

# THE "SHELTERSET" THREE-VALVER— See page 86

A  
NEWNES  
PUBLICATION

Edited by  
**F. J. CAMM**

Vol. 17. No. 414.

# Practical Wireless *and*

# 6<sup>d</sup>

**EVERY  
MONTH**

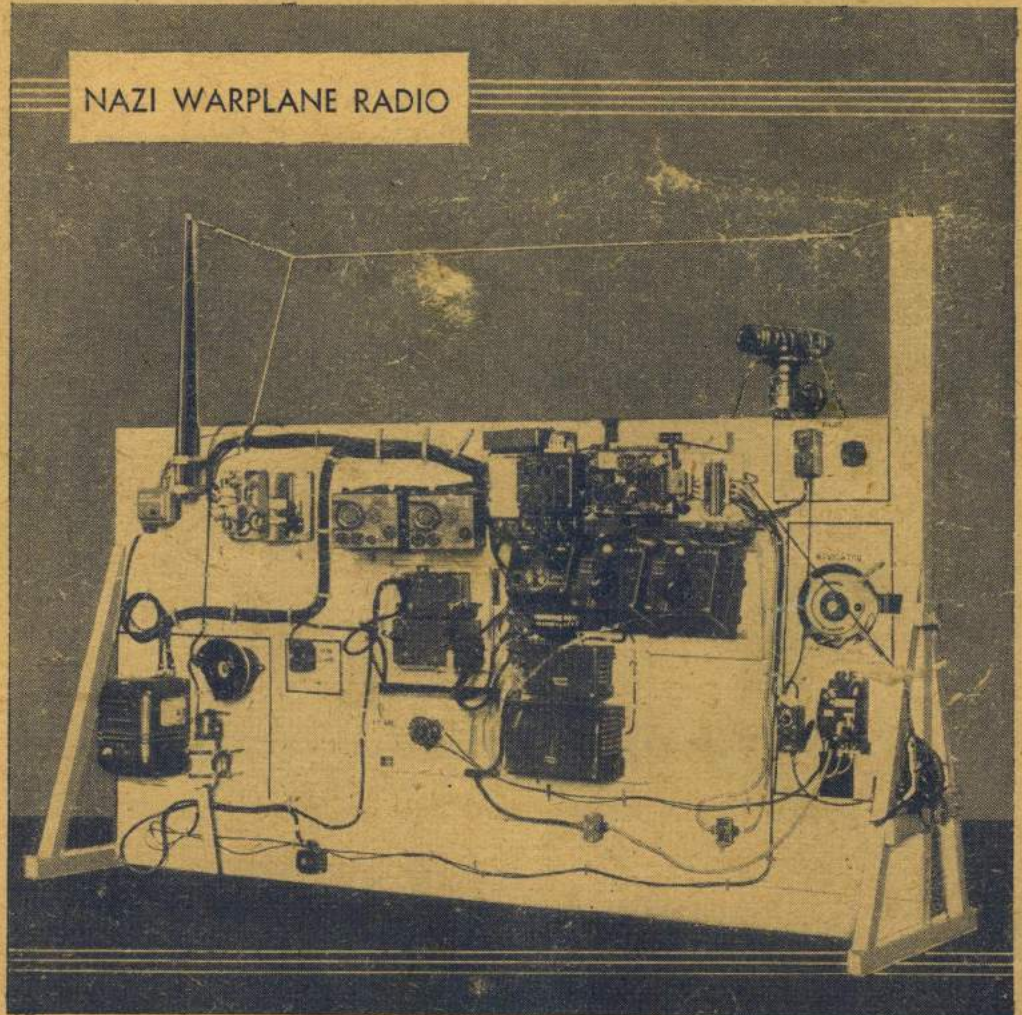
December, 1940.

## ★ PRACTICAL TELEVISION ★

### Contents

- Spares-box Superhet
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- Multi-band Short-wave Rack
- Pick-up R. production
- Service Engineer's Log
- Modern Factory Production Methods

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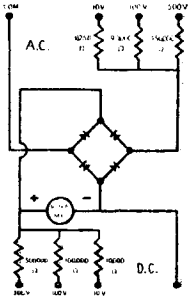
Deals with Matter and Energy, Electrified Matter, Electronic Content, Magnetism and Electro-Magnetism, Batteries and Accumulators, Wireless Communication and Broadcasting, Modern Valves, Wireless Signals, Wireless Receiving Circuits, Wireless Measuring Instruments, etc.

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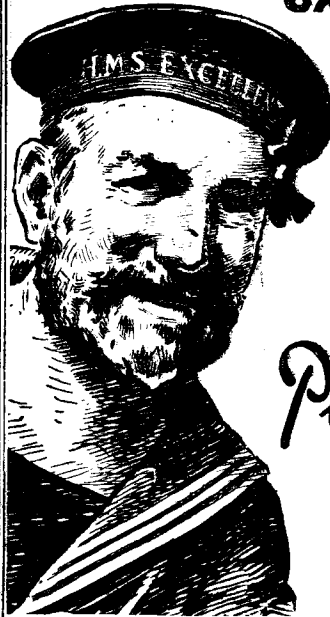
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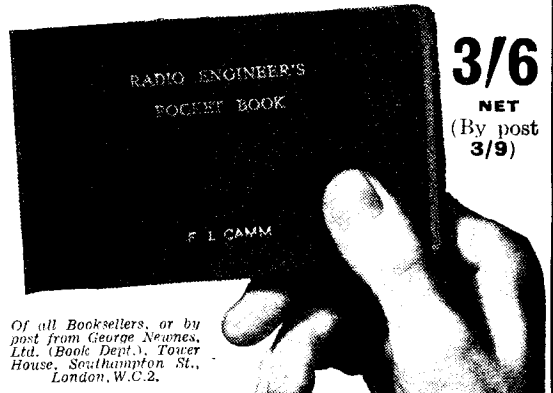
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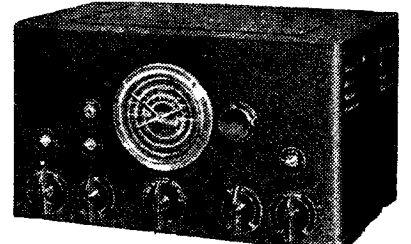
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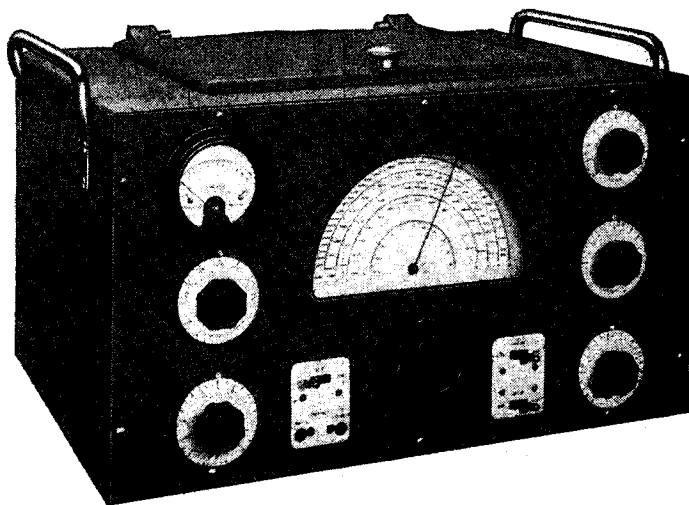


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" 2 "	1,500/1	(Range 'D')
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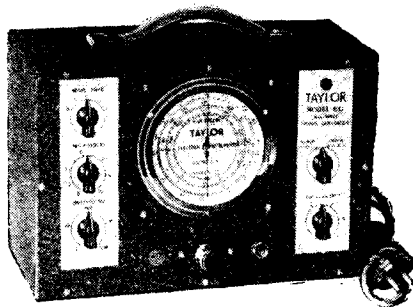
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0-25 "	0-100 "	0-25 "
0-100 "	0-250 "	0-100 "
0-250 "	0-500 "	0-500 "

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Complete with instruction booklet, leads, interchangeable crocodile clips and testing prods.

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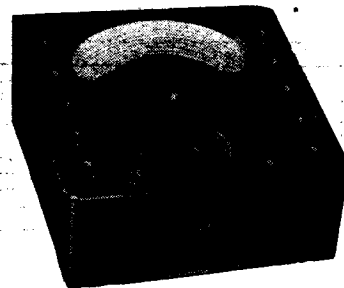
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4-watt A.C./D.C. "	3 0 0	3 17 6
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# Practical and Wireless

★ PRACTICAL TELEVISION ★

EVERY MONTH.

Vol. XVII. No. 414. December, 1940.

EDITED BY  
F. J. CANN

Staff:  
FRANK PRESTON, W. J. DELANEY,  
L. O. SPARKS.

## COMMENTS OF THE MONTH

### The Power of Speech

I SUPPOSE that everyone in this country either listened in to or read the report of Mr. Churchill's broadcast to the French nation, and felt exhilarated by his fine choice of words, and the logic of his arguments. Mr. Churchill is that rare combination, an entertaining and facile writer of literature, a thinker, a politician, a journalist, and a convincing and inspiring speaker. There is no one in this country better able to put our case than he. Our broadcast propaganda has been and will continue to be severely criticised until it is planned by an expert in a style similar to Mr. Churchill's. Such a man must be able to coin a succinct and withering phrase, be able to satirise a situation, and by droll contempt to lampoon our enemies.

Instead of that, much of our propaganda is namby-pamby milk-and-water stuff which fails to convince. If we decide that it is necessary to drop pamphlets, those pamphlets must make the best available use of the paper on which they are printed. It is my view that our enemies take as little notice of our pamphlets as we do of theirs. The Germans have not wasted time, machines, and pilots in a pamphleteering campaign. Their aircraft have been loaded with bombs instead of bombast. They reserve the latter for Lord Haw-haw.

There is a growing conviction here that we should not waste further time on pamphlets, but should load our aircraft with bombs, particularly as we are not able to spend so much time over Germany as they are over this country. Those who think along these lines urge that our programmes in German should be more intense, more frequent, and prepared by a publicity expert. The pamphlets may fall like the gentle rain from heaven upon the place beneath, but the purpose of rain is to nurture the roots and encourage growth, in this

case in the form of forcing the Germans to see the error of their ways. The B.B.C. motto is "Nation shall speak peace unto nation," but before that altruistic state of affairs can be brought about we must confine attention to winning the war. It is idle to waste programme time speaking peace to a nation which will not listen to peace. We must wage and win the word war as well as the war of arms. We must ensure that radio plays its part in preventing a recurrence of war, if we are to decide the new order of things. We owe that to posterity.

### Scrap Metal

RECEIVERS to be described in this journal in the future will, for the most part, be designed on the wooden chassis principle. We do not propose to use metal chassis whilst there is a need for the metal to be used for munitions of war; which reminds us that most constructors may have old aluminium chassis and metal screening boxes and cans which will be far better on the local scrap-metal dump than reposing in their junk boxes.

Our point of view on the long debated problem of chassis versus baseboard is well known, for almost

every one of our receivers has been designed on the chassis principle. Because some constructors found difficulty in working metal we produced the metallised wooden chassis, whilst for those who preferred metal itself we encouraged component manufacturers to supply the chassis ready drilled and bent. We propose, therefore, now to revert to the metallised wooden chassis.

### Component Supply

ALTHOUGH there is a temporary delay in the supply of components, due to a variety of causes, we assure readers that component manufacturers have not decided to discontinue catering for the constructor market. Adequate supplies will shortly be available, and in the meantime we are designing receivers around components which constructors already possess, as a further aid to national economy. Notwithstanding the war there are still tens of thousands of constructors building sets, and the war has not reduced the interest in the hobby.

### Christmas

ALTHOUGH in common with most other journals we have decided not to produce a Christmas number this year, owing to the paper shortage, we none the less wish all readers a merry and enjoyable Yuletide.

### Queries

THERE has been no diminution in the number of technical queries we receive since the war started. It is important, however, for readers to note that queries must be accompanied by a coupon cut from the current issue, and if a postal reply is required a stamped, addressed envelope must also be sent. We reply by return of post, but owing to the war there may be temporary postal delays which we are certain our readers will excuse.

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Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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# NAZI WARPLANE RADIO

*Impressions of a Member of the Staff of "Practical Wireless" who Recently Examined the Equipment of Several German 'Planes Which Have Been Brought Down in This Country*

**AERIAL MAST**

**L.W. RECEIVER**

**S.W. RECEIVER**

**D.F. SENSE AND B.A. MATCHING UNIT**

**FIXED AERIAL MATCHING UNIT**

**TRAILING AERIAL WINCH**

**TRAILING AERIAL MATCHING UNIT**

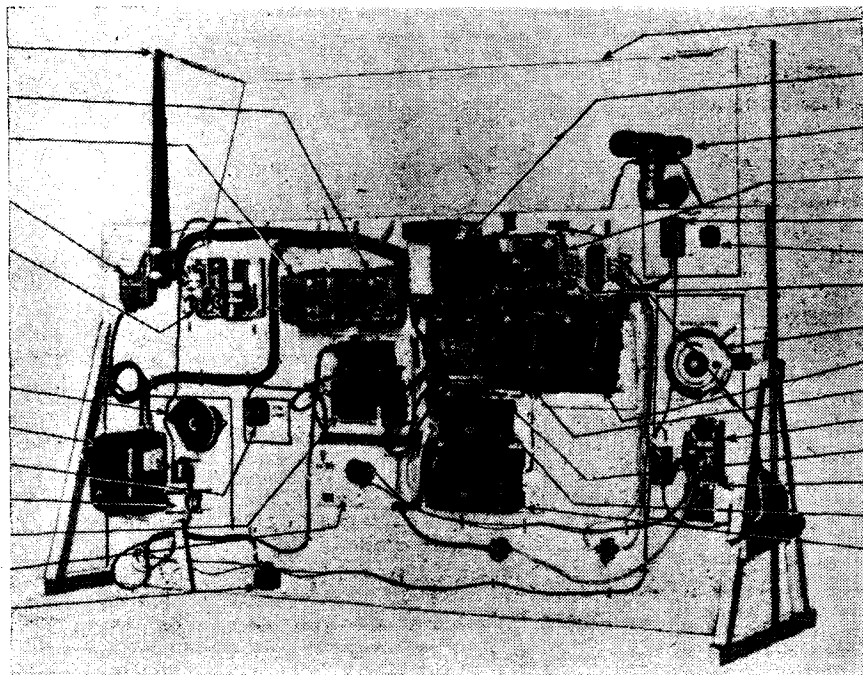
**REAR GUNNER INTERCOM.**

**FAIRLEAD**

**B.A. RECEIVER**

**D.F. RECEIVER**

**MARKER BEACON MATCHING UNIT**



**FIXED AERIAL**

**INTERCOM. SWITCH BOX**

**D.F. LOOP**

**INTERCOM. AMPLIFIER**

**PILOT INTERCOM.**

**COURSE METER**

**B.A. REMOTE CONTROL**

**NAVIGATOR D.F. LOOP CONTROL**

**L.W. TRANSMITTER**

**S.W. TRANSMITTER**

**D.F. RECEIVER CONTROL (Navigator)**

**AERIAL CONTROLLER**

**INTERCOM. (Navigator)**

**RECEIVER POWER UNIT**

**TRANSMITTER POWER UNIT**

*This illustration shows the instruments used on the Heinkel bomber, mounted on a board for easy reference.*

**T**ECHNICALLY sound, but not advanced; laboriously made; very easy to service and repair; the Germans can teach us very little about warplane radio. Those are the impressions which first occurred to me when I was recently privileged to see at close range the radio outfits of a number of Nazi 'planes of various types which have been brought down over this country. The equipment—and 'planes—was on private view to a few members of the Press at a well-known experimental station of the Royal Air Force.

Before describing the radio equipment in any detail it will be of interest to readers that there were no fewer than seven German 'planes in excellent condition at the station visited; many of them had been flown by members of the R.A.F. for experimental purposes. My first inquiry concerned the method in which some of these 'planes could have been brought down for them to have sustained so little damage. Well, one of them had actually been *landed by the pilot*, who was apparently under the impression that he was on French soil. Another, a yellow-nosed Messerschmitt 109, was in rather worse condition since the undercarriage had been broken away. Additionally there were bullet holes in the propeller, wings and engine cowling; nevertheless, its condition was quite good.

Later, I clambered into a Heinkel 111, a Messerschmitt 110, and several other German 'planes which were almost "as new"; in most cases the makers' date stamp showed that the 'planes had been built during the past few months.

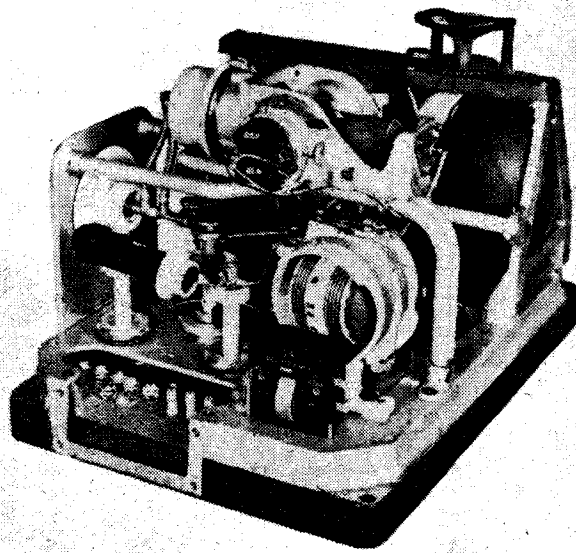
## Twin Receivers and Transmitters

With so many items of interest, it was rather difficult to concentrate on the radio equipment alone, although that was in itself extremely interesting. It is not easy to decide at what point to start a description, for there are so many units involved, as may be gathered from an inspection of the accompanying illustration of a complete bomber outfit mounted on a board for demonstration purposes. Primarily, there

are two receivers and two transmitters—short-wave and long-wave—in each. The terms used in reference to the wavebands may be rather misleading until it is pointed out that the bands are from 3 to 6 megacycles and 300 to 600 kilocycles respectively. These are, of course, equivalent to wavelength ranges of 100 metres to 50 metres, and 1,000 metres to 500 metres.

## Laryngaphones

In addition, there is an "intercom" amplifier, which is used for communication between the pilot and crew of the machine. This intercommunication is, of course, by telephony, but microphones, as they are usually understood, are not employed; instead, the crew use "laryngaphones" or throat microphones. These are in pairs, fitted in the flying helmet and press lightly against the sides of the "Adam's apple." In our own warplanes high-grade microphones are employed universally, and these have proved to be superior to the larynx microphones, although the latter are not so bad for the guttural speech of the Germans.



*Top view of the aerial tuning unit.*



**D.F. and B.A.**

In addition to the two transmitters and receivers, and the amplifier just mentioned, the Nazi bombers have a direction-finding receiver and a blind-approach receiver. The B.A. equipment operates on a wave-band of 28.5 to 35 mc/s, and is on a modified

to the D.F. loop, one of these being of the trailing kind and consisting of a coil of wire on a winch, and the other the small elevated aerial mounted on top of the fuselage. For use in conjunction with the aerials there is a multiple-way switch, which also

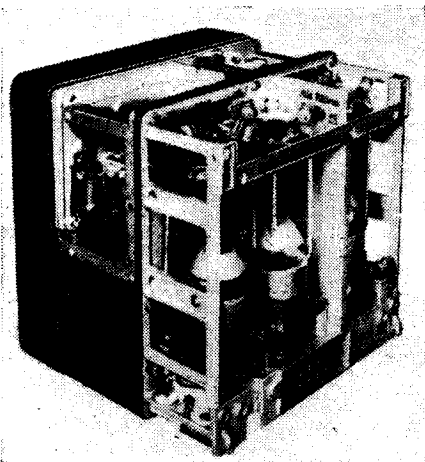
aerial-control units, generator and rotary converter.

**Alloy Die-castings**

Each unit could easily be removed from the rack after turning a couple of spring-loaded catches, whilst similar quick arrangements were provided for dismantling the units. When the case had been removed it was at once evident that the units were extremely well made—in fact, they were an instrument-maker's job. Pressings and stampings which are familiar to us were replaced by beautiful magnesium-alloy die-castings. It would appear that the equipment throughout is very costly to produce—far more so than ours. Despite this, however, it is slightly less efficient than that fitted to our own 'planes, and which it would seem can be made in a fraction of the time. What is more, ours has proved to be every bit as reliable—perhaps more so, since there are fewer rubbing contacts.

**Interchangeable Valves**

The main receivers are superhets, the other two being simple "straight" R.F. jobs. One point which is not without interest is that every valve in the superhets is of precisely the same type; all are H.F. pentodes, and can be interchanged. These valves are very compact and not unlike "acorns." They have a moulded base with side-pin contacts and a top cap. The holders are "inverted" so that the valves are pressed into place with the top cap downward; contact is made with it by means of a spring. Once a valve is in its holder it is completely enclosed and cannot be removed without a separate knob, which is screwed into a tapped hole in the centre of the base. The advantage of this is that there is never any pull on



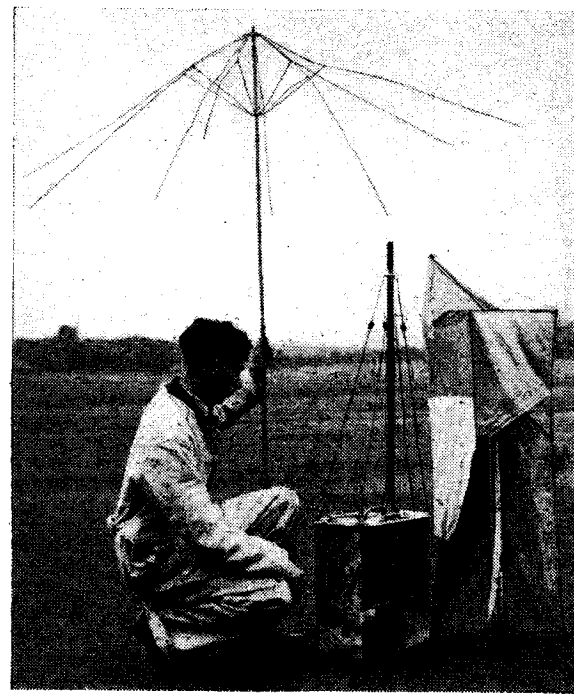
*A view of the transmitter with the cover off.*

Lorenz principle, where two beamed transmissions are used; one sends A's (.-) and the other N's (-.) and when the machine is on its correct course the two sets of code symbols "link up" to produce a steady "burr."

The direction-finding loop is unusual in that it more closely resembles a long, oval tuning coil and is under 6in. in major diameter. This is mounted inside the fuselage and can be controlled by the navigator who has a large compass with which the loop control is combined. When direction-finding the navigator's job is to turn the loop until a fixed and moving scale on the compass correspond.

**Power Supply**

Power supply is taken from a 24-volt accumulator which, as my guide explained, is constantly overloaded in the same manner that most car batteries are overworked. Charging is by means of a generator and H.T.

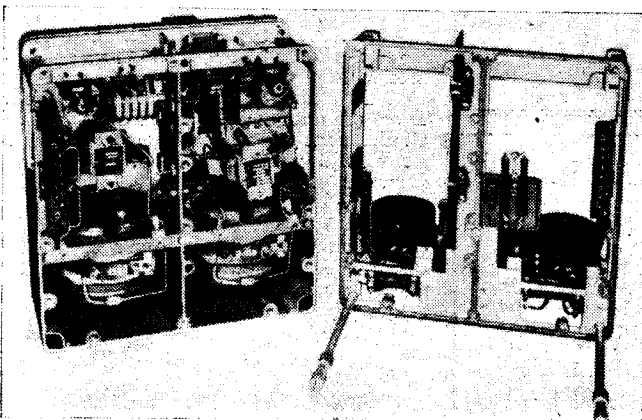


*A transmitting set found in a rubber dinghy from a German bomber which crashed into the sea. It has a kite aerial, and one of the "umbrella" type. It is used to send out SOS.*

serves to bring into use long- or short-wave receiver or transmitter.

After looking over the equipment in general, both on the demonstration board and in a number of 'planes, it was possible to examine some of the apparatus in greater detail by taking it apart. It was interesting to note that there was no shortage of German receivers and transmitters, which indicated that they had been recovered more or less intact from a large number of machines. On the bombers,

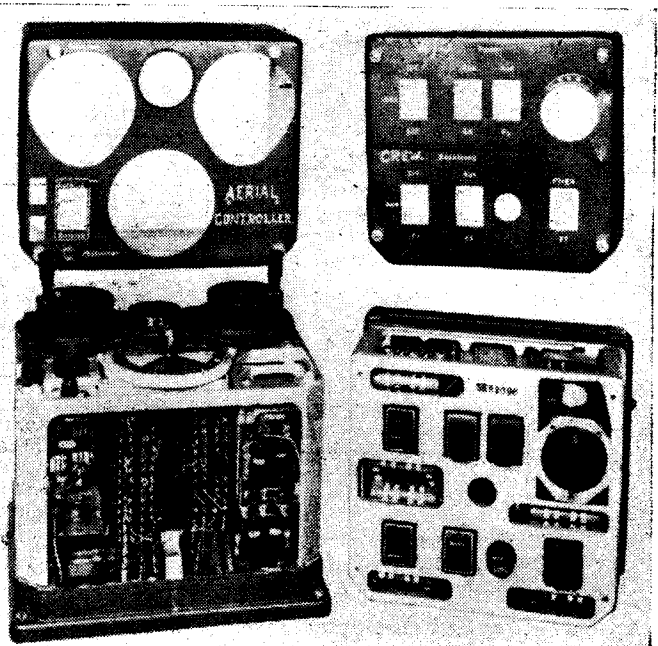
valves are very compact and not unlike "acorns." They have a moulded base with side-pin contacts and a top cap. The holders are "inverted" so that the valves are pressed into place with the top cap downward; contact is made with it by means of a spring. Once a valve is in its holder it is completely enclosed and cannot be removed without a separate knob, which is screwed into a tapped hole in the centre of the base. The advantage of this is that there is never any pull on



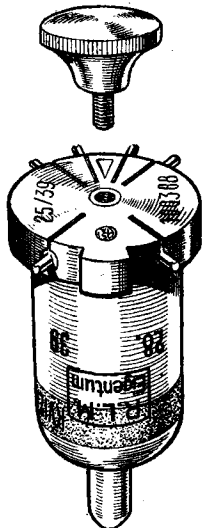
*Showing the transmitter dissected.*

is supplied by a rotary converter. Besides the main items of equipment which have been referred to, there are all kinds of switching and aerial control arrangements; it is obvious that extreme care is taken to ensure correct matching between whichever aerial is in use and the receiver or transmitter, and for this reason there are several intricate matching or aerial control boxes.

There are two main aerials in addition to the bulk of the equipment was seen to be mounted on a large and heavy bulkhead in front of which the wireless operator sits. Parts stowed away in the fuselage were the D.F. receiver,



*Aerial controller, and I/C controller.*



The interchangeable H.F. pentode, showing the moulded base, contact pins and locking screw.

the glass envelope—the base takes the whole strain imposed by removal.

### Convenient Servicing

Each unit is itself built up from separate units consisting of die-castings, so that a complete receiver or transmitter can be dismantled for service in a few seconds. The receiver tuning controls can be set to one of four "spot" positions, into which they "click," whilst the frequency at each can be checked and, if necessary, set, by making use of the transmitter as a beat oscillator. The arrangement is neat and, apparently, perfectly reliable. At the same time, if the many

"gadgets" fitted are not necessarily essentials, they are of the kind that have a strong appeal to the Nazi mind.

### Total Weight 358½lb.

In spite of the wide use of light alloys, the complete radio equipment of a German bomber weighs 358½lb. The technicians attached to the R.A.F. who were good enough to answer all my questions—or as many as I could think of in the time at my disposal—explained that, in their research into these German radio outfits, they have drawn the conclusion that, despite

their excellence in many directions, they have apparently been designed by ground engineers rather than by technicians who have specialised in aeroplane radio. They have formed the genuine opinion, after months of careful research, that there is very little which they can learn from German radio designers.

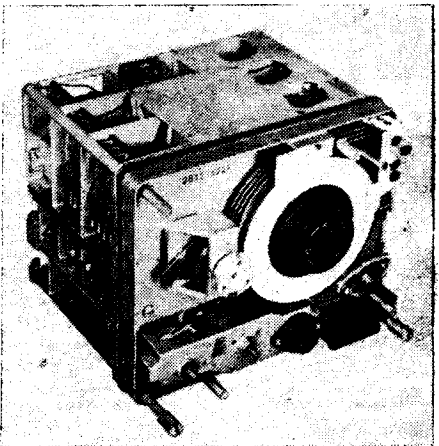
### No Secrets

The German Luftwaffe certainly have no radio secrets which they have so far been able to withhold from the Research Department of the Ministry of Aircraft Production. This Department has prepared complete dossiers which give every possible detail of Nazi Luftwaffe radio; these extend to several thousands of words and include dozens of photographs (a few of which we are able to reproduce) and many blue prints giving circuit details, valve characteristics and constructional data right down to the last screw. I saw a sheaf of these documents, and although they bore "SECRET" imprints in red letters, I was able to take a few cautious peeps at some of them. From this is evident that they know as much about the Nazi warplane radio as they do about our own! These documents pay tribute to the vast amount of painstaking work carried out by the research engineers. Another point which was obvious from a chat with one or two of these gentlemen was that they were thoroughly engrossed in their work, and absolutely determined that "Goering's boys" should not have the slightest chance to steal a march on them.

### Automatic S O S

Quite apart from the standard radio equipment of the German bombers (and it might be mentioned that the fighters carry much simpler though otherwise similar

radio equipment, without D.F. and B.A. systems), I was interested in another transmitter which had been salvaged from a German machine. This was a bulky automatic S O S transmitter contained in a metal box, which also holds the necessary batteries. There is also provision for fitting a vertical "umbrella" aerial or a kite aerial. Apparently this outfit is for the use of air crews who have to take to their well-known rubber dinghies. When they erect the aerial and switch on, a motor operates a keying system so that a string of morse S O S signals is sent out. Only one of these rather awkward-looking pieces of gear has so far been found, so it is assumed that it is carried only when there is a "big wig" on board. From appearances it seems likely that the aerial would tend to upset the boat rather than save its occupants!



A view of the receiver with the covers off.

## Broadcast Music in Factories

**A**N interesting installation of sound reproduction equipment was recently completed at the Osram-G.E.C. works at Hammersmith.

The installation, besides providing gramophone music, comprises equipment that enables it to be used both for the diffusion of radio broadcasts, and for A.R.P. and other "announcement" purposes. Two microphones, 220 speakers, amplifying apparatus, record-playing desk, radio and control panels are included.

The Employees' Welfare Department is responsible for the preparation of special programmes of B.B.C. and gramophone music, in which individual requests are considered. An extensive library of records is maintained and constantly renewed, there being about 250 discs in all, mostly of light music.

Programmes are radiated at intervals throughout the working day, and employees are extremely appreciative.

### Amplifying Equipment

The amplifying and associated equipment which comprises the system is situated in a control room in an underground part of the factory chosen for its invulnerability. The apparatus is mounted in convenient racks.

The amplifier has three 100-watt channels, taking the microphone, gramophone and radio inputs through a remotely controlled relay panel.

The remotely controlled relay panel allows appropriate switching from the

telephone exchange or control room according to which centre is being used for microphone announcements, it being possible to cut either of the microphones into the gramophone or radio programmes at will. A very flexible system is thus provided.

There are 220 speakers fed from this equipment situated in all parts of the factory, the type of speaker used depending on its situation.

### Speaker Installation

In the machine rooms, for instance, where the noise level is rather high, wide-angle projection speakers of the horn type have been fitted. These successfully overcome all extraneous noise and counteract the sound absorption propensities exercised by lathe belting. For general purposes, where relatively quiet operations such as hand assembly of valve parts are conducted, the standard industrial pattern speaker is installed. This type is also utilised for the air-raid shelters. In shops having approximately unity aspect ratio, i.e., square, concentric diffuser speakers are employed. These are designed to spread the sound in all directions at once, and are thus suitable for central mounting. Standard pattern domestic loudspeakers are fitted in executive and general offices. These speakers, together with those operating in the laboratories and in other situations where it is not advantageous to radiate music, are not connected with the radio or gramophone circuit.

It has been discovered that persistent noises of not too obtrusive a character affect enjoyment of programmes less than intermittent sounds, especially if the periods between the intrusions are irregular. By the careful placing and choice of speakers, however, this universal difficulty has been overcome.

A system such as has been described can be applied to a wide range of situations. Where factory managers are seeking, under the stress of present circumstances, to increase output and ensure the safety and welfare of their employees, it is greatly to be advocated.

### A BOOK YOU SHOULD HAVE

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GEORGE NEWNES, LTD. (Book Dept.), Tower House, Southampton St., Strand, London, W.C.2.

# THAT SPARES-BOX SUPERHET

A Reply to a Number of Similar Enquiries Which Have Recently  
Been Made by Many Readers. By "The Experimenters"

AS readers will have appreciated from a perusal of the correspondence columns of this journal, there has been a gradually growing clamour for details of a "spares-box" superhet. This is of especial interest to us since, in the issue dated October 29th, 1938, an article of ours on this very subject was published. At that time we were doing our best to whip up more interest in the superhet, and suggested that a trial of a simple receiver of this type, built almost entirely from spare components originally intended for "straight" receivers, would convince constructors of the advantages of the superhet. But we were "before our time," because it has taken more than two years for more than a few readers to appreciate our point of view.

## A Compromise Circuit

The position has not changed greatly, as far as superhet design is concerned, since we wrote the article referred to above, so we must still face the fact that a receiver of this kind can only be a compromise. It is not possible to make a first-class superhet to approach in performance the various special designs which have been published in these pages by using components which were not in the first place intended for use in a superhet circuit. But we have found that it is possible to make a simple superhet, which is better than the average small "straight" receiver by going back to a circuit arrangement of the kind which was in use before the introduction of the special frequency-changer valves now used as a matter of course.

Our difficulty is, however, that we cannot give any one complete design which is immediately adaptable to every combination of components which different readers may have lying idle in the spares box. The best we can do is to give a circuit, provide a simple explanation of it, and show how constructors can adapt and modify it to meet their own requirements. But, even then, it should be fully appreciated that individual constructors must be prepared to carry out a certain amount of experimental work on their own if they are to produce a receiver which is a sound job.

## Two-valve F.C. Unit

As most readers are aware, the portions of the superhet which follow the frequency-changer are very similar to the H.F., Det., and L.F. stages of the average "straight" receiver. It is, therefore, the frequency-changer portion which calls for most attention. Rather than making a start by building an entirely new receiver we suggest that a frequency-changer unit should be built which can be used in conjunction with an existing set of the H.F., Det., L.F. type. That will simplify matters to a marked extent because the constructor will know that the greater part of the completed superhet is in good working condition, and therefore that any troubles which may be experienced have their origin in the new unit. Fault-tracing, if any is found necessary, can therefore be confined to a couple of valves and their associated circuits.

A simple circuit for a two-valve frequency-changer, employing an H.F. pentode and a triode is shown in Fig. 1. It will be understood that the H.F. pentode

acts as so-called first detector, while the triode is the oscillator. By feeding back the output from the reaction winding of the oscillator coil to the anode circuit of the first detector, a simple form of anode-circuit "mixing" is obtained. For battery valves in particular—although the method is applicable to mains valves—this method of coupling was found very satisfactory in the pre-heptode days.

## Circuit Details

The circuit of the first detector is similar to that of an H.F. valve, and a standard aerial tuning coil can be used with it. The coil is tuned by means of a single .0005-mfd. condenser. A special oscillator coil would

circuit, about 50 per cent. of the turns should be removed from the long-wave winding and 30 per cent. from the medium-wave winding. These figures are approximate, and some experiment may be necessary to find the exact number to ensure that both tuning condensers are approximately "in step" when tuning over the two wavebands. It may also be desirable to remove about 20 per cent. of the reaction turns, but this is by no means certain. Most constructors will prefer to make a few experiments in this direction, however.

## Oscillator H.T. Voltage

In Fig. 1 it will be noticed that the oscillator-coil connections are marked to

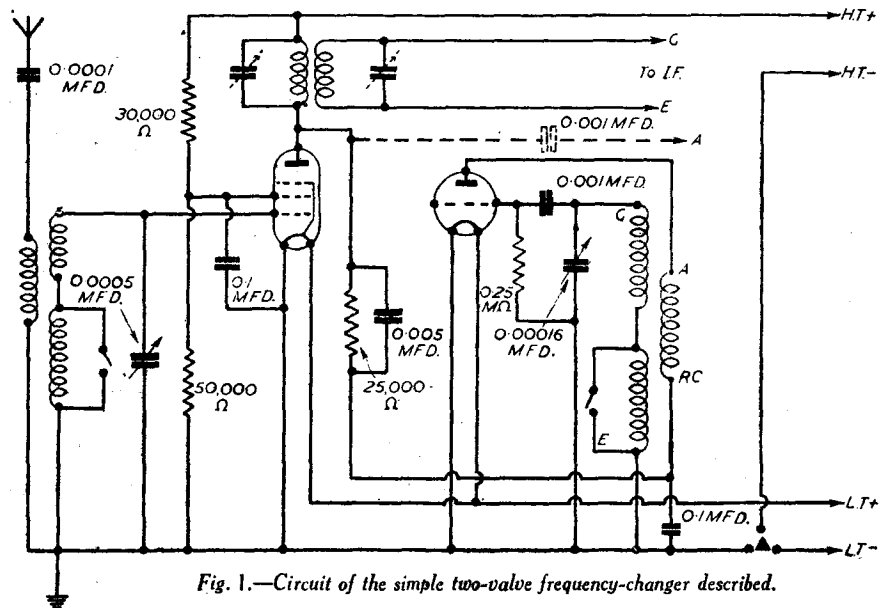


Fig. 1.—Circuit of the simple two-valve frequency-changer described.

normally be used with the triode oscillator, but since we are confining ourselves as far as possible to "spares-box" components we shall have to use a modified aerial coil with reaction. That rules out the use of a ganged condenser, since it is impossible to match up a modified coil without the use of special gear which no follower of this article is likely to have in his possession. It will be seen that a .00016-mfd. condenser is used for tuning the oscillator coil, although a value between .00015 and .00025 mfd. could be used without affecting results to a serious degree.

## Coil Modifications

The question will doubtless arise as to why a condenser of such a low capacity is to be used for oscillator tuning. The reason is that if we are to use an intermediate frequency of about 465 kc/s (and this is extremely desirable) the low capacity is necessary to permit of a tuning difference of about 650 metres between the aerial and oscillator tuning circuits. In addition to using the low tuning capacity, it is necessary to have an oscillator coil of lower inductance than that required for signal-frequency tuning; that is why special oscillator coils are made! Assuming, therefore, that a standard aerial coil with reaction is to be used in the oscillator

show the usual grid, earth, reaction condenser and detector-anode points. These should be followed after modifying the coil as mentioned above. Another point which calls for mention is the fixed resistor, by-passed by a fixed condenser, between the lower end of the oscillator reaction winding and the anode of the first detector. These values are not critical, but the condenser should have a capacity of not less than .001 mfd. In some instances it will be found that sensitivity can be improved by increasing the value of the resistor up to a maximum of about 100,000 ohms; on the other hand, the set might be "dead" in other cases if the value is greater than about 20,000 ohms. The point is that the value of the resistor governs the H.T. voltage applied to the oscillator, and therefore, the readiness with which this valve will oscillate. As most readers are aware, the valve should remain in continuous oscillation, but if it oscillates too violently the set will be less sensitive than it should be, while there might be some peculiar "dead spots" in the tuning range, or tuning may become erratic.

## L.F. Coupling

The next item to receive consideration is the L.F. transformer shown in the anode

(Continued on next page)

**THAT "SPARES-BOX" SUPERHET**

(Continued from previous page.)

circuit of the first detector. It is preferable that this should be used, although the I.F. tuning might be left entirely to the tuning circuits in the "straight" set with which the unit is to be used. Should the transformer be fitted, the aerial-tuning circuit of the "straight" set should be removed or disconnected. Additionally, it will probably be necessary to connect a .0002mfd. fixed or pre-set condenser across the section of the gang tuning condenser operating on the detector valve to raise the maximum wavelength to the necessary 650 metres on the medium-wave band.

If the transformer is not to be used, a single coil with pre-set condenser can be made and wired in place of the primary of the transformer. This coil may consist of approximately 120 turns on a lin. diameter former, and the pre-set condenser should have a capacity of .0005mfd. The lead shown in broken lines should then be taken to the aerial terminal of the receiver, and a small (say, .0003mfd.) pre-set condenser should be wired in parallel with each section of the gang condenser in the receiver; the object is, of course, to make the tuning circuits reach up to about 650 metres on the medium-wave band.

**Construction and Operation**

The construction of a unit of the type described can be along very simple lines, and Fig. 2 shows a suitable form of general layout when using a small baseboard. The exact positions of the parts are not important as long as the general rules concerning short, direct leads are observed.

To operate the complete superhet receiver it is first necessary to see that the I.F. (previously H.F. and detector) circuits are tuned to approximately the same wavelength. After that, a powerful signal can be found by operating first the oscillator

should be adjusted one at a time, starting from the "aerial" end of the "straight" set until maximum signal strength is obtained.

Before any of these adjustments are made the wave-change switch on the set should be set to the M.W. position and the tuning condenser should be adjusted to maximum capacity.

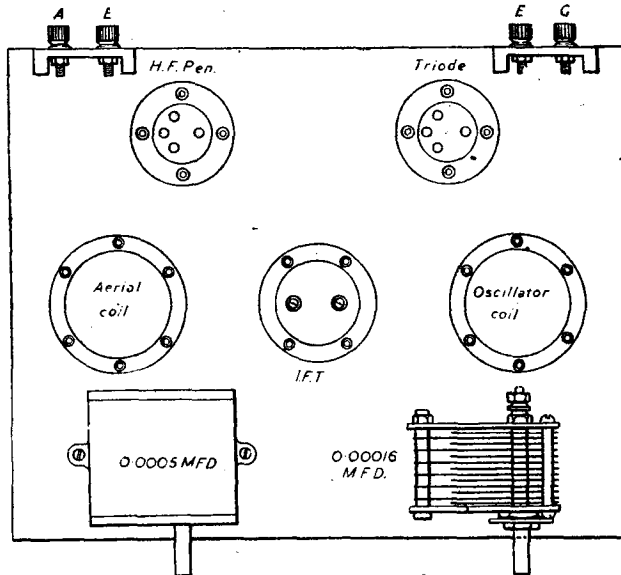


Fig. 2.—Suitable component layout for the frequency-changer, using a small baseboard.

**Tuning**

When these preliminaries have been attended to it should not be necessary to touch any condensers other than those on the unit to receive different stations. The difficulty of operating two condensers at the same time is more apparent than real, since the oscillator condenser has a more marked effect than has the aerial condenser. Until a little experience has been gained it will therefore be possible to tune on the oscillator condenser alone until a station is "found," and then to operate the aerial condenser. It will later

be found that both condensers can be operated together, fine tuning being carried out on the aerial condenser.

For those who would prefer to make a completely new superhet of the general type described, we reproduce the circuit given in our article of October 29th, 1938, previously referred to; this is shown in Fig. 3. It is similar in all major respects to that already dealt with, but has the addition of variable- $\mu$  volume control for the first I.F. valve, and uses I.F. transformers. A cross is shown in place of the resistor and condenser between the oscillator coil and the anode of the first detector. In the previous article it was explained that the value of the resistor should be chosen with some care; this has also been mentioned in this article. Special note should be made of the four-point on-off switch used to disconnect L.T., H.T. and G.B. supplies. If this were not used there would be a drain on either the H.T. or G.B. battery through the screening-grid or V.M. potentiometer.

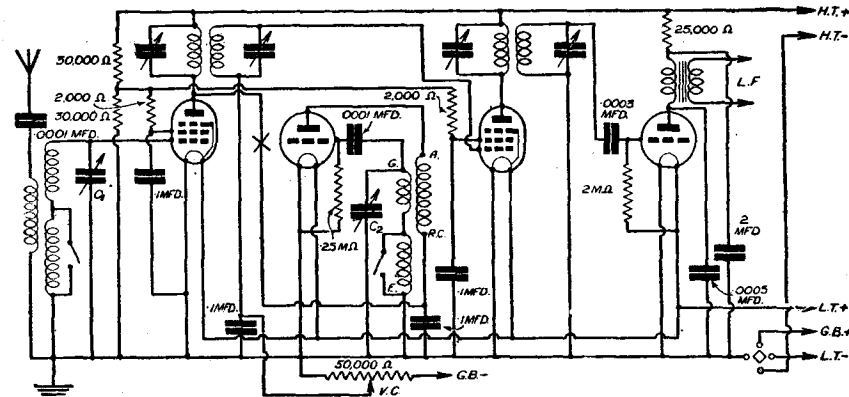


Fig. 3.—This circuit for a complete superhet, designed for construction with standard components, was suggested by The Experimenters in a previous article.

**Wireless Cure for Colds**

A STOKE-ON-TRENT consulting physician, Dr. J. P. P. Stock, has thought of a novel cure for the common cold. He claims to have perfected a short-wave wireless apparatus from which a high-frequency current passes through the head of the patient. The apparatus has recently been tested in a clinic in Manchester. A colleague of Dr. Stock said recently: "In about 70 per cent. of cases the cold improves while the patient is being treated, and he or she is much more comfortable afterwards. In about 50 per cent. of cases the cold is gone the next day, while the remaining 50 per cent. need one more treatment."

**A Radio Bombing Device**

IT is learned that William P. Lear, an American radio engineer, has perfected a device to enable mass bombing raids to be carried out in weather conditions which

**Items of Interest**

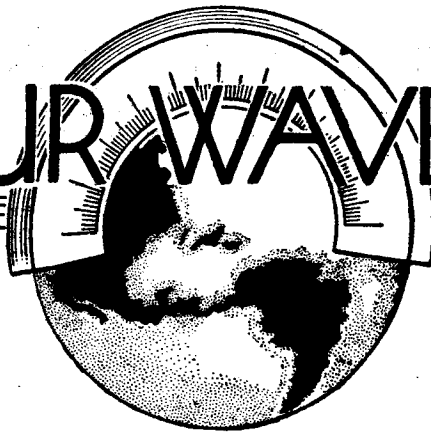
screen the bombing planes from the enemy pursuit pilots and anti-aircraft fire. Mr. Lear, who is an internationally-known inventor, demonstrated his invention before Allied military experts. The device consists of a radio set having a dial fitted with a pointer which indicates from which direction radio signals are received; a second indicator is "tied" to the North Pole. A miniature gyroscope is fastened to the second indicator, and this indicator keeps pointing in the same direction regardless of any turns an aeroplane may make. Thus, provided the pilot of a bomber knows his direction and distance from a target all he needs to do is fly a given length of time at a known speed and signal his crew to release bombs when his watch indicates that he has arrived. The test flight was extremely successful.

**Testing Radio Apparatus**

A NEW heterodyne reactance comparator has been developed by Salford Instrument Works which takes the form of a portable mains-operated test set and enables coils and condensers to be checked rapidly against standards. Two radio frequency oscillators, one of which is variable, are made to beat against each other, and the resultant signal is rectified and heard on a loudspeaker contained within the instrument. The variable oscillator is controlled by a knob and drum drive. An accuracy of  $\pm 0.1$  per cent. is obtained.

Other new instruments devised by this firm include a thermionic test set giving a wide range of both A.C. and D.C. voltages and currents; a "Q" meter for measuring the "Q" of inductances and capacitances of high frequencies; a miniature illumination meter with range 0 to 250 candles, and also further valve voltmeters.

# ON YOUR WAVELENGTH



By Thermion

## Sloppy Language

WE all have our pet irritations, and I hope no one accuses me of being an irascible critic because I criticise things with which I disagree, or which irritate me. The other Sunday I was listening to an anthology of music compiled on the theme of love at first hearing. It was a collection of songs which had appealed to the musician giving the broadcast the first time she heard them. In announcing the item she said, "I will now play you Schubert's Trout." Now you play cricket, you play football, you play tennis, you play the piano, the organ, or the oboe, but you do not play you. This grammatical error has been made by various musicians during B.B.C. broadcasts for several years, and it is time that the matter was put right. After all, we have a committee which includes a Welshman and a Scotsman to teach us how to pronounce English. They seem so busy teaching us to pronounce *cumbat* and *respit* that they forget that the correct use of English is more important. We cannot expect, nor can the B.B.C. expect, crooners and most of the band leaders to understand grammar, but we do expect the B.B.C. to give them instructions on announcing. The matter becomes more irritating when a speaker declaiming in an artificial cultured voice, makes such elementary errors. "I will play to you," or "I will play for you," would be correct. But not "I will play you." Much better still, "I will play So-and-so," omitting the *you* altogether. The verb to *play* is intransitive used in this sense and does not require, nor will it take, an object. I do hope that the B.B.C. will not allow its speakers to annoy me in this way in future.

## No Show

FOR the first year since broadcasting started there was not a radio exhibition this year. We were without the announcements of new designs and new accessories, and the glamour which is associated with the exhibition and the period preceding it. The last Radiolympia which was staged just before war was declared was abandoned before its period had expired, because of the declaration of war. That was only about 15 months ago, but it seems a remote ghost of the past to me. It was a splendid exhibition, which outshone the best of a long series. Television was about to come into its own, but that has ceased for the duration of the war, whilst America is forging ahead, particularly in the direction of colour television. This may mean that when this war is over and television programmes return we shall operate American television receivers. Skeleton experimental staffs are retained by our television firms, and we do not know what developments have transpired. Radio telephony was developed during the last war and contributed its part in bringing the war to a glorious and victorious end. Will television come to our aid in some way this time?

We are not permitted to say what new radio inventions are in being, but there will be many interesting developments after the war when these are released for general

use, and this journal reverts to weekly publication.

## Component Shortage?

I HAVE received many complaints from readers that they are unable to obtain certain components. I also learn that there is considerable delay in supplying such components as may still be supplied. This invites the thought that we should publish circuits which can be built from components which constructors may still have. One such receiver is described in this issue, and I understand that others are to follow. I welcome suggestions, therefore, as to receivers which readers would like designed round this idea. Coils seem to be the main trouble, but here our valuable book, "Wireless Coils, Chokes and Transformers, and How to Make Them," comes to the rescue. It describes how to make all types of coils and chokes, as well as transformers, and gives details for making coil winders. It costs 3s. 6d., by post 4s.

## The Front Line

WE in this office are still producing the journal from the front line, but we are carrying on undismayed by the bombings and the alleged blitzkrieg. Readers in the provinces can have but little idea of

## Our Roll of Merit

Our Readers on Active Service—Ninth List.

- D. J. Ferguson (R.N.),  
c/o G.P.O.  
East Barnet.
- D. W. Hunter (R.A.F.),  
Sussex.
- S. E. Young (R.A.F.),  
Burlney.
- V. Pellow (Bdr., R.A.),  
Lydden.
- C. F. Phillips (Pte., R.A.S.C.),  
Wiltshire.
- A. V. Pipe (A.C.2, R.A.F.),  
Tidworth.
- A. Stansfield (L/C., Royal Signals),  
N.W. India.
- R. Jackson (Signalman),  
N. Wales.
- C. S. Coathupe (Signalman),  
Stromness.
- J. Rathbone Sutton (Sgt., R.E.),  
Stromness.
- C. E. D. McLean (Cpl., R.A.F.),  
Norwich.
- F. P. Daly (Bdr., R.A.),  
Lincs.
- H. G. Swan (Signalman),  
Rotherham.
- A. Moorhouse (Gunner, R.A.),  
Kent.

the difficulties of newspaper and periodical production under present circumstances, but we know that they appreciate our efforts in carrying on. If your journal reaches you a little later than usual you will understand that the cause is beyond our control.

## Christmas

NORMALLY, this would have been our Christmas number, and packed with the interesting and topical features which have made previous Christmas numbers outstanding issues. This year, however, we have not the space available for these items, but we operate in the hope that by this time next year the war will be over, when we shall be able to prepare a journalistic feast for all our readers, including those who will have returned to civilian life from active service.

Sincere greetings to all readers at home and abroad, for the best possible Christmas under these exacting circumstances.

## Book Prizes

HERE is an interesting little contest with which you can amuse yourselves during black-out hours, when in the shelter, or in idle moments on active service. I want readers to write essays of not more than 200 words explaining how the war has affected their radio hobby, and what they propose to build when the war is over. There must be a lot of hard thinking going on about radio, and although the ideas cannot be put into practice they are none the less worth recording. Here is an opportunity for you to pass along your thoughts to other readers. Write on one side of the paper only, and send it to me not later than December 2nd. I will award books to the senders of all letters published.

## New Books

TWO new books have recently been issued from the offices of this journal. The first deals with the fascinating subject of watches, and it is entitled "Watches: Adjustment and Repair," and it costs 6s., or by post 6s. 6d. It not only deals with the principles of the watch and the history of its development but gives practical information on all aspects of watch troubles, methods of repair, whilst there is an interesting chapter on hall marks, another on making a watch demagnetiser, and a further one on watch testing machines. For the expert there is a chapter on how to tune a watch for a Kew "A" certificate—the hall-mark of watch perfection. Another new book is "Gears and Gear Cutting," which deals with all types of gears, their principles and methods of cutting them. It costs 5s., by post 5s. 6d. Both of these volumes are from the pen of your versatile editor. They may be ordered through booksellers or from the Publisher, Book Department, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.5. A handy catalogue of the full range of technical books published by George Newnes, Ltd., for students, electricians, engineers, aircraft workers and radio engineers, is available free on application.

## Comment, Chat and Criticism

# Outline of Musical History-14

**R** IENZI" was produced in Dresden on October 20th, 1842. It was a huge triumph, and Wagner was famous overnight. Two results followed. The management acquired "The Flying Dutchman" from Berlin, but owing chiefly to an inadequate performance it was a failure. And Wagner accepted the post of Kapellmeister with a salary of 1,500 thaler. He took it with many misgivings, and found himself hedged round with red tape and convention, which tried his fiery soul to its limits. He even had to put into writing that he agreed "to alter nothing in the hitherto accepted interpretation of tempo, etc., when conducting older operas, even when it goes against my artistic judgement, leaving myself nevertheless free, when studying newer operas, to exercise my best judgement with the object of getting as perfect an interpretation as possible."

### "Rienzi"

It was in the style of the failure, "The Flying Dutchman," rather than the triumphant "Rienzi," that Wagner founded his next work on. He was entranced with the old Tannhäuser legend when he discovered it in an old volume of German folk lore, and at once commenced work on a libretto, abandoning one he had started on, "The Saracen." The themes came to him during a holiday in Teplitz in June, 1842. It was to be a great advance on the "Dutchman"; "numbers" would be expanded to "scenes." The characters would plumb psychological depths not attempted in the former work, and the singers would be "really made to work."

The score was not finished until the spring of 1845. He again needed money badly; the success of "Rienzi" had brought all his creditors flocking after him, and Schroder-Bevriant had generously lent him a thousand thaler. But after harassing troubles during rehearsal, and the first performances, it settled down in the repertory, thanks to such famous numbers as "O Star of Eve" and "Elizabeth's Greeting," rather than to the "finer points," which few then grasped.

But it didn't make money, as they paid no royalties at Dresden, and the master rapidly reached a parlous state. Schroder-Bevriant presented his IOU and the piano-makers wanted their money. Sheer worry prevented him from making a start on "Lohengrin," which was then seething through his mind. A lease of life was granted by the Court Intendent advancing him 5,000 thaler out of the pension fund.

### "Lohengrin"

He found Lohengrin in the same volume along with "Tannhäuser," and commenced work on it in 1845. Two other tasks he undertook at this time were a performance of Beethoven's 9th Symphony—into which he threw himself heart and soul—and the writing of a remarkable report "Concerning the Royal Orchestra." He was arousing many rivalries and animosities through his presumptuousness and reforming zeal. Schumann and Mendelssohn, exemplars of "classicism," loathed him. Only Liszt and Spohr among the notables had anything to say in his favour. He felt isolated, and although he had many friends, the public remained cold and aloof. He had been

able to "make a complete success of the 9th symphony, but, as often as it was put on the stage, my 'Tannhäuser' taught me that the possibilities of its success had yet to be discovered. How was this to be done?"

## Further Notes on the Life and Work of Wagner by Our Music Critic, MAURICE REEVE

"Lohengrin" largely solved the problem. He devised a music that would not only express the emotions of each character. He elaborated the technique of the "leit-motif," making many motifs symbolise each character and mood in the opera, and constantly introducing them throughout the work.

Wagner himself was like Lohengrin. He came from Montsalvat, where unquestioning obedience, and the love that accepts without doubting, are demanded. All he asked for was faith in his message, and belief that what he had to say would be accepted as the truth by future ages. Although this was not granted him then, yet he lived to hear the world ring with his fame and his splendour.

### Revolution

He was profoundly moved by the wave of revolution that swept Europe in 1848.

Abandoning a project based on the life of Frederick Barbarossa, he turned more and more to "the expression of the purely human" that he believed underlay all our actions, and away from mere history and facts where life and conduct were so frequently tampered with and stultified. He turned to the simpler, more plastic, myth, and found Siegfried. In doing so he attained a far clearer vision of his goal. He decided that poetry was incapable of expressing the "purely human," and that it was music, the language par excellence of elemental motives and emotions, that could. Music, with a never-ending stream of expressive and character-drawing melody—the "leitmotif"—would express this whilst poetry's function was to direct this power.

That only he, Wagner, has succeeded with this "formula" is not surprising. The most cursory glance at these mighty works will show how peculiar they were to the man himself, and how, as with Beethoven's handling of the symphonic form, he left nothing for others to do but to imitate—if they cared to.

His debts were enormous—at least 5,000 thaler. The revolution had been succeeded by a strong reactionary movement, and the king and court, gaining new strength from it, managed to hold the master up as a dangerous revolutionary. Performances of the "Dutchman" and "Rienzi" were cancelled, and "Tannhäuser" rejected. He would have been dismissed but for the Intendent Luttichon.

### National Theatre Scheme

All this only drove Wagner into the revolutionary movement. But with black ingratitude he wrote articles in the press renewing his arguments in favour of a national theatre, a scheme which, if carried out, would have meant Luttichon's dis-

missal. In the spring of '49 civil strife broke out again, but when it was quashed, in a few days, and the rebel government, with Wagner, retreated to Freiburg and Chemnitz, it was found that the musician, by going to a separate hotel, was more prudent than the statesmen. The whole government, in their hotel, was captured. Wagner escaped.

The civil war fascinated him and he took an active part in it. He fought with the rebels behind the barricades and hurled pamphlets at the Prussian troops reading "Are you with us against foreign troops?" He requisitioned horses and carts and kept in constant touch with the provisional government. Then he heard from Minna that a warrant was out for his arrest. Liszt it was who befriended him, and who got him over the frontier. It was decided he should go to Paris via Switzerland, and he took a last farewell of Minna at Jena. On May 28th he was free and safe, but he was not to step foot on his native soil again until 1862, when he was granted an amnesty.

### In Paris

Arrived in Paris, Wagner's feelings soon underwent change, and despair and loneliness seized hold of him. He greatly missed Minna but she refused to join him until he assured her of regular support. He worked at uncongenial plots which he hoped would be taken up by the venal Paris Opera authorities largely out of a sense of loyalty to Liszt, to whom he was under deep obligation. Liszt was very anxious to help him. He lent him money, produced Tannhäuser in Weimar, and wrote laudatory articles in the Paris press. But he could not go on helping indefinitely.

Wagner returned to Zurich in July. Minna rejoined him in September and was furious to see that he was still dabbling with the schemes that had led him on to ruin in Dresden. But he was unexpectedly saved by two ladies. Frau Ritter, an elderly widow of Dresden, who had heard of his predicament from a friend, and Jessie Lausot, née Taylor, a beautiful young Englishwoman married to a Bordeaux business man. The two women arranged to give him an income for two years.

Needless to say, he fell in love with Jessie but space precludes us following the details of an affair not very creditable to Wagner. She, too, was unhappily married, so the soil for such an affair proved very fertile. The long-enduring Minna forgave him again and once more they settled down to a chastened existence of very limited horizons, expecting less than ever of each other. He wrote to Frau Ritter: "At a single stroke I became old and I remain so," and to Liszt: "A too hasty marriage to a woman estimable but totally unsuited to me has made me an outlaw for life."

### European Reputation

During a period in Montmorency of anxious waiting for Jessie, Wagner perused "Lohengrin" and wrote off to Liszt: "A great longing has flamed up in me to have this work performed. Get my 'Lohengrin' performed." Liszt fulfilled his wildest expectations. He produced it at Weimar before a glittering audience, and Wagner's European reputation was established.

# Problems of Amateur Receiver Design—4

Some Notes on the Methods of Determining the Correct Values of Resistors Required in a Typical Circuit.

By FRANK PRESTON

**T**HERE are so many resistors, both fixed and variable, in the average modern receiver that it is sometimes rather puzzling to decide on correct values and suitable ratings. Primarily, in D.C. circuits, a resistor is used purely and simply to reduce the voltage or pressure in the circuits. But there are comparatively few circuits in a radio receiver which can be considered simply as D.C. circuits, since many of them carry both D.C. and A.C. (the latter probably in the form of H.F. or L.F. currents).

The most important D.C. circuit—and A.C. must be kept out of this if performance is not to suffer—is that which supplies the high-tension current to the valves. In most instances a number of resistors are required here for the purpose of reducing the full H.T. voltage available to figures suitable for the anodes and screening grids of other than the output valve. As far as battery sets are concerned, it used to be the common practice to use a battery with tapings and to tap off the required voltage for each valve. This method is, however, practically obsolete now. There are various reasons for its falling into disuse, the first of which is that some parts of the battery are more heavily "loaded" than are the others.

## Voltage-dropping Resistors

For example, suppose we had a 120-volt dry battery and took 1 mA. from the 60-volt tapping for the detector anode, 2 mA. from the 72-volt tapping for the screening grid of an H.F. pentode, 3 mA. from the 108-volt tapping for the anode of the H.F. pentode, and 6 mA. from the 120-volt terminal for the anode of the output valve. It is not difficult to see that the whole of the current (12 mA.) would be taken from the 0-60-volt portion and only 6 mA. from the portion between 108 and 120 volts. Similarly, the "load" on that part of the battery between 60 and 72 volts would be 11 mA., and between 72 and 108 volts it would be 9 mA.

In current practice, all of the valves are fed from the 120-volt terminal, and the intermediate voltages required are obtained by means of resistors—often referred to as "dropping" or "voltage-dropping" resistors. As a result, the same current is taken from every cell in the battery. The resistors also serve to isolate the various valve circuits and thereby assist in making the receiver more stable in operation.

Besides the H.T. voltages, it is not unusual to take the grid-bias supply from the H.T. battery, also by means of a voltage-dropping resistor.

## Finding the Voltage Drop

Before referring to the specific resistor in a typical circuit it will be as well to gain a clear impression of the action of a resistor; this brings up the familiar Ohm's Law, which almost every reader now knows as well as he knows the alphabet. Expressed in its simplest terms, the Law states that the voltage dropped by a resistor is equal to the current flowing through it (in mA.), multiplied by the value of the resistor in ohms, and divided by 1,000. Thus, if a 20,000-ohm resistor were used to supply the anode of a de-

detector valve passing 1 mA., the voltage drop would be 1 multiplied by 20,000 and divided by 1,000; that is, 20 volts. Therefore if the battery had a voltage of 100, 80 volts would be applied to the valve through the resistor.

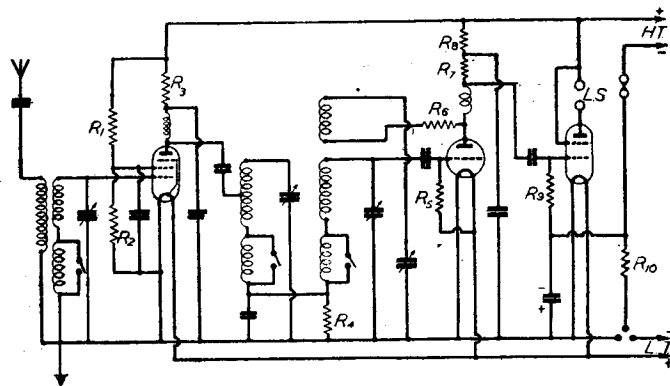
## Coupling and Decoupling

The accompanying illustration shows a general circuit for a three-valve "straight" receiver of the H.F.-Det.-Pen. type, and the various resistors are numbered from 1 to 10 for convenience of reference. It will be best to start by considering those in the anode circuit of the detector valve, and marked R.7 and R.8. The former is the coupling resistor or anode resistor; the latter is the de-coupling or voltage-dropping resistor—it serves both purposes. The value of the coupling resistor is not determined on the basis of voltage drop and current flowing, but is governed by the impedance or A.C. resistance of the triode detector valve. It is a general rule—based on both theory and practice—that the optimum value of that resistor is twice the impedance of the valve. Thus, if the detector valve were listed as having an impedance of

Having settled the question of the coupling resistor we can deal with the decoupling component. It will be clear that the voltage drop between the H.T. terminal and the anode of the valve is governed by both resistors, which are in series. Thus, the total voltage drop is equal to the sum of that across each. If we assume that we are using a 13,000-ohm detector valve, that the coupling resistor is 25,000 ohms, and that the total available H.T. voltage is 120, we can determine the value of R.8. First we must know what voltage should be applied to the detector valve and what current the valve passes at that voltage. For present purposes we can satisfactorily assume that the voltage required is 60, and that the valve passes 1.25 mA at that voltage (this information could be obtained from the valve-makers' literature or from valve curves).

## A Simple Calculation

We can easily find that the voltage dropped by the coupling resistor is 1.25 times 25, or approximately 31 volts. In all, we have to drop 60 volts, so the decoupling resistor has to drop about 29 volts.



A representative three-valve circuit, showing the principal resistors, which are numbered from R.1 to R.10. Methods of determining the values of some of these are explained in the accompanying text.

13,000 ohms, R.7 should have a value of 26,000 ohms. In practice, we should use 25,000 ohms as being the nearest convenient value.

## A Compromise

This rule cannot always be applied when using an H.F. pentode or tetrode as detector since the impedance of such a valve is often 1,000,000 ohms or more. And if the anode resistor had a value of 2,000,000 ohms very little current would pass through it or, conversely, the voltage "at the other end" would be negligible. If the current were 1 mA. for example (this would be quite impossible unless the H.T. voltage were phenomenally high) the voltage drop would be 2,000! In that case a compromise would have to be made by using the highest value which proved practicable or, better still, using choke or transformer coupling. Incidentally, this introduces a convenient rule-of-thumb method of applying Ohm's Law: the voltage drop is equal to one-thousandth of the resistance value in ohms for every milliampere of current. Another example will demonstrate this. If a current of 3 mA. were passed through a 20,000-ohm resistor the voltage drop would be 60—3 times 20.

In practice, then, we should use another 25,000-ohm resistor, bearing in mind that standard components are not generally guaranteed to have a degree of accuracy exceeding 10 per cent. above or below the nominal figure. Had our calculation showed that the decoupling resistor should have had a value of less than 10,000 ohms we should have used a 10,000-ohm component because, in general, efficient decoupling of a detector valve is not given by using a value of less than this. In other words, it is better to sacrifice anode voltage than decoupling efficiency, in the majority of instances.

When we turn to the voltage-dropping resistor in the anode circuit of the H.F. valve, marked R.3, the position is similar to that for R.8, except that there are fewer facts to take into consideration. We may know, for example, that we should apply 100 volts to the anode of the valve, and that the anode current of the valve at this voltage is, say, 2.5 mA. Again using Ohm's Law, we know that the resistance value required (in thousands of ohms) is equal to the necessary voltage drop divided by the current in mA. Thus, we have the value as 20/2.5 times 1,000,

(Continued on next page)

## PROBLEMS OF AMATEUR RECEIVER DESIGN

(Continued from previous page)

or 8,000 ohms. In practice we should use the nearest standard value obtainable—probably 10,000 ohms.

If the fixed potentiometer formed by R.1 and R.2 were connected to the lower end of R.3, instead of to the H.T.+ end as shown, the value of R.3 would be quite different. This is because the current passed by it would be the sum of the anode current, screening-grid current and the current passed by the potentiometer. This is a rather more involved case which we must leave for consideration in a later article of this series.

### Auto Bias Resistor

Another resistor indicated which is similar in principle to those we have studied so far, is that marked R.10. This is the automatic bias resistor, the voltage drop across which is used to bias the output tetrode. The first point to bear in mind is that, although the resistor develops the bias for one valve only, the whole of the H.T. current passed by the set goes through it. Before its resistance value can be assessed, therefore, we must find the total H.T. current consumption. We have stated that the detector passes 1.25 mA., and that the anode of the H.F. pentode takes 2.5 mA. To the sum of these we must add the current passed by the screening grid of the pentode, by the fixed potentiometer and by the output valve. For simplicity at this stage we will assume that the potentiometer and screening grid together pass 2 mA. And if we knew that the output valve passed 6 mA. when the bias was correct at 4.5 volts and when the anode voltage was 100, we could easily find all we wanted to know about R.10.

At this point it should be noted that we have assumed that the output valve will receive only 100 volts—not 120 as might be expected. This is to allow for a voltage drop of 20 across the speaker transformer and bias resistor; we could find the exact voltage drop if we knew the D.C. resistance of the transformer primary winding, and in practice we should make a check on this. However, we know that the total current passed by the resistor is 11.75 mA., and that we need a voltage drop of 4.5. The value of the resistance should therefore be  $4.5/11.75$  times 1,000. This works out at about 380 ohms, so we should use either 400 or 350 ohms, whichever may be more convenient. Probably neither value could be obtained easily, in which case we could use a 500-ohm variable resistor set to approximately the correct value, or we could connect a 1,000-ohm resistor in parallel with one of 500 ohms, which would give an overall value of 330 ohms.

In the next article of this series we can go a little further into the question of resistors.

## THE PRACTICAL WIRELESS ENCYCLOPEDIA

By F. J. Camm

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# The A.C. Four-wave Three

**SPECIAL NOTE.**—Owing to unforeseen delays, due to circumstances beyond our control, we regret that we are unable to publish, in this issue, the constructional details of the A.C. Four-wave Three receiver, the general specification of which was given in our November issue. We trust that all readers will accept our apologies for the unavoidable omission, and suggest that in the meantime they will proceed with the making of the mains unit, details of which are given below.

The Mains Equipment for this Receiver is Arranged as a Separate Unit, and the Complete Constructional Details of it are Given in This Article

**G**ENERAL details of the mains equipment were given in our issue of November, but for the benefit of those who are without such information we give below a brief description before proceeding with the constructional details.

The receiving circuit, in its present form, requires an A.C. L.T. input of 4 volts at 3 amperes, and a D.C. H.T. input of 300 volts at 60 mA's. To obtain these require-

ments, it was decided to use a standard Heyberd mains transformer, type W.33, in conjunction with a Westinghouse Metal rectifier, type No. H.T.16. The transformer is provided with two L.T. windings: one giving 4 volts at 5 amps., and the other 4 volts at 1 amp. Although these current ratings are not wanted in order to use the 5-amp. section and, at a later date when additions are made to the circuit, fuller use will be made of the surplus current. The high-tension winding gives a full output of 240 volts A.C. which the H.T.16 requires when it is connected as a voltage-doubler as in the Unit now being described. Separate tapping points are provided on the primary, thus allowing it to be used on any 50-cycle A.C. mains between 200 volts and 250 volts.

A Dubilier block condenser, type No. B.E.355, is used for the reservoir condensers. For smoothing purposes, a Premier L.F. choke, type 60/400, is specified and this, together with one of the 4-mfd. fixed condensers housed in the actual receiver, takes care of ripple and provides a hum-free D.C. output.

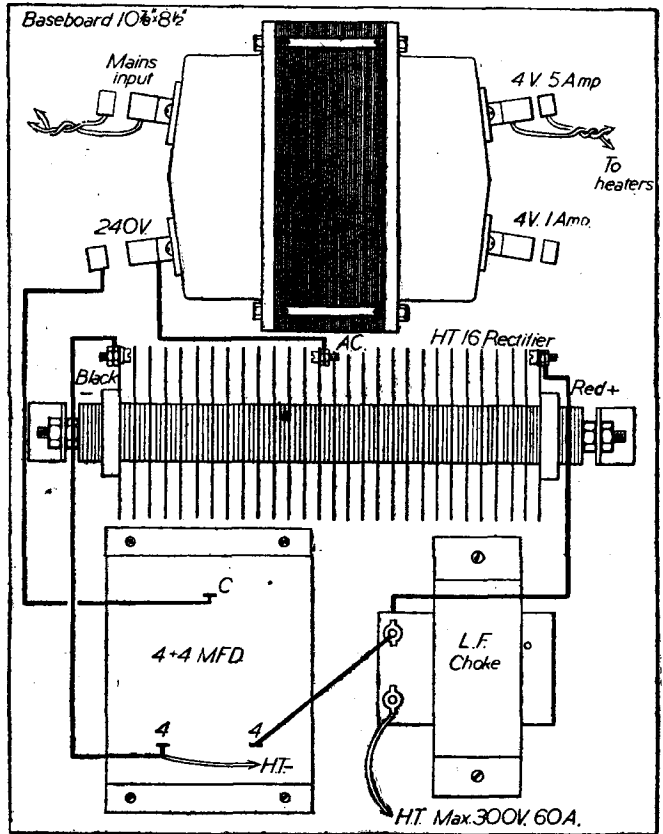
fixed in the horizontal position shown, and care should be taken to see that it is placed so that its markings correspond to the diagram, otherwise the polarity of the output will be reversed.

### Construction

As it is not always an easy matter to obtain metal during existing conditions, we have used a wooden baseboard for the Unit, but if sufficient metal should be to hand, then it would be more satisfactory to use that provided that it is earthed to the negative side of the circuit, i.e., D.C. output. The dimensions of the base are 10½ ins. x 8½ ins., this size providing just enough room for the components without crowding or making the assembly too

bulky. The plan drawing shown below gives the actual location of all the parts and clearly indicates the small amount of wiring necessary to enable them to form the complete rectifier unit.

The mains transformer, owing to its weight, should be fixed with small bolts right through the baseboard or with wood screws of sufficient size to render the fixing absolutely secure. The rectifier must be



Layout and wiring for the mains unit for the A.C. Four-wave Three.

The block condenser is fitted with three soldering tag connectors, one being common to both 4-mfd. sections and marked C, whilst the other sides of the two condensers are marked with a 4.

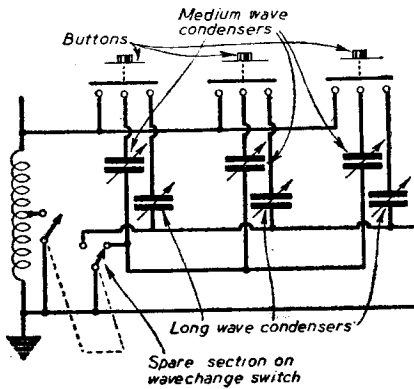
It will be noticed that no mains switch or voltage dropping devices have been incorporated in the unit. It is assumed that it will naturally be housed in or near the cabinet containing the set; therefore, use is made of the single-pole switch embodied in the volume control potentiometer—used in the set—for making and breaking the mains supply.



# Practical Hints

## An Improved Push-button Tuning Circuit

**M**OST push-button tuning systems employing pre-set condensers suffer from the disadvantage that the total number of stations is very limited. Here is a simple circuit whereby changing the waveband of the receiver brings into circuit another set of condensers. Thus if a four-button switch is used, i.e., three buttons for station selection and one for manual turning, three stations can be obtained on long waves,



Circuit diagram showing the application of a simple push-button tuning system.

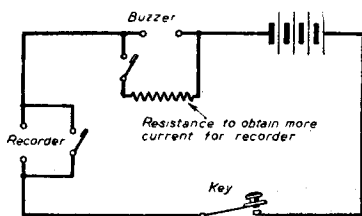
and by operating the wavechange switch another three are available on medium waves.

The circuit for 3 buttons is shown in the diagram.

In my case the wavechange switch is a six-pole three-way unit, and only one section is spare, but for those who use a wafer-type switch by adding an additional three-pole section, three stations could be provided on the short-wave band by changing over the condensers connected to one point. If this is attempted care will have to be taken that the additional wiring does not cause too great a loss, but this works quite well on two wavebands (medium and long). I have not yet tried including it on short waves, as my switch has not enough spare contacts. As will be seen, the cost of the switch is reduced, as a four-button switch is ample for average requirements where normally a six or seven button-switch would have to be purchased.—D. TWIVEY (Navenby).

## A Simple Morse Recorder

**T**HE following simple device may be of use to other readers learning the Morse Code, as it records the "dots and dashes" and enables the student to obtain correct spacing and length of signals. As my friend and I could not receive at the



Circuit diagram, and details of a simple morse recording apparatus.

## THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

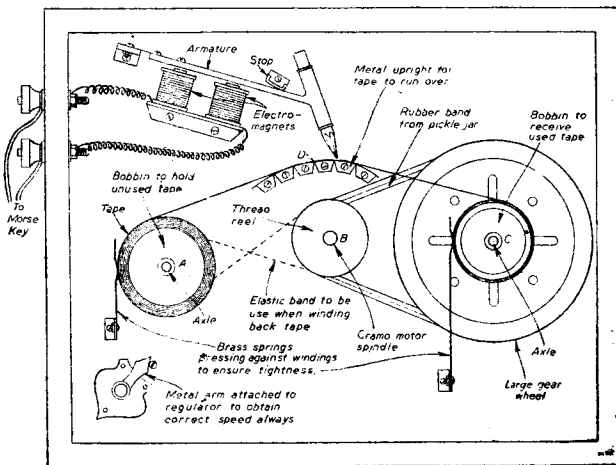
## SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

speed at which we could transmit, we found it very helpful in checking the accuracy of speed transmission.

The simple apparatus can be made from parts which most people have amongst their "junk." These are: an old gramophone motor, two electric magnets from an old electric bell—the armature from the bell having a pencil-holder soldered to the hammer end—three thread bobbins, a length of tape (we found gummed repair linen tape best, as it could be erased indefinitely without deterioration), a curved piece of metal, a large gear wheel, two steel axles, two strong elastic bands, two springs made from brass sheet, and supports (made from old audio-frequency transformer clamps).

The arrangement is as shown in the diagram. The tape is wound round bobbin "A" and kept in position by a springy piece of brass. From this bobbin the tape passes round a curved piece of metal "D" to the bobbin "C," which is screwed to a large gear wheel. This is driven by means of an elastic band geared to the bobbin "B," which is on the drive axle of the gramophone motor. The electro-magnets are fixed in position by a support. The armature is fixed opposite the magnets to enable it to be attracted, and in such a position that the pencil in the pencil-holder strikes the tape when it is passing over the curved metal.



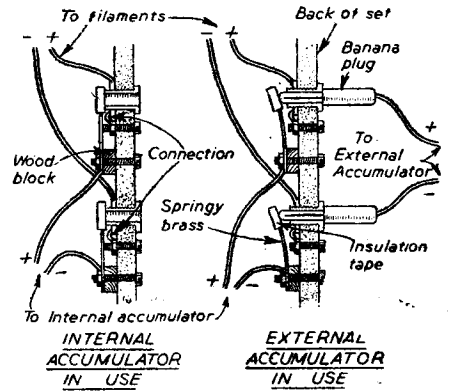
The gramophone motor is switched on, and bobbin "C" revolves, taking the tape from bobbin "A." When the Morse key (see circuit diagram) is depressed, the armature is attracted to the magnets and the pencil strikes the tape recording the signal transmitted.

By moving the armature up and down, two or more messages can be recorded on the same piece of tape without erasing.

To rewind the tape on to "A" for other messages, disconnect the band from "B" and connect "A" to "B" by means of the other band which is crossed so that "A" revolves in the opposite direction to "B." To prevent the tape on "C" from slipping, and to ensure a tight winding on "A" when winding back; a springy piece of brass is pressed against "C."—D. C. ADAMSON (Gateshead).

## An Accumulator Hint

**A**FTER finding that the accumulator supplied with a 4-valve battery portable ran down in a very short time, I devised the following system whereby a larger external accumulator can be used



Sectional views of an accumulator switching device.

with the set as a permanent installation, but without sacrificing its portability.

Two sockets, fitted with springy brass strips, are fixed on the set back and wired to the internal accumulator and existing I.T. leads, as in the accompanying sketch.

When the set is to be used as a portable the internal accumulator is connected to the set, but when the set is permanently installed two banana plugs connected to the external accumulator are inserted in the sockets, so disconnecting the small internal accumulator and bringing the external one into circuit.

In order to keep the internal accumulator in good condition, it is advisable to have it periodically charged.—M. JERVIS (Newcastle).

# Misleading Seasonal Faults

In this Article Various Causes of Burnt-out Aerial Coils are Explained.

**T**HE service engineer has to deal with many faults which crop up at definite times each year, some of which are real and others imaginary. For example, in spring and summer the complaints of poor sensitivity increase due to longer daylight listening and general summer receiving conditions, dry "earths," noisy reception due to increased static, etc. Autumn brings crackling caused by frayed and broken wiring in aerials when the gales commence. Complaints of short life of batteries in battery receivers are often due entirely to the longer listening hours in the winter time, and the generally more attractive programmes. Most engineers readily differentiate between the real and the imaginary of these kinds of troubles.

## Burnt-out Coils

There are a few troubles, however, which at first sight appear to be due to atmospheric conditions, but which are not due to that cause, and therefore divert diagnosis from the seat of the trouble. A type of this fault is where the aerial coils are burnt out, and the impression is that lightning or heavy static charge on the aerial build up a voltage which causes a heavy current to flow through the coils to earth. Before dismissing natural causes as being the source of the trouble, examination in other directions should be made.

In many cases where there is no outdoor aerial, and burnt-out aerial coils are met with, suspicion may be directed to any attempts on the part of the owner of the receiver or an "expert" friend to utilise the mains wiring as an aerial. If this cannot be proved it is possible that the aerial may be in a attic or in some location where the wire can come in contact with the mains wiring either directly, or through perished insulation material having a low resistance sufficient to pass enough current to burn out the aerial coils. It is generally found that the long-wave coils are the ones to burn out because of the thin wire with which they are wound, as compared with the heavier gauges of wire used in the construction of M.W. and S.W. coils.

## Mains Aerial Trouble

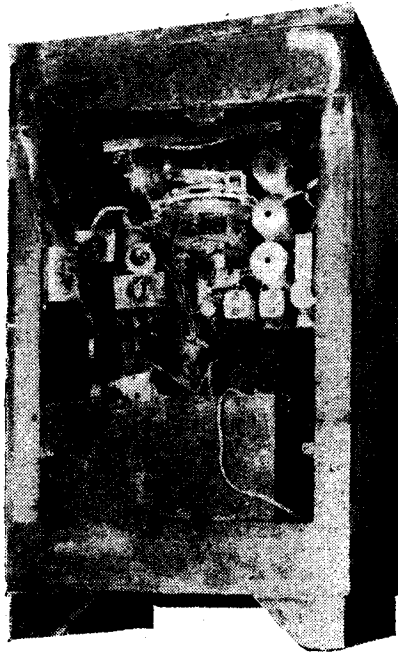
If the receiver is fitted with a mains aerial device it will be found that there is a series condenser which isolates the aerial coils from the mains wiring and if this breaks down, all coils burn out and a real fire is set up in the receiver. The condenser, however, may not be broken down completely but may have only a high resistance leakage which prevents sufficient current flowing to blow the fuses, but quite enough to burn out thin wire coils.

Another cause for burnt-out aerial coils is the mains transformer having a short circuit between the primary winding and its laminations which will, of course, put the mains on to the "earth" side of the aerial circuit. A leakage instead of a direct short circuit in a transformer is also sufficient to cause the fault.

The combination of conditions necessary to bring about burnt-out aerial coils due to transformer trouble is where no earth is used or where the earth has become, through

neglect, ineffective. Thus fuses in the mains supply do not blow.

The next condition necessary is that of low insulation between the aerial and earth, and the third and final condition that there is no aerial series condenser. With regard to the aerial condition, this may be due either to weathered or cracked insulators or generally poor erection, or the condition may arise due to the use of an anti-static aerial having some sort of aerial coupling circuit which connects the



actual aerial wire to earth through an aerial transformer.

With all these conditions satisfied the mains current will flow from the transformer primary, along the chassis to the earth side of the aerial circuit, through the aerial coils and along the aerial lead-in and aerial wire to earth through the leakage path, thus completing the circuit. One line of the mains supply is generally earthed at the power house. The aerial coil is then burnt out, smoke arises and there is an urgent appeal from the owner for service.



*Lightning may have caused the fire in this burnt-out receiver—but did it? Don't jump to conclusions is the theme of this article.*

This combination of conditions may seem very unlikely, but the writer, in conjunction with fire insurance officials, has on many occasions found the trouble to have been caused just as stated.

## Insulation Test

When new aerial coils have been fitted it is well to make an insulation test, preferably with a small megger or insulation tester which will apply 250 or 500 volts to the circuit being checked. Tests between the aerial coils and the mains input to the transformer should be made, and a measurement taken between aerial and earth and a general inspection on the lines outlined above to see that conditions of the burning of aerial coils due to mains leakage are not present.

It is easy to blame lightning or heavy static for burn-outs, but it is not easy to explain to the owner why the same fault happens again when you switch on the instrument for the first time after putting in new aerial coils!

## Broadcast Talks on Substitute Materials

**T**HE B.B.C. broadcast on Thursday, October 17th, the first of four talks on "substitute" materials which are to be delivered under the title, "Just as Good: how Science makes new materials out of old." The talks will cover Foodstuffs, Textiles, War Materials—rubber, petrol and plastics from the engineering point of view. Each talk is being given by an expert in that particular branch: thus Dr. Drummond, of the Ministry of Food, spoke in the Food Talk; Dr. Slade, of Imperial Chemical Industries, in the second and third; and Mr. Beaver, of the engineering firm of Sir Alexander Gibb and Partners, will speak in the fourth.

While it is certainly fatal that a nation should have to depend on substitutes, yet the search for the substitute is the foundation of all scientific and engineering progress, and in all—or nearly all—industrial development. The search goes on unceasingly and nowhere more energetically or more successfully than in our own country.

The so-called "substitutes" are often by no means mere substitutes; they are new materials, the creation of scientific development. If they are "synthetic" they are also progressive. In some ways, and for some purposes, they are often better than the products of nature.

# A Single-valve S.-W. Receiver

Constructional Details of an Efficient Receiver for the Experimenter, by Ex. 2FWA

**M**UCH interest seems to have been shown in so-called "hotted-up" single-valve short-wave receivers, so readers may possibly be interested in some further notes on the subject.

First of all, it must be realised that the detector stage of any "straight" receiver must detect the signal (no matter what its strength may be) before it can be amplified. Therefore it is advisable to get a single-valve working well, and not add L.F. stages on to a bad set, thinking they will make up for anything that is lacking.

It is surprising how two of these receivers can vary in performance. They have nothing in reserve, and losses cannot be compensated for by turning up a volume control. Now, what makes all this difference? There does not seem to be much in the circuit, but it can be narrowed down to one thing—the tuned circuit. Look at your own receiver. Does the wire from the moving vanes of the tuning condenser wander round the set? Does it go to the valve filament, and then on to the L.T.—and earth terminals before ending up at the coil? If so, it is hopeless! In the accompanying diagram the tuning condenser is right across the grid coil with the shortest possible amount of wire between them. Until you have tried this out for yourself, it is difficult to believe what a difference it can make. For instance, on a receiver similar to the one shown, the writer receives the 16-metre band at the bottom of the tuning scale with the yellow spot type coil advertised as going down to 22 metres. Admitted, the 100  $\mu\text{F}$  condenser has a lower minimum capacity than

the 150  $\mu\text{F}$  type with which the Eddystone people have calibrated their coils, but this alone does not account for the lower wave-ranges covered. The 100  $\mu\text{F}$  tuning condenser shown gives a nice overlap between each of the 4-pin Eddystone coils used. A bandsread arrangement could be incorporated, but still keep the wires as short as possible. Mount the two condensers as close as possible on the panel, and do not bother about getting them nice and symmetrical—it is efficiency that counts!

### Reaction Control

So much for the tuning; and now for the reaction control. This has been mounted on a bracket at the left-hand side of the receiver. Besides considerably shortening the wiring, this also gives quite a comfortable operating position.

The coil-holder and valve-holder are set close together. The [grid-condenser itself (one of the "tag" type) forms the actual wiring link between the two "grid" terminals. A 3-megohm grid-leak is suggested, but do not be afraid to try other values in order to get smooth reaction. Both selectivity and sensitivity are largely looked after by the efficient use of reaction, and many of the weaker stations can be

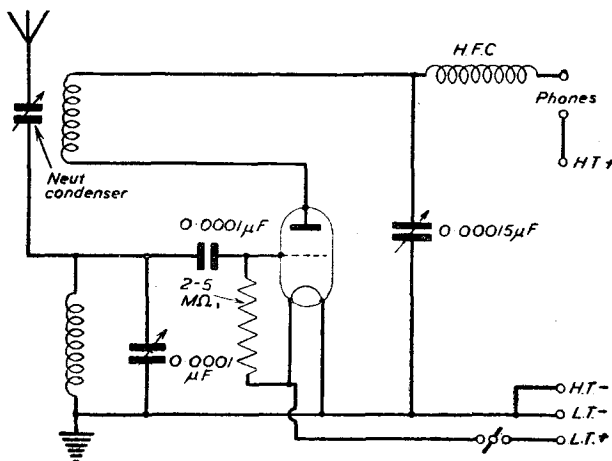


Fig. 1.—Theoretical circuit diagram of a simple one-valve short-wave receiver.

lost by a reaction control which is at all "ploppy." The receiver should slide into oscillation with a gentle breathing noise. Use a valve of the HL2 class, with just sufficient H.T. to get smooth reaction control on all of the bands. If the aerial coupling is made too tight "blind-spots" will appear. But, on the other hand, if it is too loose there will be a great deal of oscillation with a general "dead" feeling.

As for components, use the best you have got, and, if there is anything doubtful, cut it right out and use something beyond reproach.

About your headphones. You would probably be surprised how many ancient demagnetised pairs are in use. If yours come under this heading, invest in a new pair—it is essential!

### Plywood Chassis

Plywood construction is suggested. Some of that well-known grey enamel would give a good finish to it. Chassis construction has much to be recommended, and then all the battery leads can be tucked away underneath. If the valve and coil-holders are mounted up on short pillars, say one inch long, a further shortening of wiring is achieved.

Readers are strongly advised to get a receiver going on these lines, and to experiment with it until really satisfying results are obtained. If you are not satisfied with the signals received, do not do the time-honoured stunt of adding another valve. Find out the trouble in your detector, and when you are in a position to add an L.F. stage you will be pleasantly surprised at the results.

If the constructor intends to add an L.F. amplifier at a later stage, the chassis must be of sufficient length to accommodate the additional components.

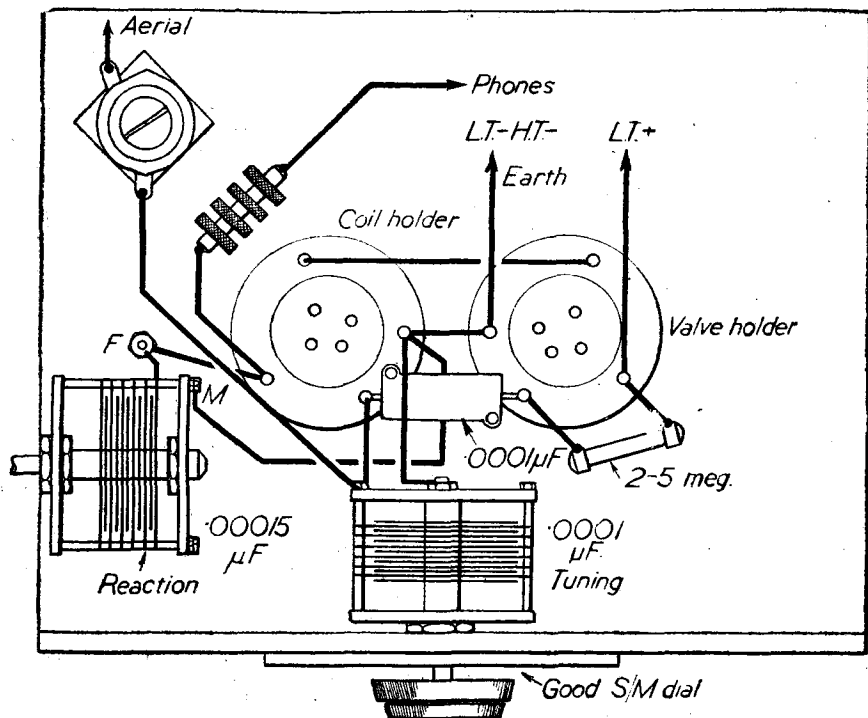


Fig. 2.—Suggested layout of a single-valve receiver built to the circuit shown in Fig. 1.

## PRACTICAL WIRELESS SERVICE MANUAL

By F. J. CAMM.

From all Booksellers 6/- net, or by post 6/6 direct from the Publishers, George Newnes, Ltd. (Book Dept.), Tower House, Southampton St., Strand, London, W.C.2.

# THE "SHELTER"

ONE very satisfactory form of detraction from the cause which obliges us to occupy A.R. shelters is, undoubtedly, a radio receiver capable of picking up the transmissions from our Home Stations. In many shelters it has been possible to install mains-operated commercial receivers; in others, use has been made of the usual house installation to operate an extension speaker but, judging from the inquiries received, the majority of our readers are not able to adopt either of these arrangements. In view of this, therefore, we are describing a very simple three-valve circuit which, in areas where normal reception is obtained and where it is possible to use a short external hook-up aerial, will provide satisfactory results from the stations mentioned above, though, of course, it must be appreciated that the efficiency of the receiver will be governed to a great extent by the effectiveness of the aerial used.

bodyed, as the sole purpose of the receiver is to get the most satisfactory results consistent with the minimum of constructional work and expense. Bearing in mind that conditions will force the operator to use an aerial on the short side, it is not necessary to use coils capable of providing a high degree of selectivity. Those specified, they will be described in detail further on in this article, gave adequate selectivity and, what is even more important, allowed a generous portion of the signal strength to reach the associated grids.

An H.F. pentode is recommended for the H.F. stage, although an ordinary S.G. valve can be used if so desired. Its output is

A Simple Three-valve Receiver, to Provide Headphone or Loudspeaker

piece of postal cardboard tubing or, better still, paxolin, should be used, provided, in the case of cardboard, that care is taken to see that it is perfectly dry.

For the aerial coil, 70 turns of 22 gauge enamelled wire is required, the winding being made so that all turns are tight up against adjacent ones. A tapping loop is brought out at the 23rd turn from the start, and this is accomplished by doubling a length of the wire and pushing it through a small hole which has to be made in the correct position in the tube by means of a fine bradawl. When bringing out this loop, take great care to see that the turns do not become loose. It is essential for the winding to be both neat and taut, otherwise any looseness or unevenness will seriously affect the ganging of the two circuits. When the 70th turn has been wound, leave 5in. or 6in. of the wire before cutting off, and then make the winding secure by passing the end twice through two holes in the tube so that a firm anchorage is obtained. A little extra trouble taken with the winding and finishing of the coil will be amply repaid by improved results. The tapping loop forms the connection for the aerial, as shown in the theoretical circuit.

The H.F. coil is identical to the aerial, but it has to have an extra winding for the reaction circuit! When we say identical, we mean it in the true sense, so far as the 22 gauge winding is concerned, for the very important reason of securing perfect ganging as mentioned above. The position and method of winding the reaction winding are shown in Fig. 2, which gives a good idea of what the two coils should look like. At the bottom end of the coil, i.e., the end most remote from the tapping point, wind over the enamelled wire a strip of dry paper or Empire cloth, 3in. wide, until two or three layers have been put on. Over this band of insulating material now wind 20 turns of 34 gauge enamelled or D.S.C. wire, taking

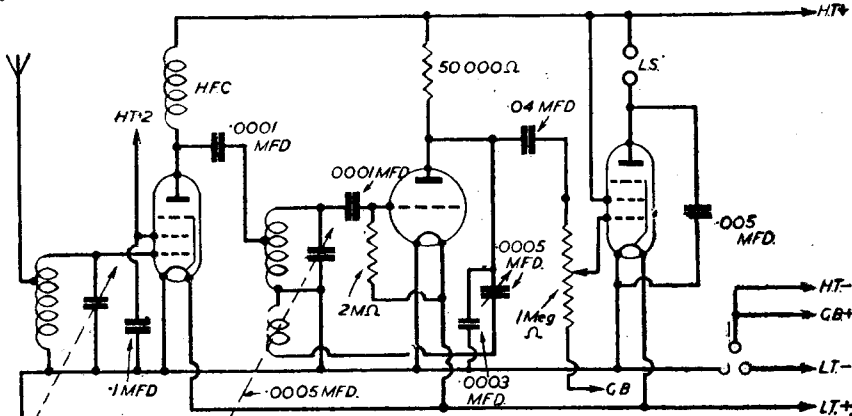


Fig. 1.—The theoretical circuit shows that there is nothing complicated in its design or wiring. The coils are fully described in the text.

To meet general demands, and to make construction cost as low as possible, battery operation and home-made coils are used, and as the latter only have to tune over the medium wave-band no complicated or tedious winding is required, and wave-change switching is eliminated. It is quite possible that the majority of the parts specified will be on hand but, if this is not the case, no trouble should be experienced in obtaining them from our advertisers, as we have been careful to select those items of which large stocks are normally available.

Although the receiver is shown in simple chassis form, it is suggested that the constructor takes the matter a step further, and houses the chassis and, if possible, the batteries in a stout wooden case, thus making it an easy matter to take the set into the shelter when required or, depending on individual ideas, fixing it in the shelter in the form of a permanent installation. The loudspeaker is intended to form a separate unit, although there is nothing to stop it being housed in the receiver and battery case, provided that a small speaker is used, such as the W.B. Junior. Due consideration should also be given to the use of headphones. Apart from hearing the News, it is known that many people do not care to listen to radio during an actual raid, therefore, if 'phones are included in the equipment, those who wish to listen can do so without causing any interference to the other occupants of the shelter.

### Circuit

An examination of the theoretical circuit, Fig. 1, will reveal the fact that no frills or unnecessary components have been em-

coupled to the triode leaky-grid detector by means of the recognised "tuned-grid" arrangement. This system is both simple and efficient, as it allows a very satisfactory gain in a single band receiver to be secured, and eliminates high-tension from the coil and condenser circuit of the detector valve.

Resistance-capacity coupling is used between the output from the detector and the output pentode, the latter being selected because of its high gain and reasonable high-tension consumption. To enable the output volume to be kept within the limits required by individual requirements, and to prevent the pentode from being overloaded when a powerful signal is received, an L.F. volume control is provided in the form of a potentiometer between the grid of the pentode and its source of negative grid-bias.

The component specified incorporates a three-point switch which comes into operation when the control is turned to its minimum setting, thus making or breaking the L.T., H.T. and G.B. supplies according to which way the control is turned. A very simple tone corrector is provided by the .005 mfd. fixed condenser connected between the anode of the output valve and the common negative-earth line. If the response is too deep, i.e., if the tone is not sharp or clear enough, a lower capacity condenser can be used, but the value shown is that which gives the most satisfactory general response.

### The Coils

These are wound on a former having a diameter of 1 7/8 in., the length being 2 1/2 in. A

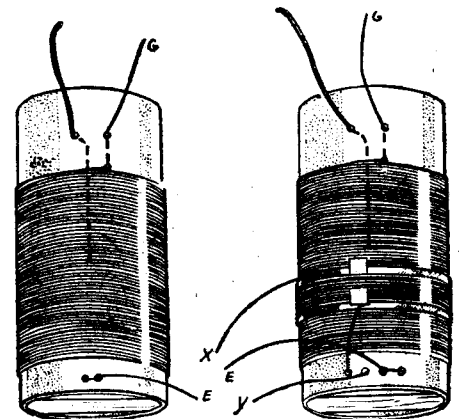


Fig. 2.—These diagrams, with the details in adjacent columns, will make the coil construction easy. Note that wire Y is connected to neg-earth line and X to reaction condenser.

# RSET" THREE

ing Home-made Coils, Designed  
peaker Reproduction in an A.R.  
ter

care to see that the turns are in the same direction as the other winding, and that they are neatly and firmly side by side. Anchoring the ends of this additional winding can be achieved by small blobs of Chatterton's Compound or sealing-wax; or perhaps a better way is to use a needle to thread the ends through the insulating band in such a manner as to make them secure. With this method, however, great care must be taken to see that the insulation of the underneath winding is not harmed and that electrical contact is not made between the two windings.

Inside the bottom end of the former fasten a small strip of wood, say, 3/8 in. to 1/2 in. thick, to provide some means of securing the coil, in a vertical position, to the chassis.

### Construction

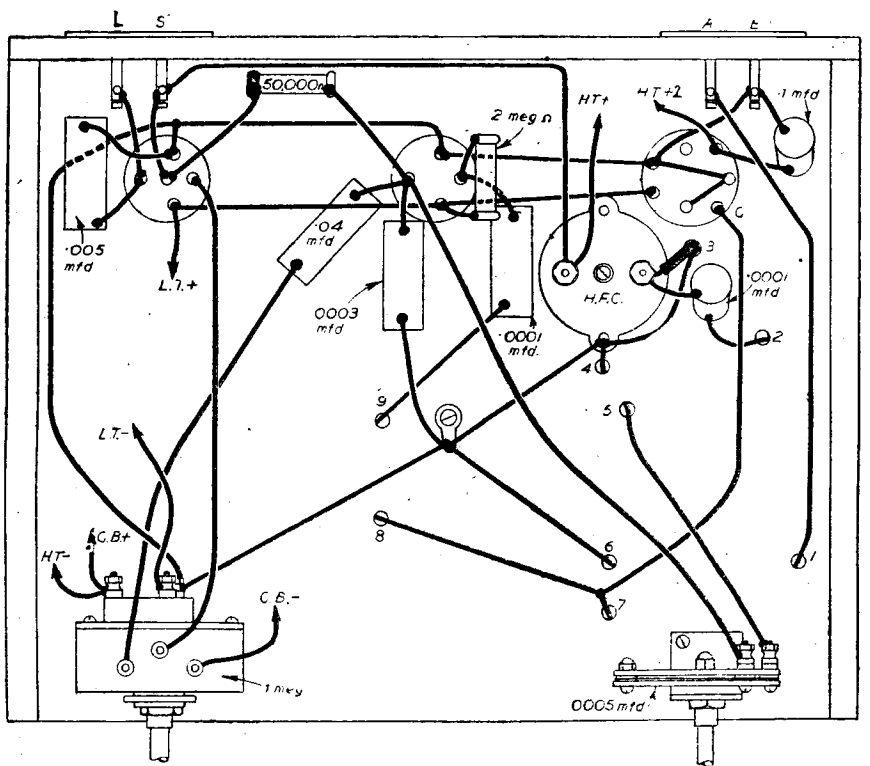
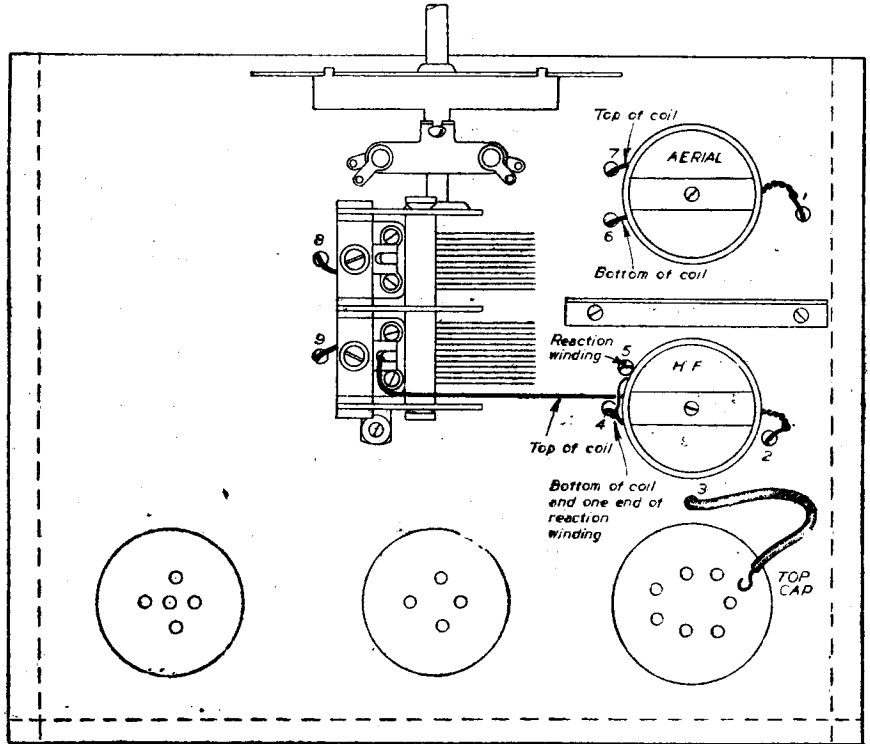
The plan diagrams show the exact location of all components, together with associated wiring. The mounting of the 2-gang condenser, the small metal screen and the two coils should be left until it is necessary to mount them for wiring purposes. The volume control and reaction condenser can be fixed in position by the brackets shown or by using a wooden runner along the front edge of the chassis. It will be found that the majority of the wiring can be finished before mounting anything on the top side of the chassis, excepting, of course, the valve-holders. The screen is cut from an odd piece of aluminium or, if that is not available, copper or very fine mesh perforated zinc. The dimensions are 3 1/2 in. x 3 1/2 in. The specified 2-gang condenser, if used in conjunction with the recommended S.M. dial, has to be mounted on three small supporting pieces. These can be wooden blocks, cut neatly to the required size, i.e., sufficient to allow a 4BA bolt to pass through them and the chassis, or, as in the case of our original model, the insulating tubes off of ordinary H.T. connecting plugs, etc.

Adjust the volume control to its maximum setting and the reaction condenser to, say, a third of its travel, and then rotate slowly the main tuning control from vanes

fully meshed to fully open. During this movement your nearest station should be heard. Once it is received adjust the tuning control until the maximum signal strength is obtained, and then adjust slowly

and carefully the small trimmers, one at a time, fitted to the top of the gang condenser. It is essential to make sure that the receiver is not oscillating when carrying out these adjustments so, if possible, have the reaction condenser at its minimum setting and the volume control turned down until the station is only just audible. By doing this any slight improvement obtained by varying the trimmers will be more readily noticeable.

## Wiring Diagram of "Shelterset" Three



### COMPONENTS REQUIRED

- Two coils. See text.
- Tuning condenser. One bar-type J.B., 2-gang, .0005 mfd.
- Reaction condenser. One Dilecon J.B., .0005 mfd.
- Fixed condensers. Dubilier. Two .0001 mfd., one .0003 mfd., one .005 mfd., type 4601 S, one .04 mfd. type 4602 S, one .1 mfd. type 4603 S.
- Fixed resistances. Dubilier. One 2 megohm, one 50,000 ohms, 1/2 watt type.
- Potentiometer. One 1 megohm Bulgin type V.M.65.
- H.F. choke. One Bulgin type H.F.9.
- Wooden chassis. 10 x 8 x 3 1/2 ins.
- Two socket strips. A and E, L.S. Clix.
- One W.B. speaker. W.B. Junior.
- Batteries. One 120 volts, one 9 volt G.B., one 2 volt accumulator. Exide.
- Valves. Cossor. One 210 S.P.T. (7-pin), one 210 H.F. and one 220 H.P.T.

# ROUND THE WORLD OF WIRELESS

## Sets for the Troops

**T**HE urgent need for radio sets for the troops as part of a general effort to enable them to fight boredom was stressed by Mr. Anthony Eden, the War Minister, recently.

Opening an information bureau for the Forces in Trafalgar Square, he said that a number of sets had been provided out of the Nuffield Fund. The War Office was producing a special set for places where the ordinary commercial set could not be used, and the Treasury had made a substantial grant for this purpose.

## Tick-tock Interval Signal

**S**OME listeners are surprised to hear the tick-tock signal from time to time in both the Home and Forces programmes. There is no change in policy, however, and this signal is only heard during gaps before and after news bulletins in foreign languages. For these broadcasts the tick-tock signal is used deliberately as it provides a fairly unobtrusive tuning signal for surreptitious listening.

## Leipzig Fair

**T**HE Germans have recently advertised the fact that the Leipzig Autumn Fair has been held in spite of the war. At this fair the section devoted to wireless replaced the normal Berlin Radio Exhibition, which was held annually from 1922-39. Among the latest developments to be exhibited was a tiny centimetre-wave radio-telephone set.

## Radio-controlled Landing Lights

**N**IGHT landing lights, for use at seaplane bases, which can be switched on from a distance of approximately six miles by wireless, have been developed in the U.S.A. by Westinghouse Electric and Firestone Tyres. The lights, mounted on oval-shaped rubber buoys, are each equipped with a small battery-operated receiver, and a "whip" aerial.

## Japanese S.-W. Broadcasts

**B**EGINNING this month, Japanese short-wave broadcasts will also be given in Malay and Arabian.

## Finnish Anti-interference Scheme

**I**T is reported that as part of a scheme to reduce electrical interference the Finnish electricity supply companies refused to instal electrical appliances unless fitted with anti-interference filters. A committee appointed to inspect appliances already installed found that of the 1,500 lifts examined in Helsinki 635 required interference filters.

## Radio Messages to Far East

**W**IVES and families will soon be able to send messages to British troops in the Far East by means of special broadcasts being arranged by the B.B.C. Mr. F. W. Ogilvie, Director-General of the B.B.C., in making this announcement recently, said that with the messages would go special request programmes of favourite music.

Mr. Ogilvie was inaugurating Special Transmission, a new service in two parts; one Eastern, for India and the Far East, and the other Southern, for Africa and the Near East.



*A new photograph of Miss Adelaide Hall, the celebrated Coloured Singer of stage, screen, radio and recording fame.*

## Radio Listeners' Interests

**A**CCORDING to a report from Schenectady, N.Y., radio listeners' interests change with the seasons. As a part of the weekly Science Forum broadcasts from stations WGEO and WGEA, a portion of each programme is given over to answering scientific questions submitted by listeners in all parts of the world.

The seasons are reflected in these questions with each summer bringing in many requests pertaining to lightning, while it would appear that listeners spend more time thinking about science subjects during the winter months than at any other season, since it is then that the mail is heaviest.

## More Chance of Flying

**A**S the result of recent publicity a large number of men of high type have come forward to be trained as wireless operators in the Royal Air Force. The facilities for training are now expanding so rapidly that

educated men who are intelligent and quick can rely on being accepted if suitable in other respects.

More opportunities can now be offered to men to fly. Those who volunteer for flying duties during their training as wireless operators and are accepted are given a course in air gunnery. Pay during training is 2s. 6d. a day; for wireless operators (ground) it is 4s. a day, and for wireless operator/air gunners 8s. 3d. a day.

## Street Railway Car Control

by Radio

**W**E understand that Detroit Street Railways have introduced radio for controlling their services. Thirty motor rail-coaches have been equipped with receiving and transmitting sets, and a main transmitter and receiver control the working of the services from a central building. This system has already proved of value in the case of accidents, fires, and other emergencies.

## New Radio System

**MAJOR EDWIN H. ARMSTRONG**, a Columbia University professor, who has been responsible for numerous radio inventions as well as being a pioneer of the modern super-heterodyne circuit, has developed a new system of broadcasting which cuts out interference from lightning, sunspots, tramcars, etc. Transatlantic broadcasts will no longer be cancelled if the system is adopted universally. The new system is already being used by 16 American stations, and their broadcasts are free from "atmospherics" and fading. Eighty other stations are hoping to use the system and have applied for licences. The Federal Communication Commission is considering the granting of an exclusive ultra-short wavelength to Major Armstrong.

## B.B.C. Evening Programmes

**T**HE B.B.C. evening programmes for the winter months are likely to be re-arranged soon as a result of consideration which is at present being given to the matter by the B.B.C. departments concerned. News bulletins, for one thing, are under review. In present circumstances it is felt that the 9 p.m. news is being displaced in importance by the 6 p.m. bulletin, and we understand that there is likely to be a move to make important talks and postscripts follow the six o'clock news, with the main entertainment programmes earlier in the evening, when they would probably have the widest audience.

## Television in Aircraft

**I**NVENTORS in many countries have for some time been experimenting with television apparatus which can be carried in pilotless aircraft. Transmitting machinery has previously been of such a size that a ten-ton lorry has been needed to carry it. It is now claimed in America that the size and volume has been so much reduced that the apparatus can be packed into seven light suitcases. If the invention lives up to its claims, observation planes equipped with it and either manned or unmanned, and operated by remote control, can now send views of the underlying terrain back to army headquarters or to receiving stations on ships. This television eye can penetrate through the mist and haze that obscure human vision.

## LATE DELIVERY OF "PRACTICAL WIRELESS"

### A Message from the Editor

We are doing all we possibly can to ensure that "Practical Wireless" reaches you regularly every month, but occasionally there may be a delay owing to the dislocation of transport caused by air raids.

If, therefore, "Practical Wireless" should arrive after the normal day of sale, please help your newsagent by accepting your copy as usual. Under the Government's Paper Control Order he is unable to return unsold copies, and if you refuse to accept he will have to pay for it himself.

Your newsagent is working under difficult conditions these days, and your kind co-operation in this matter will be greatly appreciated by him—and by ourselves.

# A Multi-band S.W. Rack

A Useful and Efficient Arrangement to Overcome the Complications Involved with Band-change Switching

By EX. 2 C HW

WHILST many of the modern communication type of receivers incorporate efficient band-change switching arrangements, the design, construction and wiring of such refinements has always presented a rather stiff problem to the average constructor. The manufacturer can design all associated components, the chassis and the general assembly to enable him to achieve the desired results without introducing factors which will offset the advantages by reducing the overall efficiency of the receiver. The constructor, on the other hand, has to take what components are available and, in so many instances, quite irrespective of what he would like, make do by attempting to modify this and that until the constructional work assumes something like this original idea or design. Whilst admitting that there are many various types of multi-purpose switches on the market, the writer always found that the question of locating them with satisfactory relation to the other associated components, intro-

S.W. receiver of the L-V type with 'phones, the valves being battery-operated but with an eliminator for the H.T. I would add that I had a small trickle-charger for keeping the accumulator fully charged. On the top shelf, therefore, I placed the two-valve receiver; on the second, a small two-valve L.F. amplifier coupled to a P.M. M.C loud-speaker; on the third went the accumulator and charger; whilst on the bottom one the H.T. eliminator was stored. After taking a great deal of care with all the wiring of the various parts, and certain switches which I introduced, I was fairly well satisfied with the general assembly, as it certainly made a very neat and compact outfit. I soon realised, however, that band-changing had not been rendered any easier; in fact, as I had gone to the trouble of fitting a lid to the top compartment, on which I used to keep my log book, etc., coil changing became rather annoying. Thus, from the original and perhaps rather crude arrangement, I devised the system shown in Fig. 1.

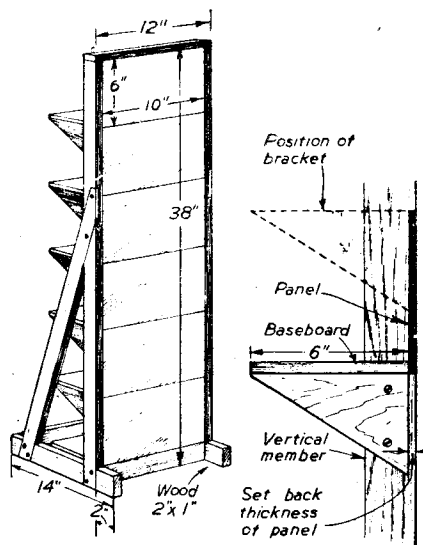
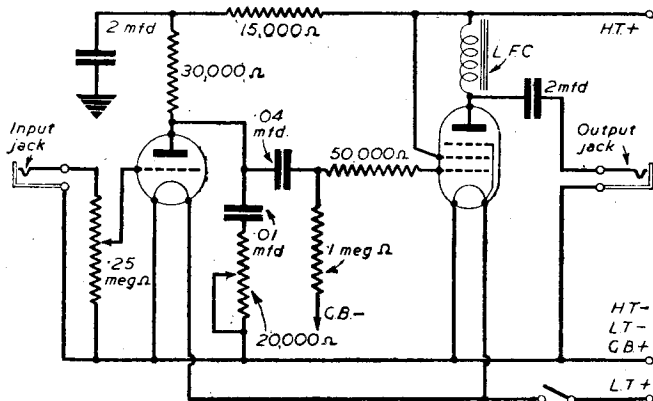


Fig. 1.—The essential constructional details of the rack are shown in this sketch.

duced many chassis constructional difficulties which, possibly through the lack of the required skill and equipment for the metal work, rendered the task very difficult or else prevented an efficient and business-like-looking piece of apparatus from being built. The system which is described in this article, and which the writer has used with most satisfying success, was really the result of having met with two or three rather costly failures with switching devices, the desire to secure a receiver which would allow quick trouble-free change over from one band to another and, finally, the urge to make use of a rack which was originally constructed to house transmitting equipment. As it is highly possible that there must be a vast number of S.W. enthusiasts who have similar desires, it is hoped that these details will enable them to achieve some measure of success and, at the same time, find a good use for many parts from their "spares" boxes.

Fig. 2.—Circuit diagram of the two-valve battery-operated amplifier used in the rack installation.



duced many chassis constructional difficulties which, possibly through the lack of the required skill and equipment for the metal work, rendered the task very difficult or else prevented an efficient and business-like-looking piece of apparatus from being built.

The system which is described in this article, and which the writer has used with most satisfying success, was really the result of having met with two or three rather costly failures with switching devices, the desire to secure a receiver which would allow quick trouble-free change over from one band to another and, finally, the urge to make use of a rack which was originally constructed to house transmitting equipment. As it is highly possible that there must be a vast number of S.W. enthusiasts who have similar desires, it is hoped that these details will enable them to achieve some measure of success and, at the same time, find a good use for many parts from their "spares" boxes.

## Original Idea

My original rack was the four-shelf type, described in "Wireless Transmission for the Amateur," and, when I had to hand over Tx gear at the commencement of the I set out trying to find a use for the vacant shelves. I was using a simple

## General Design

It will be seen that the rack is of the open type similar to that used by many manufacturers, but, unlike their metal productions, the one shown is constructed from wood, the two main vertical supports being 38 in. by 2 in. by 1 in. The two bottom cross members are 14 in. by 2 in. by 1 in. The rest of the woodwork, i.e., the supporting brackets or pieces, were all cut from odd five-ply that happened to be on hand, or was secured as the work progressed.

Owing to the formation of the rack, it is essential for the main weight to be at the bottom to add stability. For this reason

## Two-valve Amplifier

On the next shelf above, a two-valve amplifier (Fig. 2) is housed. This consists of a triode resistance-capacity coupled to a steep-slope pentode. It was found that this simple combination gave all the volume required without tending to bring up, too much, background noises. An input volume control and a variable tone control are incorporated, whilst "jacks" are used for both input and output, thus allowing quick connections.

The next three shelves carry single-valve receivers of the general S.W. type; the actual circuit is shown in Fig. 3, and it will be seen that it is perfectly orthodox in all respects. Throttled controlled reaction is used, and triodes as detectors are employed throughout the detector sections. Band-spread tuning is rather essential, if the full benefit of the arrangement is to be obtained; this will be more readily understood from the following. Each detector panel consists of an aerial input tuned circuit, i.e., the grid circuit of the valve, tuned by a tank and band-spread condenser. Each circuit has its own reaction control, so that the utmost efficiency can be obtained from each section. The idea of the three separate panels is to cover, in the writer's case, the three frequency bands in which he was most interested. The coils used, therefore, will depend on personal requirements, but it is very desirable, after making a reasonable number of frequency checks, to note or mark the tank

(Continued on next page)

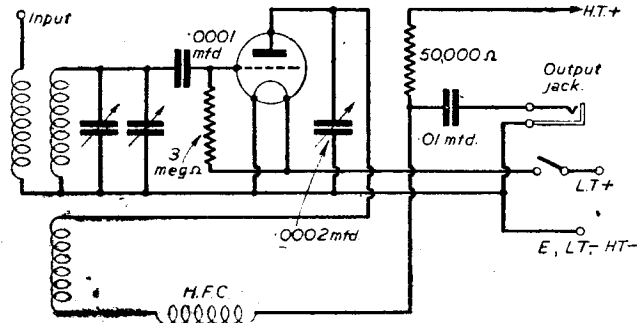


Fig. 3.—The circuit of the detector stages. Three of these were used, each tuned to different frequency bands.

tuning dial to indicate the total movement necessary to cover the exact frequency band width which has to be covered or explored by each detector section. If a little care is taken with the selection of the tank and band-spread condensers and, possibly, with a slight adjustment to the coils, it will be found that the normal band-width of any one band can be covered by the complete movement of the band-spread condenser alone, thus greatly facilitating the tuning of the worth-while frequencies.

The earth, H.T. and L.T. negatives are common throughout, therefore, a simple on-off switch should be wired in the positive filament of each section or, if double pole switches are to hand, then the L.T. positive and the H.T. positive can be controlled. The top shelf of all is used for an untuned H.F. stage. This acts most efficiently as a buffer between the aerial and the detector grid circuit and provides slight amplification. Its main object is, as will no doubt, be appreciated, that of a buffer to allow the utmost gain to be obtained from the reaction circuits and, of course, the best possible selectivity. With greater elaboration, a tuned H.F. stage could be incorporated but, if its output is to be fed into the three detector stages, each tuned to a different frequency, one would have to employ coil switching, or plug-in coils for the H.F. stage, and thus introduce an item the whole idea is intended to eliminate. The circuit of the H.F. valve is shown in

Fig. 4. A resistance is used across the grid circuit, as it was found that this tended to reduce the possibility of peaking on any particular frequency, especially as an H.F.C. is used in the anode circuit. The output is taken from the coupling condenser via a screened lead, to the desired detector stage. An ordinary split plug with appropriate sockets will be found quite satisfactory. Bearing in mind that the lead will be carrying H.F., the writer found it an

advantage to have the detector panel tuned to the highest frequency at the top, i.e., that nearest the H.F. stage.

**Detector Output**

The output from each detector valve is taken to an open-type jack on the right of each panel. This permits headphones being plugged-in, or if greater amplification for L.S. work is required, then the output is coupled to the input of the amplifier section by means of a single screened lead, fitted, of course, with suitable plugs at each end. It was found advisable to have plug and jack input to the amplifier, so that that unit could be used for other work should the occasion arise, and, as this so often does, when one is experimenting, and the slight extra cost is well worth while.

The loudspeaker used was a separate unit; experiments were made to try to incorporate it in the general rack construction but in view of several things, including microphonic valves, it was finally decided to keep it apart from the assembly.

**Cost**

In case the question of cost is raised, it should be noted that the majority of the parts used are those which most amateurs will have in stock. If this should not be so, then the method of construction so readily lends itself to parts being bought as funds permit, but in the meantime one of the detector stages, at least, can be in service, thus allowing the enthusiast to carry on.

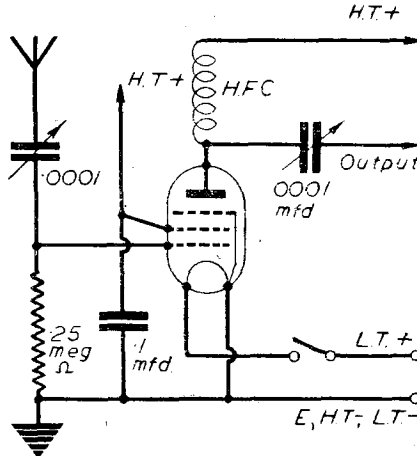


Fig. 4.—A simple untuned H.F. stage—as shown here—was found quite satisfactory.

# Patents and Trade Marks in War-time

We have Received the Following Letter from Rayner & Co., 29, Southampton Buildings, Chancery Lane, W.C.2, Who Supply Us with the Patent News Matter which is Published Regularly in Our Pages

"SIR,—Owing to the late publication of certain of the Official Records, and to the discontinuance of Patent Abridgements, we have been having some difficulty in furnishing you with the usual information with regard to Patents and Trade Marks. It may therefore be of interest to your readers to have some information with regard to Patents and Trade Marks in war-time.

"The war has naturally stimulated the production of inventions relating to munitions and warlike supplies, and also inventions relating to articles of public consumption, which have come into special demand owing to war conditions, or modifications of such articles to meet the new conditions.

"The various Government departments are taking an interest in such inventions and they have a special organisation for dealing with inventions. This we believe applies to the Ministry of Aircraft Production, the War Office and the Ministry of Supply. These departments appear to take note of any patent applications filed which from their title appear as though they might be of some interest to the department. When this is the case a formal letter is sent to the applicant either direct, or through his Patent Agent, asking the applicant to submit to the department a copy of his specification, together with any particulars and explanation of the invention which would enable the department to consider whether it could be used in the national war effort.

"The Government departments have power to prohibit the publication of the particulars of any invention which they consider might be of benefit to the enemy if it should come to their notice. The departments also have the right to take over and use an invention, and they may in some

circumstances arrange for the patent to be made secret or to delay acceptance of the application for the period of the war so as to avoid publication. These actions do not abrogate the inventor's rights in his invention. Although the Government departments are entitled to use an invention for the national benefit and are not actually obliged by law to make any payment in respect of such use, they do in practice make a suitable payment where an invention has admittedly been used by them. If they are unable to agree with the inventor with regard to the amount of the payment, then this may in some circumstances be settled by arbitration.

"The Government is anxious to stimulate exports from this country, and we believe that special facilities with regard to the supply of materials are available to firms in respect of manufactures for export.

"Firms who are already engaged in the export business, and also firms who are desirous of producing goods for export should, wherever possible, use distinctive

Trade Marks in respect of those goods. It is also very desirable that such Trade Marks should be registered in the country to which the goods are to be exported. Firms who already have well-known Trade Marks in use in this country can apply at any time to have them registered in the countries to which they may be exporting their goods. Firms who are not already using Trade Marks would be well advised to select a suitable Trade Mark, or Trade Marks, for their goods, and to register these both in this country, and in the countries to which their goods will be exported.

"The value of Trade Marks for use in this country, and particularly abroad, has not in the past been fully recognised by British manufacturers. There has been a greater tendency recently to utilise registered Trade Marks, and in view of the possibility of opening up new markets for the export of goods this tendency is likely to be extended in the future.

"If any of your readers are interested in the above matters or in any matters concerned with Patents and Trade Marks, we should be glad to give them any information we are able, or to deal with any special problems which may arise in connection with these matters in their business.—RAYNER AND Co. (London, W.C.2)."

## BOOK RECEIVED

**DRY BATTERIES: HOW TO MAKE THEM.** By G. Bernard Hughes. Published by Hutchinson's Scientific and Technical Publications. 160 pages. Price 6s. net.

ALTHOUGH the war-time black-out has greatly increased the demand for dry cells, published particulars regarding dry-battery manufacture are very scanty, but in this book will be found much information on the subject which has not appeared in print before. The book embodies the result of twenty-five years' practical experience in the world of dry batteries, and the potential manufacturer will find in its pages

every necessary detail which will enable him to make torch and flash-lamp batteries, inert-cells and high-tension wireless batteries of high capacity, and all well adapted for storage. Written in straightforward language, the book is divided into twelve chapters, and deals in the first chapter with the evolution of the dry cell. Other chapters deal, amongst other subjects, with Polarisation and Depolarisation; Building a Dry Cell; and High-tension Batteries. There are sixteen illustrations and a six-page index. Although primarily intended for the commercial manufacturer of dry batteries, the amateur will find much helpful information within the covers of this useful book.



# Pick-up Reproduction

## Showing How Volume is Not Necessary for True Enjoyment of Records, and How to Obtain the Benefits of "Personal" Listening. By L. O. SPARKS

THE electrical reproduction of suitable gramophone records, carefully selected to suit individual requirements, offers a particularly attractive form of entertainment during the existing conditions, and it would appear that many music lovers are neglecting the possibilities of such reproduction through lack of appreciation of its scope and operating

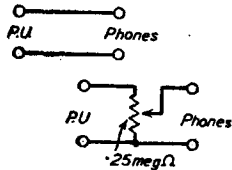


Fig. 1.—The simple connections required between P.U. and 'phones for "personal" listening.

methods. Too many people have the impression, quite possibly forced upon them by some misguided enthusiast who favours volume rather than quality, that it is absolutely essential to use an amplifier having an output rating of five or more watts and, having no desire to have their ear drums shattered, or of being accused of disturbing the peace, they have passed by the so much abused pick-up, and have thus failed to realise its true value.

This does not imply that volume cannot be obtained without sacrificing faithful reproduction, providing that well-designed equipment is used. In certain instances, however, powerful amplification will reveal latent imperfections in the input signal in the same way as a magnifying glass will expose defects not visible to the naked eye.

The question of output level necessary to secure perfect reproduction is a problem already too involved in controversy for the writer to add fresh fuel to the discussion, but it is still very apparent that the governing factor of an individual installation is the owner-operator, therefore, in actual fact, the whole question seems rather senseless so far as the ordinary listener is concerned.

During the present period, when all reasonable persons remember to keep the volume of their radio receivers down to a local listening level, to avoid disturbing their neighbours who, quite possibly, are trying to get a little sleep, it is more than

ever essential to also keep down the output of P.U. amplifiers. This does not mean that record enthusiasts must sacrifice their entertainment; far from it, but the writer would like to suggest a slogan for such people, namely, banish the watts and secure restful entertainment.

### Amplification

Bearing in mind that this article is dealing with domestic listening and not P.A. work, when the volume of sound required would be that necessary to fill, say, a small hall, the question of how much amplification is essential forms a vital problem, not only from the point of view of volume but also for considerations of cost of apparatus, space required, upkeep and simplicity of operation. Another item is bound to arise; there is still quite a large percentage of people still dependent on using, for preference, batteries, so that form of equipment must be considered in

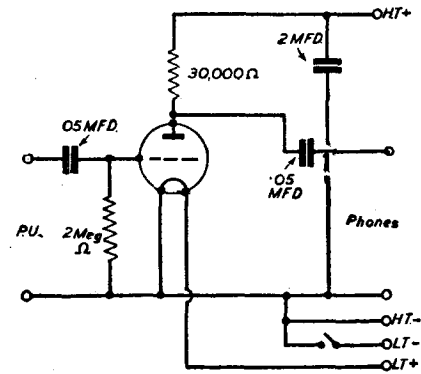


Fig. 2.—A single valve booster suitable for use with headphones.

looked, especially when records of first-class condition are being used.

Headphones have so often been classified as unsociable and uncomfortable and, likewise, have fallen to a very great extent out of favour; therefore the writer makes a plea for their return in view of the vast difference between modern types and their earlier counterparts. To those who have not already used headphones in conjunction with P.U. work, I would say that they have missed much. A good make of 'phone can now give most satisfactory response, provided that it is operated within its limits, and, if a little trouble is taken with fitting it to the head, the question of comfort will no longer arise. While admitting that it might appear to be unsociable to see one or more persons wearing headphones, and a very satisfied and pleasant expression on their faces, it does not follow that such folks are unsociable; in fact, they might be showing every consideration for the other occupants of the room. No two tastes are alike, and this applies in particular to music, and other forms of entertainment. Where one is very keen on Hot Swing, Crooners, Opera or Chamber Music, it does not follow that the rest of the family are the same, therefore it becomes a question of the enthusiast sacrificing his amusement, inflicting it on those not interested, or adopting the very wise and diplomatic course of using headphones. During the present time, this procedure has sterling qualities; one can enjoy to the full their favourite records or radio stars any time of the day or night without feeling that they are interfering with anyone's rest or pleasure, whilst in addition to these quite important items, the very fact of wearing 'phones will eliminate a good deal of unpleasant sounds which are now so common in many parts of the country.

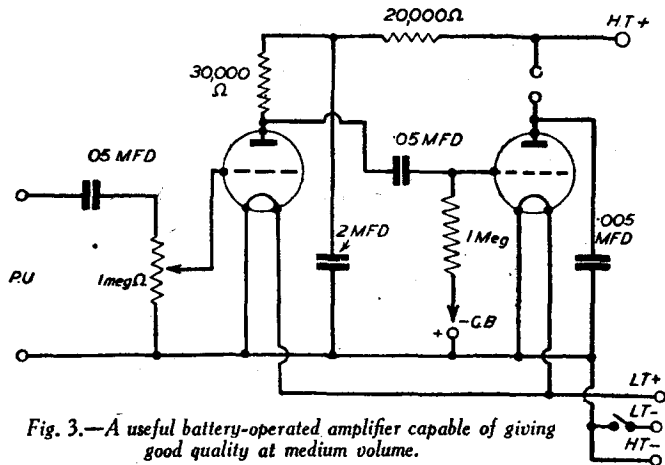


Fig. 3.—A useful battery-operated amplifier capable of giving good quality at medium volume.

addition to the more elaborate mains operated system. It will be appreciated that with the former one must not expect the same output, as regards volume, as when using an all-electric amplifier, but against that one can place a dead silent background, an advantage not to be over-

particular to music, and other forms of entertainment. Where one is very keen on Hot Swing, Crooners, Opera or Chamber Music, it does not follow that the rest of the family are the same, therefore it becomes a question of the enthusiast sacrificing his amusement, inflicting it on those not interested, or adopting the very wise and diplomatic course of using headphones. During the present time, this procedure has sterling qualities; one can enjoy to the full their favourite records or radio stars any time of the day or night without feeling that they are interfering with anyone's rest or pleasure, whilst in addition to these quite important items, the very fact of wearing 'phones will eliminate a good deal of unpleasant sounds which are now so common in many parts of the country.

### Circuits

For the music lover, the record enthusiast who requires only what can best be termed as personal listening volume, and the person who wishes to restrict cost of apparatus, the circuit shown in Fig. 1 is ideal. It is depicted in its simplest form, but it lends itself to many little additions according to individual requirements. For

(Continued on next page.)

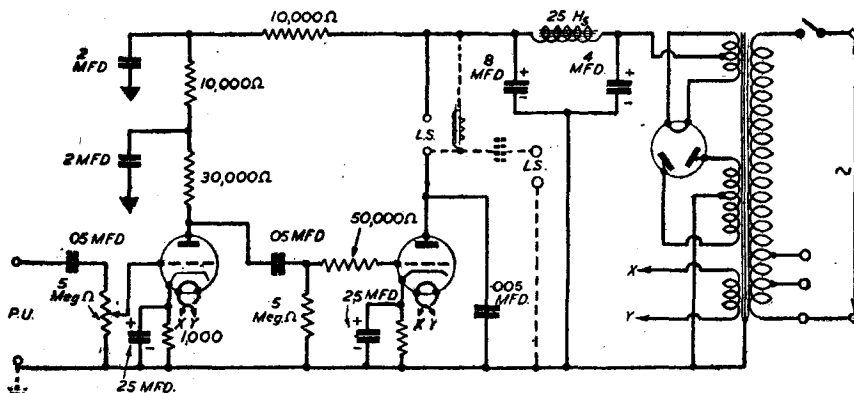


Fig. 4.—A very satisfactory form of A.C.-operated amplifier suitable for good P.U. reproduction; a choke filter output system, shown by dotted lines, is an advantage; the condenser should be 2 mfd. or 4 mfd.

**PICK-UP REPRODUCTION**

*(Continued from previous page)*

example, with the normal type of electro-magnetic P.U., it might be desirable to incorporate a variable potentiometer across the P.U. to allow a reasonable degree of volume control to be obtained. This is often useful when listening to certain classes of recordings but, generally speaking, it is not absolutely essential. Another modification of the circuit shown would be the insertion of a suitable matching or step-up transformer between P.U. and 'phone, whilst in rare instances, depending on the characteristics of the P.U. and personal taste, a simple form of tone or response corrector could be embodied.

The simple arrangement shown in Fig. 1 has much to commend it and, if record enthusiasts have not already tried it, then it can open to them a form of listening which the writer feels sure they will appreciate, especially during existing conditions.

**Battery Amplifiers**

The next circuit arrangements, from the point of view of simplicity after the above,

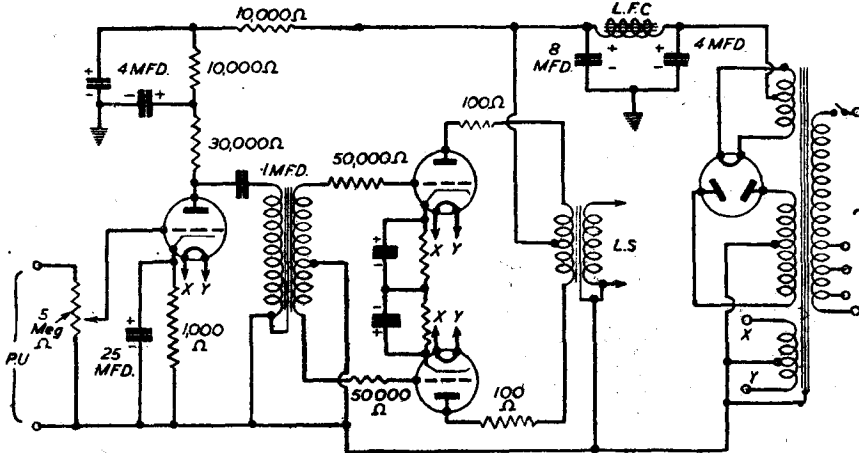


Fig. 5.—This A.C.-operated push-pull amplifier gives a better response and a greater output than that shown in Fig. 4 and, if well constructed, forms an ideal amplifying unit.

are those which utilise battery-operated valves and, although it is appreciated that battery maintenance can prove to be an irksome business, a well-designed amplifier, using batteries for the sources of supply, can provide very faithful amplification together with a dead silent background and, if headphones are to be used, there is no fear from high anode voltages.

The circuit shown in Fig. 2 is really intended for 'phone users. It is not designed to give high amplification, but rather to act as a booster to the output from a pick-up, especially those having a lower output figure than some of the electro-magnetic types. A suitable valve would be, say, the Cossor 210 L.F. or the Osram HL 21 operating with 120 volts H.T. to the anode via the resistance which has been incorporated to allow the 'phones to be isolated from the D.C. current. If a suitable L.F. choke is to hand, that, of course, could be substituted for the R.C. coupling and thus obtain a normal choke-filter output system.

**Greater Volume**

Still keeping to battery-operated equipment, Fig. 3 shows a circuit arrangement which can be used in its existing form or as a basis for a more powerful amplifier. As depicted, it consists of a medium amplification triode resistance-capacity coupled to a power valve, such as the Osram L.P.2, which has a rated output of 0.1 watts. Alternatives to this would be to use two

such valves, or even larger ones, in parallel, or replace the R.C. coupling with a well-designed push-pull input transformer and have two valves, triodes, in push-pull in the output stage. Although the latter arrangement requires a more powerful input to obtain the desired increase in output, it has the advantage of reducing second harmonic distortion, and is, therefore, very satisfactory from the quality point of view. With the parallel system greater power output is obtained, approximately double, than with a single valve, and it is not absolutely essential to increase the value of the input.

**Mains-operated Equipment**

It will be seen that the actual valve arrangement of the two mains-operated amplifiers is practically identical with those previously mentioned but, in spite of this, it must be appreciated that a higher output will be obtained owing to the greater efficiency or better characteristics of the A.C. valves. No endeavour has been made to show a Universal A.C./D.C. circuit, as there does not appear to be much demand for an amplifier of that type, and in addition

**NOTES AND NEWS**

**Colour Television Development**

ACCORDING to a recent report from New York, colour television is now possible by the addition of a simple mechanical device to the standard television receiving set. A demonstration of the new television was recently demonstrated by Dr. Peter Goldmark, of the Columbia Broadcasting System. In front of the present standard television tube, a wheel of colour discs is rotated, so synchronised that the eye sees successive red, blue and green pictures through the transparent colour discs. The frames thus glimpsed have been similarly scanned through corresponding colour filters. The eye combines the whole, and the result is to make the televised scene stand out with startling fidelity in brilliant natural colours.

**Off the Air After Dark**

BERLIN radio announced recently that "for technical reasons" many German wireless stations cannot be heard in Germany after dark.

**Mobile Bar for Desert Troops**

AS a result of a recent Egyptian radio appeal, a mobile "Kumantit" van to provide British troops in Egypt with drinks, cigarettes, and other luxuries was subscribed for within eight days. This fact was mentioned by Richard Dimpleby in a despatch recently broadcast to home listeners. British troops in the Western Desert are far from the luxuries of headquarters, and the appeal was given in order that they might be supplied from time to time with some of those things that make life worth living.

**"Useful Trigonometry Ratios"**

THE National Institute of Engineering, 148, Holborn, London, E.C.1, have issued a new edition of their Tutorial Service Card on Trigonometrical Ratios which is proving useful to draughtsmen, skilled operatives, and executives in various departments of engineering and building. Readers may obtain copies gratis on application to the Institute at the above address.

**Radio Sets Sales in U.S.A.**

THE number of radio sets sold by American manufacturers during the first six months of 1940 totalled 4,865,803, an increase of 914,817 sets above the same period in 1939. The total sales for 1939 were 10,500,000 sets, and it is expected that 1940 sales will number between eleven and twelve million units.

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to that reason, such apparatus calls for particular care in operation, owing to one side of the mains supply being common with one side of the circuit and, finally, if only low values of output are required, i.e., say two amplifying valves, the mains voltage-dropping resistance becomes rather large and has to dissipate a fair amount of heat. These remarks do not, of course, imply that satisfactory A.C./D.C. amplifiers cannot, and are not produced, that would be far from the actual facts; we are only concerned in this article with low-power equipment suitable for general P.U. work and for construction by the listener.

The two-valve plus rectifier circuit shown in Fig. 4 is ideal for low-volume personal L.S. listening; in fact, it will provide reasonable volume for the normal domestic room, when used in conjunction with a modern permanent magnet type of M.C. speaker.

The alternative arrangement, shown in Fig. 5, makes use of push-pull output and is, therefore, capable of giving a very faithful output. The volume will not be greatly in excess of Fig. 4 unless, of course, larger valves are used in the final stage. It is very essential to see that true matching is obtained between speaker and output valve, or valves, in all the circuits mentioned, whilst with those of the A.C. operated types, particular attention must be given to the decoupling and smoothing circuits, as it is vital to remove all trace of instability and hum.

# B.L.D.L.C. The British Long-Distance Listeners' Club

## Spares-box Receivers

**M**EMBERS will have noticed that this subject has received quite a good deal of publicity lately, and perhaps wonder why it has suddenly come to the fore. The reason is not very difficult to find; members in certain parts of the country are experiencing little difficulties or prolonged delays when trying to secure new parts: therefore, rather than hold up their work, they have resorted to the spares-box and, with minor modifications here and there, they have been able to carry on. Although this reason does exist, it must not be thought that component manufacturers are not doing their utmost to meet the constructors' demands; they are still turning out the gear we amateurs want and, at the same time, coping with other work of a far greater importance, namely, National work—work to further the nation's war effort. If, therefore, any slight delay should be experienced, we hope that all members will bear these remarks in mind.

The idea of turning out the spares-box, and seeing what can be done with the material thus revealed, has a very great deal to commend it. It is quite an easy matter to use a specified component and wire it into a circuit according to a clearly-defined blueprint but, for many, it might not be such an easy matter to use up a component about which they do not know too much. This is where spares-box work offers a fine opportunity for endless experiments; testing the various parts, determining the correct connections for that coil unit of mains transformer, or whatever part the search might reveal; building a circuit around such pieces and generally developing the initial hook-up until a good receiver has been constructed. It is really surprising what can be done without, in many instances, having to purchase a single new item.

## Correspondence

**D**URING the past month, we have received a very satisfactory mail from members and, as much as we would like to publish extracts from many very interesting ones, we are afraid that space limitations prevent us so doing. Will all those who have written us therefore, and who have not already received a reply or acknowledgment, please accept our thanks for their communications as we do appreciate hearing from them. We feel that special thanks are due to the following members for their particularly interesting letters and, in several instances drawings. Members No. 6,799, 6,610, 6,500, 6,773, 6,516, 6,519, 6,796, 6,295, and 6,501 who was good enough to send us a photo of his den, which we are reproducing on this page. His receiver is of the 1-V-2 type, built, as he says, on the lines of the Short-wave Four.

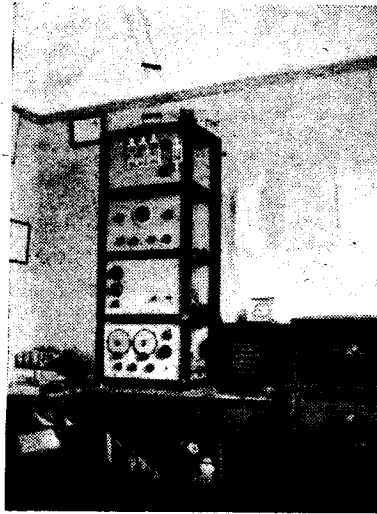
## Contacts Required

**T**HE following members would like to get into touch with others in or near their districts. Might we suggest that with the winter months now on us, a great deal of enjoyment and interest can be secured by cultivating and making full use of "contacts"? Bristol: Member

6,501, 8, Weston Crescent, Horfield, Bristol, Dorset: Member 6,610, The Anchor Inn, Stoke Abbot, Nr. Beaminster, Dorset. Yorks.: Member 6,294, 3, St. John's Mount, Easingwold, Yorks. Birmingham: Member 6,816, 4, Frankley Avenue, Quinton, Birmingham.

## Aerials

**W**HILE admitting that much more interest is now shown in aerial design and erection, there still appears to



The neat rack equipment in the den of B. C. Tunstall (Member 6501).

be quite a number of amateurs who, while spending a great deal of time getting their receivers to maximum efficiency, do not go out of their way, so to speak, to make sure that the actual aerial of their installation is such that it will give the set the utmost help. Many members have, of course, let us have details of the aerials they are using or have tried but, in the majority of cases, they do not give all the essential items, such as height, length, direction, comparative gain in signal strength, method of coupling employed, insulation at points of suspension, and such data as would allow another member to judge for himself the efficiency compared to, say, the aerial system he is using. A great deal of work can be done around this subject, and we feel that any member who has, shall we say, specialised on aerial design and testing, should, in the interests of the other members of the Club, let us have all the information he has. We will gladly pass on all useful details,

provided that they can be applied in a general sense.

## Screening

**M**ANY members seem to be having difficulty in obtaining metal for chassis, panel and screening work. This can be readily understood during the existing conditions, and it is up to all of us to make do with what material is available. Most members will already know that quite efficient screening can be obtained by using metal foil but, something which is far better and which can still be obtained, is perforated zinc sheet. This material is very easy to work and lends itself to backing panels, covering the tops of chassis, and making quite efficient screens. If it is cleaned properly, it solders quite well, thus allowing a very neat finish to be obtained.

## Home Recording

**T**HERE must be many members who have had a good deal of experience with home recording equipment and its operation, and who have carried out some very interesting experiments around this fascinating subject. We are getting quite a number of requests for general information about the work, therefore, will some of you home recorder experimenters let us have details about any of the work you have carried out, and the results you have obtained?

## From Egypt

**W**E were very pleased to receive a most interesting letter from a member residing in Daher, Cairo, which gave us further proof of the world-wide membership and activities of the Club. The member in question is No. 5,871 (Mahmoud Hosni), to whom we send our best wishes for continued successful DX work. In his letter he says: "I enclose a photo of my gear, and I think that a brief description of my receiving apparatus may be of some interest to other members. I have three receivers, a 'Sky Buddy,' a home-built A.C./D.C. all-wave four-valver with plug-in coils (seen on the right in the photo) and a 1-v-1 S.W. battery-operated set, constructed through the guidance of PRACTICAL WIRELESS, and I think it is the best set I have built as it gives very good results. The aerial is a 50ft. inverted L, 35ft. high, running due E. to W., but I sometimes use a 25ft. indoor rig with the 'Sky Buddy.' I also have a 5-watt P.A. amplifier.

Wishing the Club and PRACTICAL WIRELESS every success in these difficult times. . ."

Judging by the photo, which we reproduce below, it would appear that No. 5,871 has a very nice installation, and every facility for operating in comfort.



Member No. 5,871 (Mahmoud Hosni) seated at his desk in his comfortable den at Cairo.

# A Service Engineer's Log

## Details of Some Simple Faults and the Remedies Which Prove Effective

It is seldom that I am called upon to trace faults in home-constructor sets, because most constructors who follow complete PRACTICAL WIRELESS designs are able to overcome any small "snags" which may develop as a result of bad connection, or the use of a defective part. Recently, however, I was asked to test a four-valve "straight" A.C. set which was not working at all well. It was explained that the receiver had been made at least two years ago, and although it had behaved fairly well the results had never been quite up to expectations. Recently, both sensitivity and quality had begun to suffer.

### Defective Valve

A casual examination did not at first reveal any fault, and a check of H.T. voltage at various points did not show anything seriously amiss. When the first H.F. valve was cut out of circuit by transferring the aerial lead to the anode of the second H.F. valve, there was some improvement. Consequently, the first valve was removed from the receiver for test in a complete valve tester of the type which checks the mutual conductance; that indicated that the valve was well below par. A new valve was tried, and this gave an improvement, although results were still not entirely satisfactory.

The next step was to measure the voltage reaching the heater terminals of the valve-holders. The voltage on the output pentode was correct at slightly more than four volts; the same could be said of the voltage applied to the detector, but the H.F. valves

and last two valve-holders were then linked up with separate lengths of flex, as shown in Fig. 1. This gave a great improvement, and was a hint to the constructor that he should always follow published designs very carefully, instead of making his own "improvements."

### Filament Voltage

It is not always realised that the average mains valve suffers far more damage if its heater is supplied with slightly less than four volts than if the voltage is slightly—very slightly, of course—in excess of this figure. The reason is, to put it rather crudely, that the anode "sucks" away electrons from the filament or cathode, and if this is insufficiently heated the electrode itself suffers damage. This applies mainly to large power valves and valves in the high-efficiency class, but the point is not without importance in other cases. It is also evident that if a length of wire is called upon to carry, say, 6 amp., the voltage-drop along it is far greater than if it carries only 2 amp. In a length of flex such as that used by the constructor in the example mentioned above, there is a continuous fall in voltage right from the terminals of the transformer to the heater terminals of the first valve.

### Sudden Loss of Performance

The owner of a compact type of battery receiver found that it had suddenly become very unselective and that sensitivity had

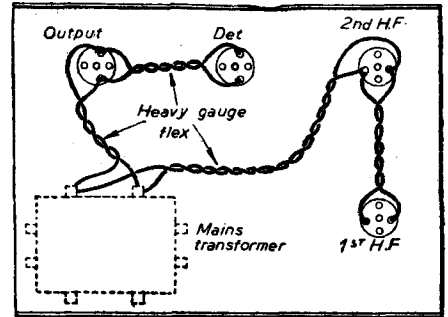


Fig. 1.—Correct method of wiring heaters of indirectly-heated valves to minimise voltage-drop along the flex used to carry the 4-volt A.C. from the mains transformer.

in question, however, the owner had "asked for it," by fitting a trickle-charger socket to the case of the receiver and over-charging the battery while it was still in the case. Naturally, considerably more gas or spray had been given off than would be the case in ordinary circumstances. With a very compact receiver it is better to remove the battery for charging or to take care that it is not charged to the "gassing" point; the trouble is less likely to occur if the back of the set is removed while the charger is connected.

### Instability and Difficult Tuning

Here is the story of another home-constructed set, which had been built on a wooden chassis. It must be admitted that the constructor had made an excellent job of the set, and had obviously had a good deal of experience of set construction. Despite this, however, he found that the receiver, a "straight" one, was thoroughly unstable and difficult to tune. He had tried various earth connections, suspecting that the fault may lie in that direction, but to no good purpose. A check on the wiring did not at first bring any fault to light, but after further examination it was found that there was no connection between the normal "earth line" (the negative sides of the valve filaments, L.T. negative, H.T. negative, grid-bias positive, etc.) and the earth terminal of the set, to which the moving vanes of the tuning condenser and the lower end of the aerial coil were joined.

### Forgotten Connection

If a metal or metalised chassis had been used this connection would have been made automatically, but with a wooden chassis it was necessary to run a wire between the two points. When this was done, and it had been made sure that all other earthing points were well "bonded," the receiver worked perfectly well. Not only had the instability been overcome, but the set was far more responsive in every way. This, incidentally, is not an uncommon mistake, even among experienced constructors and professional radio engineers.

### Makeshift Repair Became Permanent

A simple remedy which I had to adopt as a temporary measure recently may be of interest to many readers. The set was a commercial one fitted with an H.F. pentode as detector, but it had become inoperative after a period of crackling. Most readers will recognise in these symptoms a burnt-out transformer primary in the detector anode circuit. A few continuity tests soon proved that this was the fault. Unfortunately, however, a new transformer was not to be found in my tool and spares

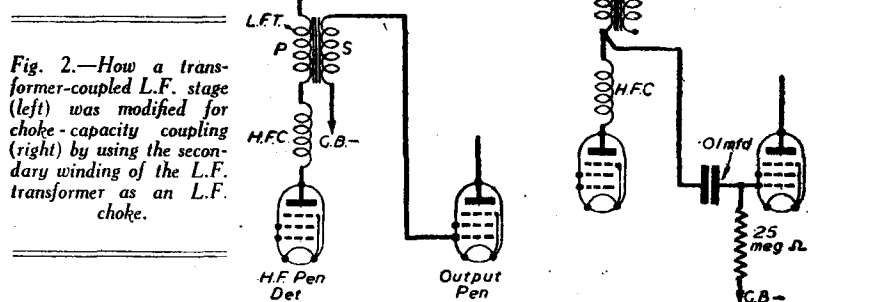


Fig. 2.—How a transformer-coupled L.F. stage (left) was modified for choke-capacity coupling (right) by using the secondary winding of the L.F. transformer as an L.F. choke.

were certainly receiving under four volts, especially the first one.

### L.T. Voltage Drop

It was only then that I noticed that the heaters were wired "in a line" from the output pentode to the first H.F., by means of what was virtually a single length of thin twin flex. Moreover, the length of flex used was something like 16in., due to bad arrangement. As a result of this unsatisfactory method of wiring the heaters, there was a voltage drop along the flex, and the first valve was being under-fed. The whole of the heater wiring was removed, and some flex of stouter gauge—actually standard house-lighting flex—was fitted in its place. Additionally, instead of running only one pair of leads from the transformer to all the valves, one length of flex was taken to the second valve, and another to the output valve; the heater terminals of the first two

dropped to a marked extent. I was asked to overhaul the set which was, as the owner pointed out, nearly three years old. He rather naturally thought that one of the valves might be in need of replacement, and that it was time that the set was generally run over, quite apart from the particular trouble experienced.

It did not take very long to find that there was an open-circuit in the medium-wave winding of the aerial-tuning coil, and it could be seen after removing the screening can that the trouble was due to corrosion of the wire and the insulation. This particular fault is not very unusual in compact sets of the battery type and is generally ascribed to the action of the "gas" given off by the accumulator. It can usually be avoided by allowing the accumulator to stand for a few hours after removal from the charging board, so that "gassing" of the acid has time to cease. In the case

bag which I carry with me when visiting the houses of set owners. But the owner was anxious that at least a temporary repair should be effected, so that the set could be used without delay. The first method which comes to mind is that of replacing the transformer coupling by R.C.C.; but this is not usually satisfactory with an H.F. pentode, since to obtain anything approaching correct matching, the anode resistor must be of such a high value that it seriously reduces the detector anode voltage.

**C.C. Coupling**

I therefore used choke-capacity coupling, using the secondary of the transformer as a coupling choke, and adding a grid condenser and grid leak, as shown in Fig. 2. Incidentally, this gave far better performance than the original transformer had done, and the owner asked that the temporary repair should be left as a permanency. The reason for the improvement was no doubt that the secondary, having a comparatively high impedance, gave better matching than did the primary. This would have been a serious censure on the designer and manufacturer of the set, had it not been learned later that the original transformer had previously been replaced by another so-called service engineer. Obviously, he had used a transformer which was not suited to the circuit.

**Transformer Causes Crackling**

The fault just described brings to mind another case which arose recently. A violent form of crackling had developed in a superhet receiver and rough-and-ready tests of the principal components made by the owner had failed to show anything which may be responsible for the trouble. I felt fairly certain that the fault was in the L.F. transformer between the double-diode triode and the output valve, and proved this by substituting a new transformer. The owner quite clearly thought that I was misleading him with the object of selling a new component. He had "tested" the transformer windings for continuity, and had even tested for insulation between the windings themselves and between the windings and the core. He assured me, as a result of these tests, that the transformer was quite sound. He also suggested that if there was a break in a transformer winding the crackling would have been continuous,

instead of appearing only at irregular intervals.

**Unsuitable Tests**

I discovered that this "test" had been made with an H.T. battery and a milliammeter; I tested with a high-grade multi-purpose meter set to read ohms. With his test an appreciable current had been "forced" through the windings, and had probably been sufficient to bridge the small gap in the broken winding and perhaps also to make a temporary "weld" of the wire. When a very small current was passed through the component this effect did not take place, and an open-circuit reading was obtained.

**S.W. Interference**

Here is a simple hint for those who are making use of the B.B.C. "Home Service"

and "Forces" programmes now being put out on around 48 and 41 metres. Should interference be troublesome try the effect of tuning-in the programme a few degrees above or below the point at which interference is experienced. This is sometimes helpful when using many types of superhet.

**PERSONAL PARAGRAPHS**

Lt.-Col. J. T. C. Moore-Brabazon, whose appointment as Minister of Transport was announced recently, has a link with the radio industry in that he is a vice-president of the R.M.A.

Sir John Reith, upon whom a barony was conferred, and who was appointed Minister of Works and Buildings and First Commissioner of Works, is, of course, a former director-general of the B.B.C.

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# Modern Factory Production Methods—3

## A Description of the Test Gear for Assembly Checking By "Service"

**T**HE meeting of designers, production and service engineers, with which we closed last month's article in this series, has many purposes other than the approval of the components to be used in the new receiver.

From earlier and more or less informal discussions with the designer, the layout engineer will have arranged the wiring and components in the best way possible to satisfy all concerned. The latter will view with critical eyes the result of the engineers' efforts when it is put before them.

### Wiring Technique

The service engineers will examine the model in the light of their practical experience, and will insist on changes to overcome any possibility of troubles arising from some condition which has been overlooked by the layout engineer who probably has been guided by production difficulties. For example, wires carrying H.T. may be found pulled tight round corners of a screening partition because that particular path for the wire will simplify assembly work. The service engineer, however, will insist that this is changed because of the possibility of the insulation covering the wire becoming frayed and shorting the H.T. circuit to earth.

The accessibility of components will be a point closely examined by the service representatives. Ease of withdrawal of the chassis from the cabinet is a feature they will watch, and they will see that there is sufficient length of lead connecting the chassis to the loudspeaker so that the former may

be serviced and tried out without having to put it back into the cabinet every time it is desired to make a test of reproduction.

It is difficult for the outsider to understand why a process engineer should quibble about two or three inches of wire until it is appreciated that in, say, a three-wire connection to a loudspeaker an additional length of two inches means a total extra length of six inches. Multiply this by the numbers of receivers to be made, which in a large factory may quite well amount to 20,000 receivers, and it will be appreciated that if he can get away with a shorter lead he will be saving some 10,000ft. of wire. It is these small items which can save the money, and allow more interesting features to be incorporated in the receiver which will attract the public.

### New Types of Components

At this stage in the evolution of the model it will be apparent whether the designer intends to incorporate any entirely new types of components. The service department must see that they have full information concerning any servicing tools that may be required to adjust the components while in use or to facilitate their removal and replacement. For instance, new type trimmers may need insulated box spanners for their adjustments of a size not hitherto employed by the firm: a novel design of wavechange switch will require a specially shaped switch-blade adjusting tool to get at the awkwardly placed switch contacts, etc.

Such tools must be available at the time of the model's release. Not only have the

firm's service engineers to be supplied, but stocks must be acquired for sale to dealers who must be advised in the service manual or by circular at the time of release of the model, if the service manual is not available for distribution at that date.

### Production Test Gear

Simultaneously with the holding of the meetings already mentioned another group of engineers will examine the types of instruments under consideration and commence to draw up their own plans for equipment which will test the chassis as they come off the production lines. Their aim is to produce a series of tests which will not only show whether the chassis is assembled correctly but will allow this to be done quickly and if possible by comparatively unskilled and, therefore, inexpensive labour.

For a big production there will be several types of test gears in the final stages of the production line. For example, as the chassis receives its last attention from the assembly personnel it will be fed to the operator in charge of one of the test racks who clamps it in position and connects up any leads, etc., although, as stated previously, for speed as many connections as possible will be made by knife contacts automatically as the chassis is clamped into position. A switch is then operated and by various meters the wiring of the chassis will be checked. If there are any faults such as a short from H.T. to chassis or an incorrectly wired valve-holder, such a state of affairs will be shown up by a wrong reading on one of the meters.

These meters are interesting as they often do not have any values of calibration on their scales, but only two small red indicators at certain positions. So long as the meter needle comes to rest between these red indicators the operator can accept the reading as showing that that part of the circuit is O.K.

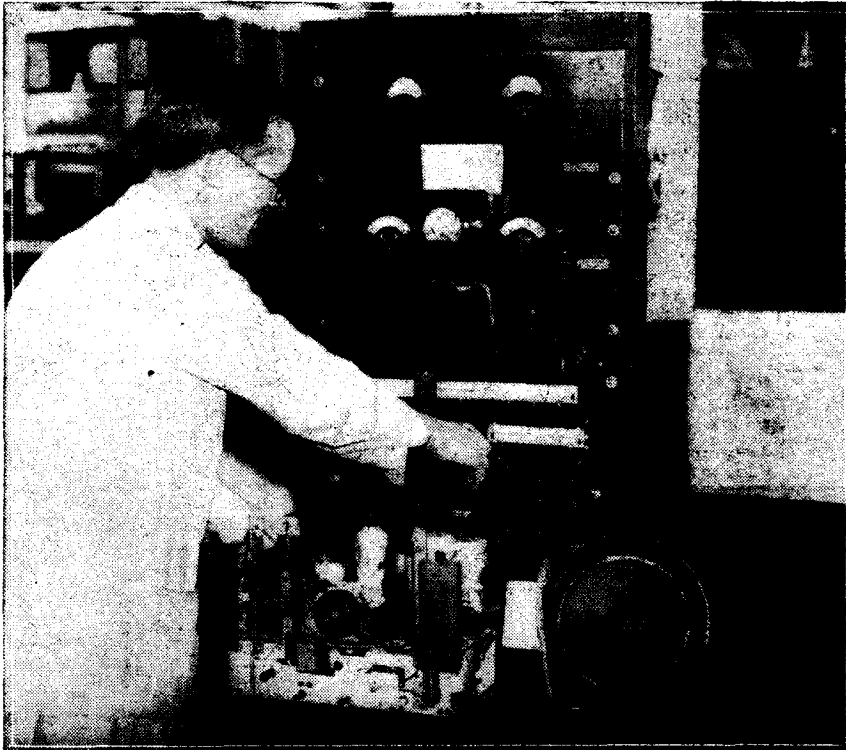
### Voltage Tests

The reason why two indicators are used is that on mass-produced electrical equipment certain limits must be tolerated, as it is impossible to obtain identical results from a large number of receivers. For example, if the full H.T. positive voltage was required to be 300, slight differences of the emission of the rectifier valves and currents taken by other valves, plus the fact that the values of the various anode resistances will differ slightly, may all result in the H.T. voltage being above or below the nominal 300 v. figure.

The designer in collaboration with the production and test-gear engineers will decide between them what is the lowest and highest voltage that can be allowed. They may decide that  $\pm 10$  per cent. may be tolerated and, therefore, with a nominal voltage of 300 the chassis can be passed through as O.K. if the voltage is anything between 270 and 330.

Now, on the meter used to indicate this particular voltage the test-gear engineer will employ a 0-500 v. meter, and will place one red indicator at what would normally be the 270 v. mark and the second indicator on the 300 v. mark. Therefore, as far as the operator is concerned

(Continued on next page.)



A typical test rack for a complete receiver chassis. The output from the receiver is being checked up against a definite input voltage under standard conditions for applied voltages as indicated by the meters on the rack. This test is, therefore, a check on the sensitivity of the receiver after it has passed all its stages on the assembly line and had its circuits adjusted.

**MODERN FACTORY PRODUCTION METHODS**

*(Continued from previous page.)*

the meter needle has only to rest between the marks to indicate an O.K. circuit.

Other voltage meters or circuit meters can all be set up in a similar way so that all the tester has to do is to connect the chassis to the gear, operate a master switch and glance at all the meters to make sure that the needles are located between the red indicators. This need only take a matter of seconds, and he can then pass the chassis on to the next stage.

To save meters a selector switch is often arranged beneath certain meters so as to switch them quickly into any one of many circuits in the receiver being tested. For example, it may be desired to check that a desired heater voltage is being applied to each valve-holder. In such a case there will be one voltmeter with its red indicators properly adjusted by the designer and the selector switch will have its various positions marked V.1, V.2, V.3, etc. The operator, when testing the receiver chassis, would merely turn the switch round to each position to see that the correct reading was obtained at each position of the switch.

A similar arrangement can be used for checking the various anode voltages and anode currents of several valve circuits, thus economising in the number of test meters, but still making the complete test simple in execution. Of course, in some circuits the anode voltages will be different, and in these instances the designer will either provide separate meters, or he will mark on the meter scale the positions at which the needle should come to rest and will mark these positions V.1, V.2, V.3, etc.

In order to allow for limits or tolerances mentioned previously he will mark his scale with a broad line which will cover the voltage range plus or minus 10 per cent. of the nominal value. Thus there may be on the meter scale a short line corresponding to about 150 v., another line at about 200 v., and a final one at about 300 v., and above these lines will be written the valve numbers applicable to that reading, and the operator can pass the chassis he is testing if the meter needle comes to rest on any part of the line at each position of the selector switch.

**H.F. and I.F. Alignment**

The next test of the receiver chassis after it has passed from the circuit test just described will, in most cases, be the H.F. and I.F. alignment procedure. Generally, two gears are used, the first for I.F. and the second for H.F. circuits. These two stages are staffed by skilled engineers working with oscillators, and output indicators which may be humble meters, or cathode-ray oscillographs, depending upon whether the circuits are simple peaked arrangements or whether they are intricate band-passed arrangements for high-quality reproduction.

Having got the circuit into line the chassis may then be passed on to the operator, who will put the chassis through exacting sensitivity checks on special test gears. This entails the feeding of very small voltages into the aerial sockets of the receiver to ensure that the output as measured across the loudspeaker speech coils reaches a predetermined value. Actually the comparison of measurement is made the other way round, although results are the same, and the operator will adjust his signal input into the receiver to

obtain the output which is often 50 mW. He will then see what the voltage of the input is, and will reject the instrument if the voltage is higher than a certain value. A higher voltage applied to the receiver for the same standard output wattage means that the receiver is not so sensitive as it should be. The measurement will be made at various points on each wave-band and, of course, the values will have been determined by the designer and recorded on cards for reference by the operator.

**Test for Hum**

A test for hum is often made on a separate rack equipment, the output being indicated on a meter with the usual small red indicators so that the operator can tell whether to pass or reject the instrument for hum. In some factories, however, where production is not very large, this test is an aural one carried out after the chassis is in its cabinet. The standard of hum is either left to the discretion of the operator, who accustoms himself to the amount of hum permitted for standard receivers approved by the designer, or he will have the approved receiver working in his test cabin with which he may make rapid comparisons against a production model by means of a throw-over switch.

In the first article in this series, published in the October issue, a schematic chart was given of the major processes in factory production. It will be seen on referring to this chart that many processes in the evolution of the receiver are carried out simultaneously. We have dealt in the present article with test gear for assembly checking, and in the next one details of processes on the actual assembly line will be described.

*Prize Problems*

**PROBLEM No. 414**

WHITWORTH designed and constructed a three-valve battery-operated receiver, with which he was particularly pleased, so far as the appearance went, but, on connecting it up for his initial tests, he was most disappointed to find that no signals could be received. He checked up on the valves; they were O.K. All other components were above suspicion, and the fuse and fuse-holder, which was connected between H.T.—and the actual earth socket, were quite allright. With a reliable meter he found that L.T. was reaching all filament pins and that H.T. was through to all correct parts. When, however, he tested for anode current, he found, to his amazement, that that was nil. Had Whitworth made quite a common error; if so, what was it?

Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 414 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, November 18th.

**Solution to Problem No. 413**

Lane had made a mistake when connecting the oscillator coil primary. In his desire to get the receiver completed he had inadvertently reversed the connections to that winding, thus preventing the oscillator from acting as a generator of local oscillations.

The following three readers successfully solved Problem No. 412, and books have accordingly been forwarded to them: Mr. C. A. Marshall, 59, Rutland Avenue, Scotforth, Lancaster; Mr. T. B. Ellison, "Timsah," Fir Tree Road, Epsom Downs, Surrey; Mr. H. P. A. Brooks, 4, St. Margaret's Square, Cambridge.

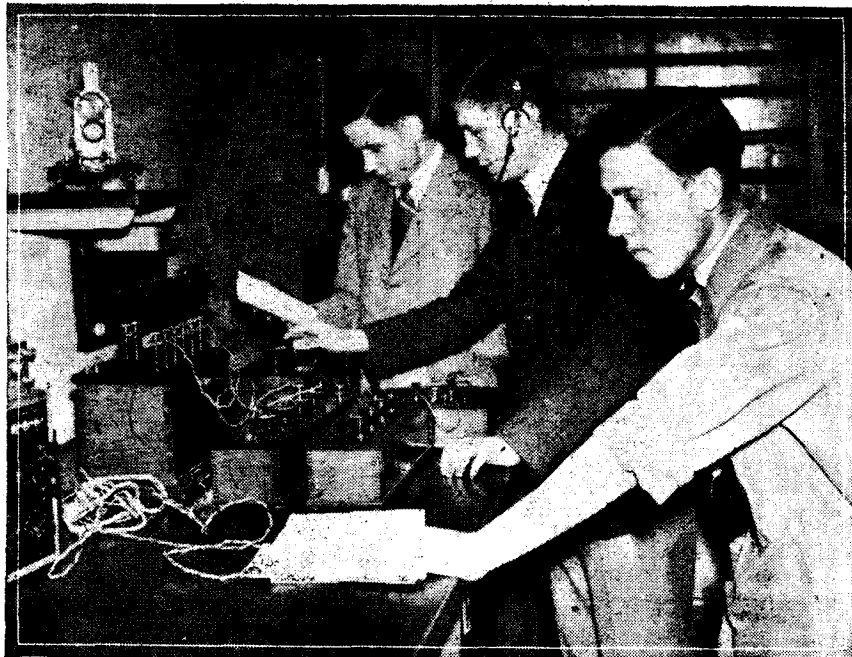
**LATHE WORK FOR AMATEURS**  
by F. J. CAMM

1/- or 1/2 by post from

George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

**Wireless for the Blind**

THE annual report of the National Institute for the Blind states that during the year the British Wireless for the Blind Fund provided 8,625 wireless sets to sightless listeners. This made a total distribution of 54,535 sets.



Technical schools and polytechnics in London are now open on Sundays for the first time in history, and the illustration shows students at work in the science laboratory of the Sir John Cass Institute on a recent Sunday morning

# Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

## Mathematical Side of Radio

SIR,—May I first of all express my appreciation of your publication and my regret at the necessity to resort to monthly publication.

I also wish to suggest that you publish a series of articles dealing with the more advanced and mathematical side of radio. This, I believe, will supply the wants of many amateurs besides myself. By this I mean not merely giving formulæ which are, as a rule, regarded with suspicion, but also the proofs of the formulæ, which are much more important. Moreover, if these articles were of a general nature, and dealt with ordinary electrical problems, instead of just radio problems, their usefulness would be even greater. It is also much easier to learn by instalments such as this, than to sit down and learn it out of a textbook.

Wishing your paper continued success in spite of the paper restrictions.—B. LAGO (Tamworth).

## A Reader's Neat Equipment

SIR,—I am enclosing a snap of my newly-built rack, which I thought might be of some interest to other readers.

The bottom section is an o-v-2 short-wave set operated from an eliminator. The next rack is the long- and medium-wave receiver, consisting of H.F. pentode and detector, and this is coupled to the amplifier and power pack which are on the top rack. The speaker is a Rola moving-coil (mains energised), and is switched to each set by means of the D.P.D.T. switch seen on the right. On the left of the rack is a morse practice oscillator.

At present I am building a mains all-wave superhet, to replace the bottom two racks.

I am also wanting to wind my own mains transformers, but do not seem to be able to get hold of any laminations and bobbins, etc.—H. L. JAKEMAN (Penzance).

## Calibrating a S.W. Condenser for Bandspreading

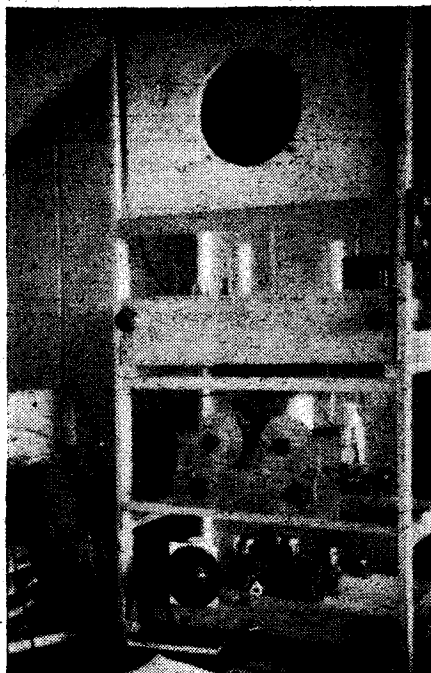
SIR,—Wishing to calibrate a .00025 short-wave condenser in 11 steps for a bandspread tuning unit I experienced a little difficulty as the condenser was not a straight line type. However, by constructing the simple bridge circuit shown in the accompanying sketch and utilising the .0003 reaction condenser I calibrated the setter in the following manner:

The .000025 bandspreader (which was obtained by partly dismantling an old short-wave condenser) was connected to the terminals X. The .0005 variable condenser in the bridge circuit was adjusted till a point was reached when no sound could be heard in the 'phones. By varying the .001 preset it was found that a definite silent point could be obtained as in previous tests with fixed condenser only, a decrease in signal strength resulted; but once the .001 is adjusted it must be locked and not moved during the calibrating of the setter. Having found the most sensitive position the calibration can take place.

The .000025 spreader vanes are slightly unmeshed and the silent point obtained in the 'phones by adjusting the bridge. When this is found, disconnect the spreader and link up the setter; tune the setter till the silent point is again obtained and carefully mark the position of the setter dial; disconnect, and repeat the process with the reaction condenser.

Connect the spreader, and reaction in parallel, and to the bridge, and adjust bridge for silent point. Disconnect and hook up the setter to the bridge and by advancing the setter again find step 2 or the new silent point. Carefully mark the position of the dial. Unhook the setter and link up the reaction only, and adjust the reaction till the silent point is found. Connect reaction and spreader in parallel, and proceed as from where they were connected in parallel the last time. Repeat until the whole setter is stepped off.

Although 10 steps would cover the range of the setter I allowed 11 to get a slight overlap on each step with the spreader.



A corner of H. L. Jakeman's den showing the neat layout of equipment in his newly-built rack.

Other short-wave enthusiasts may care to use this method to make up their own bandspread tuning units on similar lines, utilising two spare short-wave condensers.—S. WALTERS (Walsall).

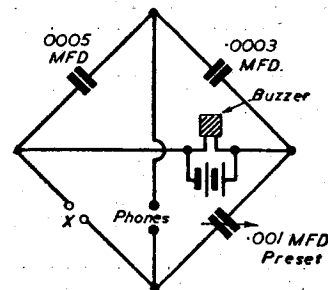
## A Bouquet from Up North

SIR,—Many thanks for circuit diagram of Hartley oscillator; it is just the thing I required. I have made four of these units so far, and they work well.

I also thank you for your promptness in replying, which is most commendable in

view of the most difficult times you must be experiencing in your city meantime. I almost hesitated to ask you for the information as I surmise you must be working under extreme difficulties from various reasons. We have had various reminders in this part of the country of what we may expect: but our sympathy and admiration go out to London, and we echo the world's sentiments of "Bravo London."

With best wishes for your splendid paper.—C. HARESHAPE (Neilston, N.B.).



A simple bridge circuit used by S. Walters for calibrating a small S.W. condenser.

## "Silencing German Stations!"

SIR,—Friend Thermion's idea of sending 'planes to silence the German stations and then transmit British propaganda on their wavelengths is so good that it will certainly be knocked on the head by High-Up-Know-Alls. Besides, would it be gentlemanly? "Must play the game, old chap, what, cake and cigarettes for Nazi airmen when they crash, military funerals with bands and full honours if the poor chaps are killed, don't you think? Nazi flag and flowers on their coffins, eh, what, best traditions and all that sort of thing, eh? Gad, sir, we must never forget that we are pukka sahibs. Damme, sir, do I gather that you are in favour of reprisals? Damme, sir, what a bounder you must be..."—K. T. H. (Birkenhead).

## "All-dry" Four-valve Superhet

SIR,—With reference to your "All-dry" Four-valve Superhet receiver, I am greatly interested in this model, and I am sure there are a great number of other readers who are also interested, as the all-dry system is just the thing required under present conditions.

Here I should like to make a suggestion, owing to the fact that long-wave reception is practically useless these days. Could you, in the near future, design a set on similar lines, covering medium and short waves only, as I, like many other radio fans, very much appreciate reception from American stations? Also, I understand that by omitting the long waves more efficiency can be obtained on the short-wave band. By the way, is the efficiency, life and output of the "all-dry" valve equivalent to the 2-v. valve?—D. A. FISHER (Llandudno).

[The efficiency and life of the 1.4 volt valves are equivalent to those of the 2-volt type, in fact, the former—by virtue of their low current consumption, will possibly give longer life. Ample output can be obtained for normal domestic use, but it is hardly fair to compare them with super-power valves working at higher filament and anode voltages.—ED.]

## Correspondent Wanted

B. RATCLIFFE, 62, Windermere Road, Leigh, Lancs, is desirous of getting in touch with another reader interested in short-wave radio.



# LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

## NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription, £2 10s.).

### Latest Patent Applications.

- 13796.—Cossor, Ltd., A. C., and Jones, K. I.—Radio-receivers. September 3rd.
- 13854.—Erskine Laboratories, Ltd., and Maconochie, H. C. E. Erskine.—Radio receiving apparatus. September 4th.
- 13855.—Erskine Laboratories, Ltd., and Maconochie, H. C. E. Erskine.—Tuning systems for radio receivers. September 4th.
- 13856.—Erskine Laboratories, Ltd., and Maconochie, H. C. E. Erskine.—Radio receiving apparatus. September 4th.
- 13695.—Marconi's Wireless Telegraph Co., Ltd.—Television. August 31st.
- 13696.—Marconi's Wireless Telegraph Co., Ltd.—Television transmission of pictures. August 31st.
- 14686.—Ferranti, Ltd., and Thomas, G. I.—Radio receivers. Sept. 28th.

### Specifications Published.

- 525405.—Hansen, N.—Tuning device for radio-receivers.
- 525613.—Fokerd, A. R.—Method and apparatus for the remote-control of wireless receivers and other apparatus.
- 525616.—Marconi's Wireless Telegraph Co., Ltd., Myers, L. M., and Starr, A. T.—Television - reproducing cathode-ray tubes.
- 525598.—Philips Lamps, Ltd.—Friction ratchet mechanism applicable for tuning radio-receivers.
- 525606.—Philips Lamps, Ltd.—Devices for automatically controlling the band-width in radio-receivers and other apparatus.
- 526361.—Kolster-Brandes, Ltd., Smyth, C. N., and Prichard, R. E.—Television receivers. (Addition to 520235.)
- 526742.—I.M.K. Syndicate, Ltd., Nagy, P., and Goddard, M. J.—Light-modulating devices for use in television receivers.
- 526878.—British Thomson - Houston Co., Ltd.—Driving mechanisms, particularly adapted for the tuning-elements of radio-receivers.
- 526757.—Roberts, E. H.—Radio-receiving and like apparatus.
- 527009.—I.M.K. Syndicate, Ltd., Nagy, P., and Goddard, M. J.—Light-modulating devices for use in television receivers. (Divided out of 526742.)

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

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**TESTERS.** Field A.C. or D.C., 19/6.

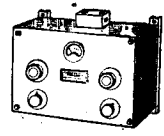
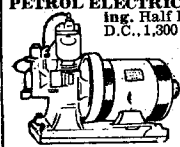
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Literature on application.



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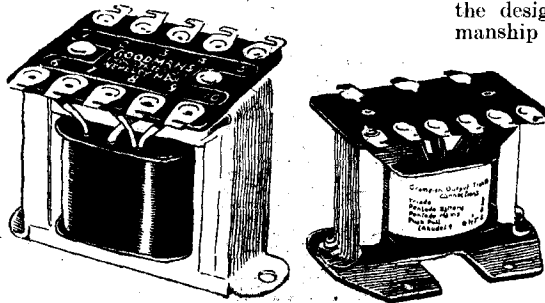
THE PERFECT EXTRA SPEAKER FOR ANY SET

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# NOTES FROM THE TRADE

## Output Transformers

SERVICE engineers are often called upon to remedy a defect in the coupling between a receiver or amplifier, and its associated loudspeaker, and in the majority of cases the defect is due to a breakdown in the primary of the output transformer. In the early days of servicing, it was quite usual for the repair to consist of rewinding the faulty section, and, as would be expected, that occupied a certain amount of time during which the owner of the set was often left without radio. Fortunately for the service engineer and the set owner, certain manufacturers, well qualified to cope with the problem, have now produced what might be called a universal output transformer, which is quite capable of replacing any original component, thus allowing the necessary repair to be under-

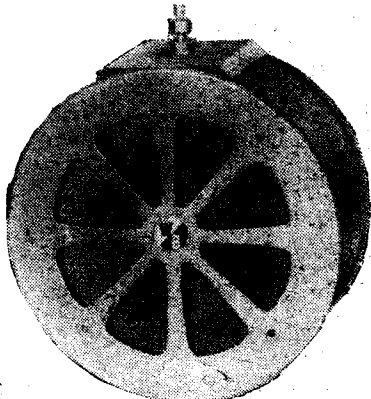


(Left) The Goodmans 10I Multi-replacement Output Transformer. (Right) Another neat and efficient output transformer produced by Grampian Reproducers.

taken and finished in a few minutes. Particular care has been taken by the manufacturers, especially those producing the products illustrated in these columns, to provide sufficient tapping points on both primary and secondary windings, to enable perfect matching between practically any output valve combination and speech coils of almost any resistance. For example, the Goodmans 10I Multi-replacement output transformer gives the following ratios: 12:1, 18:1, 24:1, 30:1, 36:1, 48:1, 60:1, and 72:1. More complete details of the two models shown can be obtained from: Goodmans Industries, Ltd., Lancelot Road, Wembley, Middlesex, and Mesers. Grampian Reproducers, Ltd., Kew Gardens, Surrey.

## "Music While You Work"

THE tremendous increase in war-time "listening-in," plus the widespread use of speakers in factories, offices, etc., for



One type Stentorian loudspeaker produced by Whiteley Electrical Radio Co. for A.R.P. or commercial installations.

A.R.P. and entertainment purposes, has created a great demand for ordinary extension speakers, and for those of special design capable of satisfying industrial needs.

Messrs. Whiteley Electrical Radio Co., Ltd., of Mansfield, Notts, the producers of the famous range of W.B. Stentorian Speakers, have been quick to bring their vast experience of reproducers to bear on the new conditions and requirements, with the result that they are able to offer some very interesting models, two of which are illustrated on this page.

For the larger industrial installations, it is very essential to secure even diffusion of sound, whilst the actual speaker unit must be capable of handling, at least, say 5 to 8 watts without showing any signs of distress in the form of distortion. Both of those very vital requirements are well satisfied by the W.B. products, thanks to the designing, technical skill and craftsmanship so closely allied with all products emanating from the modern factories of Whiteley Electrical Radio Co., Ltd.

## Varley Home Charger

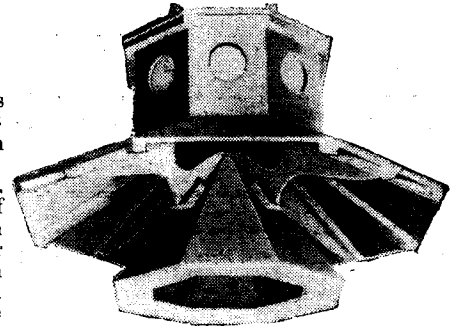
THE very neat low-tension charger illustrated on this page has been specially designed and produced by Messrs. Varley Dry Accumulators Ltd., of Bypass Road, Barking, Essex, to satisfy the demands of the users of the famous Varley Dry Accumulator, which is now being so widely used to replace certain low-voltage dry cells.

The Charger is designed to operate off 200/250 volt A.C. mains, and to give an output of 2 volts at  $\frac{1}{4}$  and  $\frac{1}{2}$  ampere D.C., therefore, it can also be used as an efficient trickle-charger for the more ordinary 2-volt accumulator for radio receiver work. It is completely self-contained, and, owing to its compactness, it can be conveniently placed in any odd corner. A twin flex lead, with plug for inserting into a convenient lamp socket, is fitted to the unit, together with two leads terminating at strong crocodile clips, and a third fitted with a metal collar, for the D.C. output connections. The idea of the three leads is to enable quick and positive connections to be made to the various types of Varley Dry Cells. The actual charging period necessary for a full charge, depends, of course, on the type of cell under consideration but, as a guide, the makers state that with their T.U.1 torch cell, 12 hours are required, whilst the cycle cells need 20 hours.

The price of this very efficient little unit is only 17s. 6d., and those interested should approach their nearest dealer and request a copy of the leaflet, "Care and Charging of Varley Dry Accumulators." If any difficulty should be experienced in obtaining a copy, then, of course, the actual makers, at the address given above, will be only too pleased to oblige.

## Hand Lamps

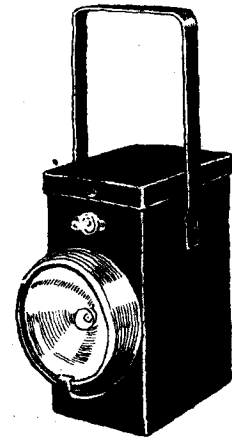
FOR use with the dry accumulators, Varley produce a series of specially-designed hand lamps, one type of which is illustrated. It is their model H.D./140, and it is specially constructed for heavy duty, the container being made from 20-gauge sheet steel. The cell fitted is the V.40 which gives 60 hours of continuous light from a 2-volt 0.3 amp. lamp. The model can be supplied with plain, pearl or



This W.B. Stentorian loudspeaker is designed to give very wide and even sound distribution.

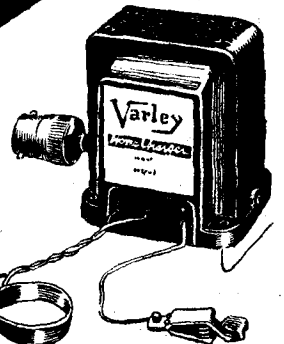
fluted glass protection over the highly-polished reflector and lamp housing. The H.D./140 is a hand lamp which is ideal for numerous purposes during the existing conditions, and the fact that its dry accumulator can be recharged after giving a very useful period of service, renders it an independent light unit having a minimum upkeep cost. Price complete with accumulator is 32s. 6d.

The "Sheltalamp" is another very interesting model, the type number being S.L./120. The strongly-constructed case



(Left) Model H.D./140 Hand Lamp produced by Varley, for use with their dry accumulators.

(Right) A neat L.T. Charger specially designed and produced by Varley for 2-volt accumulators.



of 22-gauge steel, finished black crackle enamel, is of rather different design from the usual run of hand lamps. It is so designed that it can be carried, used as a table lamp or, with the handle reversed, hung up in the shelter as a pendant lamp. The reflector and lamp are protected by a heavy glass moulded dome. The price of this model, complete with accumulator, is 35s.

Cyclists should note that Varley also include in their range of hand lamps one known as a "Cycle and Hand Lamp," and, as its name implies, it is ideal for either purpose. It is fitted with a cycle type dry accumulator, which gives 25-30 hours of continuous service, in conjunction with a 2-volt 0.3 amp. lamp, on one charge. The price, complete with accumulator, is 9s.

# Practical Wireless BLUEPRINT SERVICE

PRACTICAL WIRELESS		No. of
CRYSTAL SETS.		Blueprints.
Date of Issue.		
<b>Blueprints, 6d. each.</b>		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
<b>'STRAIGHT SETS. Battery Operated.</b>		
<b>One-valve : Blueprints, 1s. each.</b>		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
<b>Two-valve : Blueprint, 1s.</b>		
The Signet Two (D & LF)	24.9.38	PW76
<b>Three-valve : Blueprints, 1s. each.</b>		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapid" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.33	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
<b>Four-valve : Blueprints, 1s. each.</b>		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG, LF, Cl. B))	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.0.36	PW67
"Acme" All-Wave 4 (HF, Pen, D (Pen), LF, Cl. B)	2.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.0.38	PW90
<b>Mains Operated.</b>		
<b>Two-valve : Blueprints, 1s. each.</b>		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
<b>Three-valve : Blueprints, 1s. each.</b>		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.30	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
<b>Four-valve : Blueprints, 1s. each.</b>		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW17

SUPERHETS.		
<b>Battery Sets : Blueprints, 1s. each.</b>		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
<b>Mains Sets : Blueprints, 1s. each.</b>		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
<b>Four-valve : Double-sided Blueprint, 1s. 6d.</b>		
Push Button 4, Battery Model	22.10.33	PW95
Push Button 4, A.C. Mains Model	—	—
<b>SHORT-WAVE SETS. Battery Operated.</b>		
<b>One-valve : Blueprint, 1s.</b>		
Simple S.W. One-valver	23.12.39	PW88
<b>Two-valve : Blueprints, 1s. each.</b>		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
<b>Three-valve : Blueprints, 1s. each.</b>		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW68
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68
<b>PORTABLES.</b>		
<b>Three-valve : Blueprints, 1s. each.</b>		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.30	PW77
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"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
<b>MISCELLANEOUS.</b>		
<b>Blueprint, 1s.</b>		
S.W. Converter-Adapter (1 valve)	—	PW48A
<b>AMATEUR WIRELESS AND WIRELESS MAGAZINE CRYSTAL SETS.</b>		
<b>Blueprints, 6d. each.</b>		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
<b>'STRAIGHT SETS. Battery Operated.</b>		
<b>One-valve : Blueprint, 1s.</b>		
B.B.C. Special One-valver	—	AW387
<b>Two-valve : Blueprints, 1s. each.</b>		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
<b>Three-valve : Blueprints, 1s. each.</b>		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	June '33	WM327
Economy-Pentode Three (SG, D, Pen)	Oct. '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	Mar. '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
"TF" Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minutube Three (SG, D, Trans)	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400

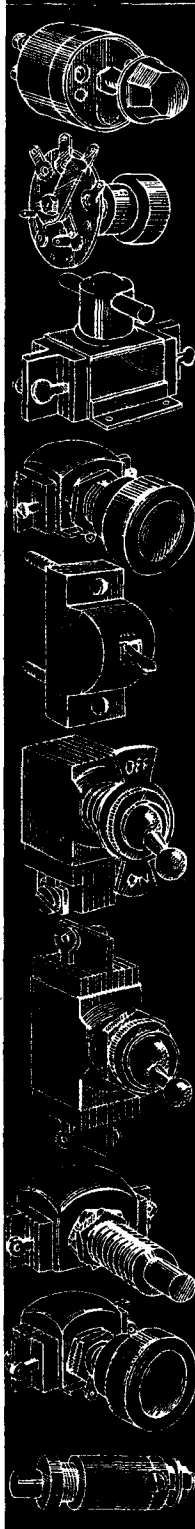
These Blueprints are drawn full size. Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices which are additional to the cost of the Blueprint. A dash before the Blueprint Number indicates that the issue is out of print. Practical Wireless (issues dated prior to June 1st, 1940). 4d. Post Paid (Issues dated June 1st to July 27th, 1940). 5d. Post Paid (Issues dated September, 1940 and after). 7d. Post Paid

Amateur Wireless ... 1/4 " " Wireless Magazine ... 1/4 " "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears : Thus P.W. refers to PRACTICAL WIRELESS, A.W. to Amateur Wireless, W.M. to Wireless Magazine.

Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

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## NATIONAL EFFORT

IN these times, in many directions, needless to say, we are directing our main efforts and supplies towards the requirements of the Government Services.

However, some supplies of components are still available for Radio Servicing, but should delays occur we know our friends will appreciate the difficulties which at present arise from day to day.

We would point out that delays can be minimised and often avoided if alternatives are, wherever possible, specified when ordering.

Prices are being kept as low as possible despite increased costs in every direction. Meanwhile you still have the best and largest range of radio products in the United Kingdom to choose from.

**THANK YOU!**

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(\* = d.p. \*\* = 18-way selector.)

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# Replies to Queries

## Wattage Rating

"As you will no doubt appreciate from my query, I am a beginner so far as radio is concerned and although I am making pretty fair progress with simple constructional work and reading theoretical diagrams, I cannot grasp the meaning of wattage rating when applied to resistances. Could you please explain the true meaning of the term and tell me how it is calculated?"

—P. S. (Cirencester).

TO avoid complications, we will consider an ordinary direct current circuit. When a voltage is applied to a circuit and current flows, the power used can be expressed electrically as so many watts. The watt then can be considered as the unit of power and it is determined by multiplying the applied voltage by the current flowing, the latter being expressed in amperes. When a resistance is inserted in a circuit, a certain amount of power is lost or dissipated in the form of heat, and it is, therefore, essential for the resistor to be capable of functioning without creating undue heating and/or without having its characteristics affected by such rise in temperature. To calculate the wattage or power which the resistor will have to handle, the current flowing across it is squared, i.e., multiplied by itself, and then multiplied by the value of the resistor. It is usually expressed as Power (Watts) =  $I^2 \times R$ . The current should be expressed as a fraction or decimal part of an ampere, but if it is expressed as milliamps then it should be remembered that the resultant figure will be in milli-watts.

## Decoupling Values

"When attempting to design a circuit, I usually get rather confused about the correct values of condenser and resistance to use for decoupling purposes. I make a careful point of studying all theoretical diagrams which come my way, but so far I have not been able to observe any fixed values, so to speak, for certain parts of the circuits. Could you tell me of any formulae or rule which can be applied so that the most efficient values are employed?"

—H. P. (Boscombe).

THIS is quite a common trouble with many amateurs, and the subject has been dealt with in article form in past issues. However, we will attempt to make the matter clear in the brief space available. The main purpose of providing anode decoupling is to by-pass unwanted H.F. or L.F. currents. The simplest way of doing this is to insert a suitable resistor in series with the H.T. supply to the individual anodes and provide an easy path to earth for the currents trapped or held up by the resistor. This path is provided by a fixed condenser.

Owing to the fact that each valve has a certain anode current flowing and that some predetermined value of H.T. must reach the anode load, the value of the decoupling resistor is often governed by the maximum H.T. available, owing to the fact that a voltage drop will be set up across the resistor, the amount of drop depending on the current flowing and the resistance in circuit.

Again, the part of the circuit in which the resistor is inserted will also have a bearing on the value; for example, on the

H.F. side of the detector much lower values can be used than on the L.F. General guide, use the highest value of resistor consistent with the anode receiving its correct operating H.T. voltage. The associated condenser has to be treated with a little more consideration. As it has to provide an easy path to the unwanted currents, it is obvious that its resistance must be a good bit lower than the decoupling resistor, and it is this requirement which can be said to be the governing factor as regards the capacity required. It is more usual to speak of a condenser having a certain reactance rather than resistance, though the effect can be considered as identical, at least for our purpose. The reactance of a condenser can be determined thus:  $X_c = \frac{1}{6.28 f C}$  ohms, where  $f$  is the frequency and  $C$  the capacity of the condenser in farads. For  $f$ , it is usual to take an

## RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

- (1) Supply circuit diagrams of complete multi-valve receivers.
- (2) Suggest alterations or modifications of receivers described in our contemporaries.
- (3) Suggest alterations or modifications to commercial receivers.
- (4) Answer queries over the telephone.
- (5) Grant interviews to querists.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon must be enclosed with every query.

average value, according to the part of the circuit under consideration.

## 25Z6 as a Voltage Doubler

"I have been given an American valve, the type number of which is 25Z6 and I am not sure as to the exact purpose for which it is designed. I have been given to understand that it can be used as a 'voltage-doubler' in a rectifying circuit. Is this correct and if so can you tell me how it should be connected?"

—D. W. (Leyton).

THE valve in question, to quote the R.C.A. Handbook, is a full-wave high vacuum rectifier of the heater-cathode type for use in suitable circuits designed to supply D.C. power from A.C. mains. The valve is well suited for transformerless receivers of the A.C./D.C. or A.C. operated type. In the former it may be used as a half-wave rectifier, whilst in an A.C. receiver it can be used as a voltage doubler which would provide, approximately, twice the D.C. output voltage obtainable from the normal half-wave arrangement.

Actually the valve envelope encloses two separate diodes, and although it is rather difficult to describe the necessary connections without a diagram, we hope that the details given will enable you to make full use of the valve. We must mention, however, that particular care must be taken

when handling such apparatus owing to its direct connection with the mains, otherwise there will always be the risk of receiving shocks which might have serious consequences. Calling one anode A and its associated cathode C, and the other anode and cathode A.1 and C.1 respectively, the following connections can be used:

One side of the A.C. supply goes to A. The other anode A.1 is taken to the negative side of the D.C. output. The positive side of this output is connected to the cathode C. The other cathode, i.e., C.1, is joined to A. Across the D.C. output terminals is connected two large fixed condensers in series, the junction of the two being taken to the other connection from the A.C. supply, which is also joined to one side of the heater of the valve. The remaining side of the heater is taken via a suitable voltage-dropping resistance to the other side of the A.C. input, i.e., the lead connected to A. The resistance must have a value which will only allow sufficient current to pass according to the rating of the valve, in this case being 0.3 amps at 25 volts (heater).

If you care to submit your diagram before putting the valve into service, we will check it and make any corrections, if such should be necessary.

## REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

**L. P. (Southampton).** As we are without any technical details of the receiver, we are unable to make any specific suggestions, but it is usual to connect a P.U. between the grid of the detector valve and the common negative earth line. With an A.C./D.C. circuit, however, it is essential to take certain precautions for the sake of safety. Perhaps the makers will help. *R.* vibrator, keep the unit as far as possible from receiver and enclose it in a complete metal (preferably iron) box, which should be connected to earth.

**L. R. T. (Pokesdown).** The article mentioned in your letter gave all the available details. Progress of the subject is being watched, and more information will be given at the first opportunity.

**M. S. (Dulwich).** The firm concerned will, no doubt, be able to quote you a price for the modifications you require. We would not advise you to attempt the work yourself. The coil is still obtainable.

**H. K. (Hitchin).** A wooden chassis can be covered with perforated zinc to provide quite reasonable screening. Carbon granules can be obtained from Messrs. Electradix Radios, Ltd.

**F. P. (Manchester).** The K.T.66 is an output pentode produced by Messrs. Osram. It is fitted with an octal base. Approximate power output is 7.25 watts. Bias resistance, at 250 volts on the screen and anode, should be 170 ohms.

**J. T. W. (Rigigate).** The theory of the idea is sound, but, in actual practice, other considerations would render the scheme too involved to be of general use. Messrs. Bulgins can supply you with a suitable switch.

**H. O. (Baiham).** We cannot undertake to provide sketch diagrams to individual requirements. One of our blueprint designs would help you, providing you are prepared to keep to the specified components.

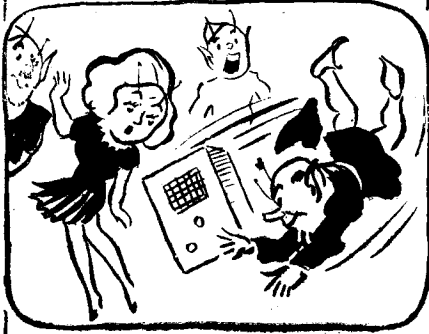
**T. W. (Wigan).** Why not try the 2½-watt Battery-Operated Amplifier? This should satisfy your requirements, and you will find full details in our issue of 23rd December, 1939. We have not published constructional details of a larger battery-operated amplifier owing to the fact that such an arrangement would not be a very economical proposition to run.

**L. M. (Glasgow).** The pilot light on an A.C./D.C. receiver should have a filament rating of the same value as the valves in use. It is best connected in series with the filaments or heaters, and some makers connect across the pilot lamp a small shunt resistance to enable the set to operate even when the pilot light fails.

**T. W. Y. (Teddington).** The lower the wavelength the higher will be its frequency; therefore, the slightest variation of the tuning condenser will have a pronounced effect. Try a small band-spreading condenser.

The coupon on page iii of cover must be attached to every query

The "Fluxite Quins" at Work.



"Look out!" cried EE, with a roar,  
As his wireless set dived to the floor.  
See the grin on his face,  
Not a wire out of place,  
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SIMPLIFIES ALL SOLDERING

THE PURCHASE TAX

How it Affects the Ordinary Listener and Constructor

FOR the benefit of those readers who are not by now familiar with the new Purchase Tax, which actually came into force on October 21st, and complete details of which became available at the time of going to press, we give brief details below of the effect it will have on the ordinary listener and constructor.

Space prevents us from giving the complete list of goods which come within the scope of the tax, but the two classes of products which will be of genuine concern to those interested in radio and allied electrical matters, whether from the trade or private point of view, are Class 7, lighting fittings and domestic appliances, etc., and Class 12, musical instruments, etc. The items mentioned above do not, at first glance, seem very extensive but, on further examination of Notice 78, issued by the Commissioners of Customs and Excise, it is found that the sections actually cover a very large number of products, including all types of domestic heating, cooking and lighting apparatus, radio sets, radiogramophones, valves, accumulators and batteries. These come under the full tax which is 33½ per cent. of the wholesale price. A certain limited number of goods are only subjected to half the full or standard tax, namely, 16½ per cent.

Although the tax will directly affect the listener's pocket, it would seem that the constructor, and the experimenter, will not be called upon to contribute to the tax when purchasing the components they usually require, excepting, of course, valves, accumulators and batteries.

New Valve Prices

To give an example of the increase in prices to be expected on two of these items, it can be noted that a valve normally listed at 4s. 9d. will now cost the public 5s. 10d. One listed at 10s. will now be 12s. 2d., whilst those in the 15s. class will become 18s. 3d.

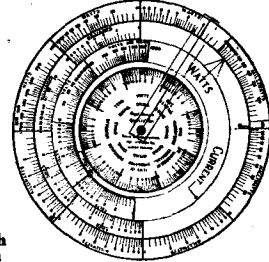
On the dry battery side, a nine-volt G.B. battery which we used to buy for 10d. will jump to 1s. 0½d., a 120-volt H.T. of the 7s. 6d. class will become 9s. 3d., and the more expensive type, normally listed at 20s., will be subjected to a tax of 4s. 8d. It is fortunate, so far as the constructors and experimenters are concerned, that the items coming within the tax are not those in too frequent demand.

It must be appreciated that this tax does not in any way increase the profit of anyone concerned with the production or marketing of the taxed goods. Broadly speaking, the tax becomes payable as soon as the goods are sold by the manufacturer or wholesaler to the retailer and it is, therefore, the latter who carries the additional load until he resells the goods to his clients.

Under Class 12, i.e., musical instruments, etc., we find that the full tax is applicable to gramophones, pick-ups, records—excepting those for the reproduction of speech specially adapted for the use of the blind—gramophone needles and motors.

After seeing what has to be paid, let us turn to the other and brighter side of the business, and see what goods are exempt. Selecting those most likely to interest our readers, we note that electric meters, neon lamps, public address apparatus, microphones and valves specialised for use with "deaf aid" appliances are free of all tax.

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- What current will flow through R resistance where voltage is E?
- What will be the resistance where current I flows at voltage E?
- What will be the resistance where watts W is at voltage E?
- What will be the resistance where watts W is at current I?
- What is the wattage at voltage E through resistance R?
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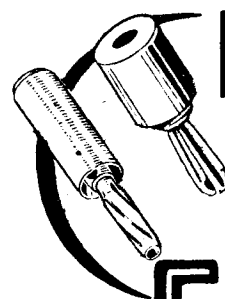
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