages replies to questions of general interest are dealt with week by week.

Lost H.T. Volts.

IN estimating the various anode voltages in a mains receiver, and particularly when dealing with D.C. supplies, several readers seem to have fallen into the error of neglecting the loss of pressure that inevitably takes place in an automatic grid bias resistance. The correct procedure, before calculating the values of anode feed resistances, etc., is to subtract the bias voltage that will eventually be developed across the resistance from the total that is available from the mains.

This seems to be a suitable occasion to point out that a three-electrode output valve inherently stands in need of a greater negative grid voltage than does a pentode, and for this reason the latter type of valve has special attractions in a D.C. set.

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The "Band-Pass Pentode Three."

THE new pentode valve used in the "Band-Pass Pentode Three" provides a large measure of amplification, and the valve preceding it is also of a highly efficient type. In consequence, there is no reason why this receiver should not be used for the reproduction of gramophone records, provided that a fairly sensitive pick-up is employed.

Queries regarding the addition of a pick-up to this receiver can best be answered by saying that there is seldom any advantage in adopting a more elaborate method of conversion than the simple scheme shown in Fig. 1. By fitting a switch as shown, the pick-up is connected across the grid circuit of the detector, which then becomes an amplifier. In the interest of economy it is a good plan to make arrangements to interrupt the filament circuits of the H.F. valve simultaneously; the switch contact for carrying out this operation may well be combined with the pick-up switch.

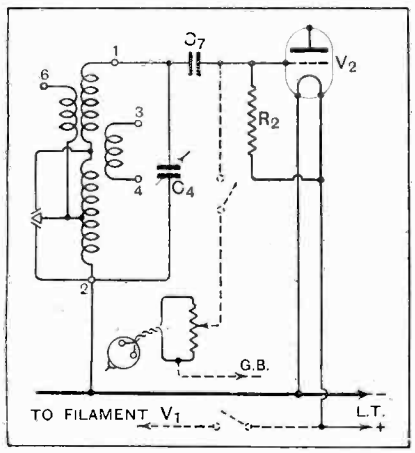

Fig. 1.—A gramophone pick-up, with volume control potentiometer, in the detector grid circuit of the "Band-Pass Pentode Three." Additions and alterations shown in dotted lines.

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A High-resistance Joint.

A VERY unusual defect must exist in the receiver of a reader who complains that his reception is normally accompanied by a crackling noise, which starts soon after the filaments have been switched on. The receiver is battery operated, and it has been found accidentally that the trouble can be temporarily overcome by momentarily short-circuiting the L.T. positive and negative bus-bars.

This is almost certainly caused by an unusual variant of what is generally known as an "electrolytic break." Somewhere in the L.T. circuit there is probably a defective connection of varying resistance, and the fault is of such a nature that full continuity is restored temporarily by a heavy surge of current.

The effect is analogous to that which is still often encountered in fine wire inductive windings. For example, an intermittent fault in an L.F. transformer primary often appears to right itself as a result of making or breaking the main H.T. circuit.

As the exact location of the fault is unlikely to be found by examination or by the usual tests, it would be as well to rewire the whole filament circuit, at the same time replacing any components, such as valve-holders, that may possibly be defective.

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Avoiding Current Leakage.

IT is easy to forget that a potentiometer for regulating the supply to the screen grid of an H.F. valve will impose a continuous drain on the H.T. battery, unless special precautions are taken to interrupt the circuit. This, combined with the fact that potentiometer feed is slightly less economical, is responsible for the usual preference for a direct connection between the screening grid and battery. The use of potentiometer feed is almost exclusively confined to mains-operated receivers.

A reader, whose H.T. battery has come to an untimely end through neglecting to provide means for breaking the potentiometer circuit, asks whether the circuit could be wired in such a way that this continuous discharge may be avoided without using anything more complicated than the simple on-off switch at present in use. Unfortunately this cannot be done, and the arrangement he submits would not work in practice, as the H.T. battery would discharge itself through the potentiometer and the L.T. cells, which are not completely isolated by the on-off switch. The simplest method of ensuring complete isolation is to adopt the method of wiring shown in Fig. 2, which calls for nothing more complicated than a three-point switch.

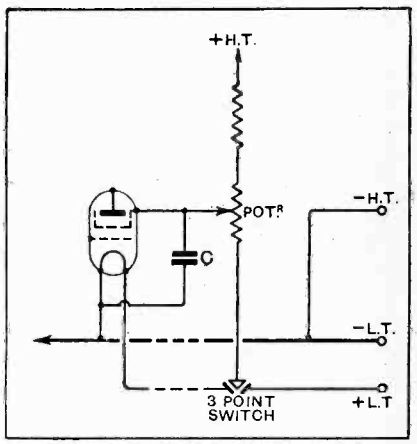

Fig. 2.—A three-point switch arranged to break both the filament and S.G. potentiometer circuits of a battery-fed receiver.

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"New Wine . . ."

A READER, who uses a 1-v-1 set almost exclusively for reception of his nearest station, at about fifty miles distance, asks for suggestions as to how the existing H.F. stage, which is admittedly obsolete, could be improved without making sweeping and costly alterations.

A neutralised tuned anode coupling is actually employed, with a triode valve, and, due, no doubt, to the fact that only a part of the valve damping is applied to the tuned circuit, it is found that selectivity is quite good, but that amplification is hardly enough fully to load a power grid detector that has just been fitted. It is asked whether the substitution of a modern indirectly heated A.C. triode as an H.F. amplifier would prove satisfactory.

In the days when neutralised couplings were popular it was always found difficult to stabilise a valve coupled by a simple tuned anode system, even with the relatively inefficient valves then obtainable. We fear that as a result of making the change in question, hopeless instability would result. Failing complete modernisation of the H.F. stage, we can only suggest that the tuned anode coupling should be replaced by a transformer, and also that more extensive screening should be added.

Anode Current Measurements.

A MILLIAMMETER, joined in series with the detector anode circuit, can be a most useful help when making initial adjustments to the high-frequency circuits of a receiver, but cases sometimes arise where sufficient back-coupling is introduced by the instrument itself to produce instability. This trouble is admittedly rare, but it seems likely that the meter is often connected in such a way that a certain amount of undesirable coupling takes place, and, in consequence, the set

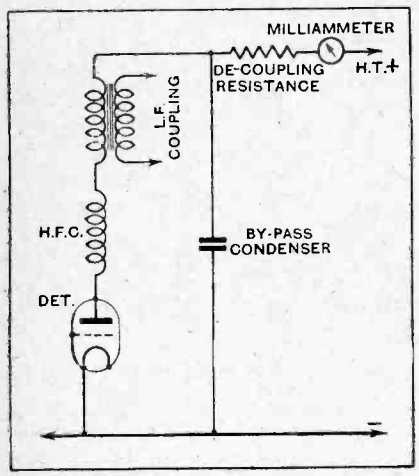

Fig. 3.—The possibility of introducing spurious inter-circuit couplings by inserting a milliammeter is avoided by placing the instrument at the extreme low-potential end of the anode circuit.

does not function in an entirely normal way—as it should, of course, when any form of measurement is being made.

The detector circuit of most sets is fairly elaborate, including as it does quite a number of components connected in series. At first sight it would appear satisfactory to join the measuring instrument at any convenient point, but, to avoid the possibility suggested in the preceding paragraph, it should always be inserted at the point nearest to the source of H.T. supply; in other words, at the low-potential end of the circuit.

Readers who have asked specific questions with regard to this detail may be guided by Fig. 3, which shows the correct position for the meter in a typical anode circuit, which includes an H.F. choke, an L.F. transformer, and a decoupling resistance. If there is no decoupling in the circuit, the instrument will be joined between the transformer primary and the source of H.T. supply.

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"Grid Current Damping."

SEVERAL readers seem to have been misled by this expression; although it is in fairly common use, it is admittedly likely to convey a wrong impression.

It is well known that the characteristics of a tuned circuit are affected adversely when current is allowed to flow in the grid circuit of a valve across which it is connected; both selectivity and sensitivity are impaired, and it is to avoid these troubles that negative bias is applied to an amplifying valve.

The natural inference of the expression "grid current damping" is that damping is due to the current itself, but this is hardly correct. The point is, that to allow the current to flow the grid-filament space in the valve must have become conductive, and therefore capable of drawing current from—and consequently imposing damping on—the tuned circuit.

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Interference from the Charging Dynamo.

A READER who obtains anode current from a 100-volt house-lighting plant, connected in series with an H.T. accumulator battery, has found that it is quite impossible to operate his receiver while the cells are being charged, as reception is then entirely spoilt by background noises generated by the dynamo. It is asked whether there is any simple way of avoiding this interference.

As current is derived from an accumulator battery, we assume that no smoothing devices are included in the H.T. feed-circuits, and suggest that the usual choke and condenser should be inserted in the supply leads. No doubt there is little, if any, surplus voltage, and this addition will inevitably bring about a certain loss; it would, therefore, be a good plan to fit a short-circuiting switch across the smoothing choke, so that it may be eliminated at times when smoothing is unnecessary.

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Idle Transformer Windings.

WHEN a receiver is being adapted for A.C. mains operation "by instalments," it is an economical plan to obtain a power transformer with one or more low-tension secondary windings, even though the original battery valves are retained. When A.C. valves are fitted at some future time, their heaters may be fed from these windings, and the extra expense will be much less than that of buying a special L.T. transformer when it becomes necessary.

The wisdom of this plan is generally appreciated, but there is some uncertainty as to whether it is permissible to leave the unused windings free until they are actually required to deliver current.

One reader goes so far as to suggest that the windings might with advantage be short-circuited, but this is definitely wrong, and should never be done. It may be assumed as a general rule that not the slightest harm can be done by allowing the unused secondary windings to remain idle. There will admittedly be a slight tendency for the voltage across those windings actually delivering current to rise beyond the rated value, but the increase will be negligible in the case of a transformer designed on reasonably generous lines.

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Loud Speaker Fields.

QUESTIONS are sometimes asked as to the possible effects of applying a greater voltage to the field winding of a moving-coil loud speaker than that for which it is designed. In the first place, it should be stated that magnetising current will naturally be increased, and so the flux density in the gap will also become greater. This will almost invariably bring about greater sensitivity, and possibly an improved performance generally. Unfortunately, no definite figures can be given as to the percentage of overload that can safely be applied in all cases, as there is nothing approaching standardisation in the windings of the magnets, or in the provision of cooling, which affects the position very considerably.

As a general rule, there is a fair amount of latitude, but the makers of the instrument should certainly be consulted before their maximum rating is exceeded by more than a few per cent.

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The Usual Order Reversed.

WHEN operating an A.C. receiver it is usual to find that mains hum is rather more pronounced when a gramophone pick-up is in use than when the set is performing its normal function of radio reception.

In the comparatively rare cases where the opposite state of affairs exists we always suspect the existence of an excessively high resistance in the detector grid circuit. Very often the trouble is finally traced to the grid leak itself, which may have increased in resistance with age, or may have had initially too high a value.

FOREIGN BROADCAST GUIDE.

COLOGNE

(Germany).

Geographical position: 50° 53′ 49″ N.; 6° 57′ 17″ E.

Approximate air line from London: 308 miles.

Wavelength: 227.4 m. Frequency: 1,319 kc. Power: 1.7 kW.

Time: Central European (one hour in advance of G.M.T.).

Standard Daily Transmissions.

G.M.T. 05.45, physical exercises, weather forecast, concert; 06.00 (Sun.), relay of concert from a Liner in port at Hamburg; 07.25 (Sun.), carillon and sacred service, then broadcasts throughout day until 15.30, concert; 19.00, main evening programme; 21.00, news; 21.30, late evening concert or dance music.

Man announcer. Call: *Westdeutscher Rundfunk!*

Interval signal: Chimes, as under, from studio.

Closes down with the usual German Good-night greetings, followed by *Deutschlandslied* (Deutschland ueber Alles).

Common wave relays: Aachen (0.3 kW.); Muenster (0.6 kW.) on 227.4 m. and Langenberg (17 kW.) on 472.4 m. (635kc.).