WISE SPENDING—Discriminating “Fury Four” Builders insist on Direct Radio Specifications (See Page 1101).
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L.P. Transformer No. 1, A.T. 13, Ratio 3:1
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Matching accurate to within $\pm \frac{3}{4}$ of $1\%$ ± 1 m.m.f.

TWO GANG WITH DISC DRIVE & COVER
TYPE P.C.2
14'.
A SOLID FOUNDATION
FOR THE
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The success of the FURY FOUR A.C. RADIOGRAM is assured. Built up with the Westinghouse Metal Rectifier as a foundation, you are guaranteed a constant and adequate high tension supply for years without any renewals; and this definitely ensures the results you expect from such a fine receiver. Send 3d. for 44-page book "The All Metal Way, 1933," which contains much of interest to users of A.C. Mains.

Please send me "The All-Metal Way, 1933," for which I enclose 3d. in stamps.

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BRAKE & SAXBY SIGNAL
CO., LTD., 82, YORK
ROAD, KING'S CROSS,
LONDON, N.1.

H.T. 8
WESTINGHOUSE
METAL RECTIFIER
PRICE 18/6
"ATLAS" GIVES MORE POWER FOR LESS THAN 1/- A YEAR

JUST imagine unlimited and infinitely better reception for less than one shilling a year—the price of a packet of cigarettes! Power from the mains with an "ATLAS" Unit is fifty times cheaper than batteries.

There's an "ATLAS" Unit for your battery set, whether portable, table or radio-gram, from 39/6 or 10/- down. Abolish batteries now and save 50/- every year.

Ask for a demonstration to-day, and be sure to insist on "ATLAS," the only Units to win the Olympia Ballots for two years in succession. No other is so silent, safe and sure. Guaranteed 12 months. Westinghouse Rectifiers.

If your dealer cannot supply, write to:
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Glasgow: The G.B.S. Co., Ltd.,
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SERADEX FILTER CONDENSERS
BRITISH MADE * NON-INDUCTIVE * HIGH INSULATION


SPECIAL BUFFER 1,500 V. test... 1x 1 Mid.... 1x 9d.

Units for WESTINGHOUSE VOLTAGE DOUBLER CIRCUITS
800 V., test. 4x4 Mid.... 1x 3d.
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Lists of full range for stamp. From your dealer or direct from makers:
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BUILD QUIESCENT PUSH-PULL INTO YOUR PRESENT SET...

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TREBLE YOUR OUTPUT

- SAVES 50% H.T.
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PETO-SCOTT—Pioneers in Radio since 1919, and FIRST AGAIN with The Pilot Q.P.P. Conversion Kit. No need to remove your present battery set in order to enjoy treble output, mains volume and quality with a saving of 50% H.T. energy. We show you how. This Q.P.P. Conversion Kit sets a new standard. No technical knowledge is required and every kit is complete—ready to be put into your present set instantly. No tools, No nuts, No bolts! Connects your set immediately. Works, or your money back. Obtainable only direct from us. KIT "A"—CASH or C.O.D.

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or 9 monthly payments of 6/2.

Each Purchase of the PILOT Q.P.P. Conversion Kit is assured of our Full Technical Assistance.

Every Model of Our Full Technical Assistance... Complete with Guarded Meter 10/- Extra

FUZY FOUR

Original Battery Model

KIT "A"—Author's Kit of specified parts, including ready drilled panel, but 100/6 valves and cabinet.

CASH or C.O.D. Carriage Paid

£6 10 0

or 12 monthly payments of 12/6.

Specified Values £2/17/6. Peto-Scott Oak Cabinet, 10/-

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Sound Sides, Input Transformer

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A.C. FURY FOUR RADIO-GRAM.

KIT "A"—Author's Kit of specified parts, including ready drilled panel, but 100/6 valves, cabinet, Motor, or 12 monthly pay-Pick-up and Speaker.

SET OF SPECIFIED VALVES 2/8 16

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Cash or C.O.D. Carriage Paid.

In Peto-Scott Co., Ltd., 71, City Road, E.C.3.

Every Model of Our Full Technical Assistance...

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RADU BY MAIL
Build with your own hands - this better set saves pounds - success a certainty!

GET YOUR FREE COPY OF MOST SUCCESSFUL CHART EVER PUBLISHED enabling you to build MOST SUCCESSFUL SET EVER BUILT!

NEVER before was there such a set within the reach of the home constructor. Never before such power from a battery set. Never before so many enthusiastic letters from constructors or so much talk about any radio set as this Lissen "Skyscraper" Kit has elicited. 50-60-70 loud-speaker stations - everybody who builds a "Skyscraper" gets results like that! Lissen have published a 1/- Constructional Chart, giving the most detailed instructions ever printed for the building of a wireless set. You can't go wrong — every part, every wire, every terminal is identified by photographs. Everybody, without any technical knowledge or skill, can safely and with COMPLETE CERTAINTY OF SUCCESS undertake to build this most modern of radio receivers from the instructions given and the parts Lissen have supplied.

This new Lissen "SKYSCRAPER" Kit Set is the only one on the market that you can build yourself employing a Metallised Screened Grid Valve, High Mu Detector and Economy Power Pentode. Around these three valves Lissen have designed a home constructor's kit the equal of which there has never been before. Why be satisfied with whispering foreign stations when you can BUILD WITH YOUR OWN HANDS this Lissen "SKYSCRAPER" that will bring in loudly and clearly distant stations in a profusion that will add largely to your enjoyment of radio?

YOURS FOR ONLY 8/6 DOWN

To-day you can buy the LISSEN "SKYSCRAPER" Kit on Gradual Payment Terms. "Skyscraper" Chassis Kit, complete "Skyscraper" Kit complete with Valves, CASH PRICE, 8/9. Or Walnut Cabinet and in-built Loud-speaker, as illustrated, 11/- down and twelve monthly payments of 10/6.

You can get the Lissen "Skyscraper" Chart FREE from your radio dealer, or by posting the COUPON below direct to factory.

COUPON

To LISSEN, Ltd., Dept. P.R.33, Werple Road, Isleworth, Middlesex.

Please send me FREE copy of your 1/- Skyscraper Chart.

Name

Address
Another 60-Kilowatt Threat

A COINCIDENCE that a French daily paper, Le Moniteur Légendaire, the Director of Radio Normandie (Fécamp), hopes to erect a 60-kilowatt transmitter somewhere on the coast of North-West France to take over the duties of the present station now working on 10 kW.

Ultra-Short Waves in Italy

BOTH at Rome and Turin experiments are to be carried out with Ultra-Short wave transmitters operating on channels between 3 and 7 metres. It is intended to carry out tests in both television and commercial broadcasting.

P.M. Speakers are Sensitive

SOME speakers do require a rather greater signal input than others, but this is in no way concerned with either high-tension or low-tension current. As a matter of fact, however, the average present-day permanent magnet moving-coil is at least as sensitive as a speaker of the older "cone" type.

Great Britain Still FORGES Ahead

DURING January, 1933, the number of broadcasting licences issued by the Post Office was roughly 668,000, which brings Great Britain to the top of the list with 5,964,000 licensed listeners. The war against radio pirates is still being carried on, and in the course of one month over two hundred prosecutions resulted in fines amounting in all to approximately £235.

Have You Logged these Short Wavers?

ALTHOUGH its power is only 250 watts, transmissions from YV11BMO, Maracibo (Venezuela) are now frequently heard by listeners in the British Isles. The wavelength is 48.35 m. (6,127 kc/s), and the call between programme items "Aquarmonode" (that station) and "La voz de Orinoco" (this station) is heard during the 1 a.m. news bulletin at midnight. Applications to the authorities have been made by two broadcasting stations for the same wavelengths 12 months ago. It is reported that the 20 kilowatt transmitter which is being erected at Barcarena in the immediate neighbourhood of the Portuguese capital will be ready to carry out tests towards the end of next August. It has been so designed that its power can be increased at a future date. The wavelength to be used is 283.6 metres, a channel which was originally conceded to that country by the Plan de Praga. In the meantime the broadcasting service is provided by CHIL, a small station owned by an amateur radio club at Parada, some eight miles from the capital, and by C71AA, a 2 kilowatt transmitter operated in the centre of the city.

Paving the Way for Lucerne

UNDER the chairmanship of Admiral Sir Charles Garpendale, of the British Broadcasting Corporation, a conference of the Union Internationale des Radiodiffuseurs has been held at the Palais des Academies, Brussels. Its aim has been to prepare a new plan for the allocation of wavelengths to European broadcasting stations in order to mitigate the interference resulting from the ever-increasing number and power of the transmitters. The work was entrusted to the members of the U.I.R. by the Madrid conference in anticipation of the meeting of European State delegates which will take place at the end of next August. It has been so designed that its power can be increased at a future date. The wavelength to be used is 283.6 metres, a channel which was originally conceded to that country by the Plan de Praga.

Amateur Transmission

FOR the past few weeks we seem to have received innumerable queries from readers who ask for particulars of wireless transmitters. In some cases we have been able to offer suggestions, in others we have referred querieists to the paragraphs on transmitters given in our "Wireless Constructor's Encyclopaedia," but in a few instances we have been unable to supply the information requested. Quite a number of querieists have entirely overlooked the fact that a special kind of licence is required before operating even the simplest form of transmitter, whilst one querieist had actually commenced radiating without giving a thought to the licence question. In reply to the latter gentlelman we were obliged to warn him that if he continued his activities he would be liable to heavy penalties.

The New Lisbon Station

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Fading

THOSE readers who have been recruited to the ranks of radio amateurs during the last six months or so, will probably have been somewhat perturbed, when listening to a distant transmission, to find it gradually fade from full loud-speaker strength to inaudibility. They may at first have thought that their H.T. or L.T. was running down, but if they have left the set alone and kept on listening they will have noticed that after an interval the signals have come back again to full strength. The phenomenon is known as fading, and is caused by atmospheric changes and requires careful tuning to overcome the trouble by means of an automatic volume control.

A.C. FURY FOUR BUILDING THE

SEE PAGES 1096 TO 1098

THE Q.P.P. THREE-FOUR SEE PAGE 1098

SELECTIVITY SIMPLIFIED SEE PAGE 1079

Lucerne during next May. It is hoped to draft a new plan to replace that worked out at Prague in 1929 following the decisions taken at the Washington Convention of 1927.
New Radio Prolonged the Life of Rabbits

A NEW YORK bacteriologist whose house had been ransacked by burglars induced his local broadcasting station to put out the following announcement: The unwelcomed visitors who stole, amongst other articles, five rabbits from Dr. —'s private house are warned that they were recently inoculated with a virulent bacillus—they should not be eaten. The rabbits were sent back to their owner the next day!

The Voice of a Dusky Maid

A T regular intervals you may pick up Oriental concerts from Radio Algiers, Arab musicians singing to the accompaniment of native string instruments. To give these broadcasts their true atmospheric listeners are claiming that announcements should not be confined to the French language, and Radio Algiers will shortly appoint an Arab girl to fulfil these duties. Many have applied for the job, but as is customary with other articles, five rabbits from Dr. —'s private house are warned that they were recently inoculated with a virulent bacillus—they should not be eaten. The rabbits were sent back to their owner the next day!

Welsh on the Ether

THE B.C. has accepted a recommendation made by the Central Council for School Broadcasting and from September next will give experimental courses on Welsh language, literature and history. These will be transmitted through the West and North Regional stations.

First Official Egyptian Broadcaster

IN anticipation of a Radio Exhibition held at Cairo during the period February 10-25, a 500 watt station was formally inaugurated on February 1. The station was on 290 kilocycles. The exhibition has been used for the purpose of popularising radio as it emanates from Kovno (the capital of Lithuania). The opening signal consisted of the 15 kilowatt station at Ab-Zabal, constructed by the Egyptian branch of the Marconi Company, may be brought into operation next month.

Listen to Lithuania

RIGHT at the top of the "long wave" band, above Hilversum, you may hear on 1,955 metres a call—Radio Kaukas; it emanates from Kovno (the capital of Lithuania). The opening signal consists of a few chords struck on a piano followed by a ticking metronome. The main evening broadcast is at 8.00 p.m. G.M.T., and music is frequently broadcast from 8.45 until 9.30 p.m. The station closed down with the call Labalnat Lietuvos Radio Kommunikacijos Centras (Cultural Right, Radio Kaukas of Lithuania), followed by a gramophone record of the National Anthem (Lithuania, Our Fatherland, the Land of Heroes).

New Wireless Bill in France.

UP to the present the owner of a wireless receiver in France paid no listening tax; he was merely required to register with the authorities and to procure a certificate costing one franc. The new wireless bill calls for a higher tax, namely, 15 francs per annum for crystal sets; 60 francs for private owners of valve receivers; 100 francs for cafes, restaurants, etc.; and double that amount yearly for public relays of broadcast programmes if an entrance fee is charged. In addition, the State will collect an extra 15 per cent. of the wholesale price of valves from all makers.

Athlone Calling

MANY listeners by now will have heard the powerful transmissions put out by the new 90 kilowatt Irish Free State station at Athlone. With the exception of Sundays, given it only comes on at 8.30 a.m.

The New H.M.V. Super-power moving-coil loud-speaker.

Gilmore's receiver; 100 francs for cafes, restaurants, etc.; and double that amount yearly for public relays of broadcast programmes if an entrance fee is charged. In addition, the State will collect an extra 15 per cent. of the wholesale price of valves from all makers.

A J. Alan will tell the story of "A Joy Ride," to National and Regional listeners, and three hours and a half later will repeat it for the Canadian Zone. Thus British broadcasting draws daily nearer to a continuous service throughout the day and night if its transmissions are to be heard by all the colonies and dominions.

SOLUTION TO PROBLEM No. 23.

Patterson's receiver was giving very unsatisfactory reproduction, quality being inferior and volume very poor for a Detector and two L.F. type of receiver. Purchasing a voltmeter he tested H.T., G.R. and L.T. batteries. L.T. was fully up to the required 2-kvols.; the grid battery read the full 2 volts, and the H.T. also read the full voltage, namely 120 volts. The loud speaker was a balanced armature with a resistance of 2,000 ohms. joined direct in the anode circuit of the valve. The first valve is an R.C.A. type, coupled to the first L.F. valve which is in turn coupled to the output valve. What was the cause of his troubles? Three books will be awarded for the first three correct solutions opened. Address your solutions to The Editor, Practical Wireless, Geo. Newnes, Ltd., 8-11, Southampton Street, London, W.C.2, and mark the envelope, "A J. Alan's Radio Problem."
The word "selectivity" is constantly appearing in articles in these pages, and on more than one occasion a query has been addressed to our Queries Department, asking what is actually meant by the term. It is, of course, quite obvious that it has something to do with "selective," which is an ordinary dictionary word meaning "choosing or picking." Another expression which is often used is the same connection is "sharp tuned," and this also should be self-explanatory. There are many readers, however, who do not know sufficient about the electrical side of wireless to fully grasp what is meant by the term. I will, therefore, try to define, with a simple analogy, the expression "selective." It is quite a common practice for writers of radio articles (especially those which are prepared for beginners), to try to draw a comparison between the tuning-in of different stations and the tuning of a musical instrument string to a certain note. This is not, in my opinion, a very clear explanation, especially for the young, or non-technical reader. I shall, therefore, ask you to forget any explanation which you may have read, and attack the subject from an entirely different point of view.

The Transmitter
Every listener knows by now that each transmitting station employs a separate wave-length, or in other words, the programmes sent out by each station are described as being "tuned" to a certain frequency. There is no need to bother about the method by which this is done, or even what is meant by the term. Simply remember that each station is of a different frequency, without even worrying about what frequency means. When the idea of reception has been fully understood, then is the time to study the meaning of the various electrical terms, but doing so now will only confuse you. Very well, then, we have got to the point where we are aware that each programme (by which I mean each station's programme), is sent out at a different frequency.

The Receiver
Your receiver is joined to an aerial which is erected, in most cases, out in the open. This provides the entry to the receiver, and therefore, all signals which you receive must pass to the receiver (and ultimately to the loud-speaker) via this aerial. It is, of course, quite obvious, without any electrical knowledge at all, that the aerial is in a position to pick up everything in the way of electrical energy without the point where a very interesting analogy may be made, so that a perfect understanding may be obtained. Everyone is familiar with the steel ball-bearing which is used in the bicycle, motor-car, etc. These are obtainable in various sizes, and at the factory where they are made a very simple form of graduating device is employed. Look at Fig. 1. At the top of this illustration is a sloping trough, very narrow, and provided with high sides. These are removed in the illustration so as to show the working more clearly. At intervals along the bottom of this trough are punched holes, the one at the highest end being very small, and each succeeding hole being a fraction larger. At the bottom (lower end) of the trough we find the largest hole. All the ball bearings are mixed up when coming from the factory polishing-room, and have, therefore, to be sorted into their individual sizes in order that they may be sent to the appropriate firms according to the uses to which they are to be put. A long chute (a sort of "helter-skelter") brings the balls in a continuous procession, one behind the other, to the sloping trough which we have illustrated. Can you see what has happened now? As the balls run down this slope it is obvious that ball No. 1 in the sketch will run across the first hole, and so be carried to its appropriate box. The smaller No. 2, will drop through the next hole, and so be carried to its box. This is quite a simple arrangement, and, I think, everyone will clearly understand the idea upon reading the above notes.

The Tuning Condenser
The helter-skelter arrangement described above is the ether or, if you prefer it, the air between the transmitter and the receiver. The sloping trough is your aerial, and the boxes beneath are the means of conveying the signal to the speaker.

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The only part of the illustration which we have not compared is the holes. This is the secret of "selectivity," which, after the above explanation, you should now be able to see, simply means a separating into classes, or picking out one individual to the exclusion of all others. The aerial in every set is joined to a wire which is, in turn, joined to earth, and therefore, the aerial may be considered as one wire starting at the lower end of your garden, running down into your room, round and round a tube of either ebonite or cardboard, and then carrying on to a piece of metal buried in the ground. Consequently, all signals which may pass across your garden, running down into your room, will correspond with the size of ball we want, that ball will drop through, and the others will pass through. As the distance between the holes is increased, so we reduce the tendency for signals to pass across, unless the signal is of the same frequency as the frequency of the second coil and condenser. An therefore your tuning arrangement consists of a non-tuned coil coupled to a tuned coil, as shown in this illustration, and you have difficulty in picking out one station to the exclusion of all others, you must contrive in some way to increase the distance between them. Obviously, as the distance is increased, less power will get across the gap, and this brings us to the first important statement. Improved selectivity can only be obtained at the expense of signal strength.

The Series Aerial Condenser.

A very common method, often recommended for increasing selectivity, is the inclusion of a small semi-variable or fixed condenser between the aerial and the tuning coil. This is certainly a good method of improving selectivity, but it has its drawbacks. If you have such a condenser in your receiver tune to Radio Paris and, when accurately tuned in, join a short piece of wire across the terminals of this condenser. In the majority of cases there will be a marked increase in strength. Therefore the series aerial condenser should be provided with some arrangement so that it may be short-circuited when the coil is tuned to the long waves.

If your receiver employs a commercial coil, and you do not wish to interfere with it, a very simple arrangement for improving selectivity is to wind over the existing coil a few turns of fairly thick wire, say 22 gauge, D.C.C., at the end of the coil which is joined to aerial. The lower end of this additional coil should be joined to earth, and the beginning of it to aerial. By experimenting with various sizes of coil, etc., different degrees of selectivity may be obtained, and a compromise found between selectivity and signal strength.

Probably the most selective tuning circuit to-day is the Band Pass filter, which consists of two separate tuned circuits (similar to Fig. 1), and these are each enclosed in a metal screening box, and therefore isolated. Obviously, from what I have already said, you will see that the signals will pass through the first coil to earth. This is the choke arrangement. The second coil of the Band Pass filter is the collecting box, and the hole graduating device is included by means of a condenser, a resistance, or a small coil. This is joined between the lower end of the two coils, and when each tuned circuit is accurately adjusted to the frequency of the station you wish to hear, that frequency can pass through the coupling medium, and so it is possible to select that station to the exclusion of all others. There is not the slightest doubt that this method of tuning the aerial circuit is the most efficient, and although there is a slight loss of signal strength, as I have already pointed out, this is so small in a correctly designed Filter, that it may almost be said not to exist.

**MAKE THE "FURY FOUR" - THE SET WHICH DOES MOST OF ALL!**

You can operate it from an Eliminator without alteration!
WHAT IS WRONG? 2

In the Second Article of this Series the Author
Deals with the Subject of Anode Voltage and
Current Tests

By FRANK PRESTON, F.R.A.

LAST week I described the necessary apparatus for fault finding, and briefly mentioned a few preliminary tests. And now I want to explain how the more intricate forms of trouble should be dealt with by isolating the various circuits and testing each in turn. It is, of course, a difficult and almost hopeless proposition to attempt to diagnose a complaint by studying the receiver as a whole. Just as a medical doctor feels the pulse, listens to the heart-beat, taps the chest, and examines the tongue of his patient, so must the wireless "doctors" examine every part of the receiver in order to locate the region of the trouble. Having tracked it down to a certain part of the circuit, it should not be difficult to discover the actual source by following a process of elimination.

Causes of Trouble

Before proceeding further, let us set out in order the various kinds of troubles and ailments to which a set is heir. We can put these under the following headings:

1. Entire absence of signals.
2. Weak reception.
3. Reception accompanied by "noises," or crackling.
4. Distortion or poor "quality."
5. Instability (often indicated by various noises).

We cannot treat the above five complaints as if they were all quite different, since very often, two or more of them go hand-in-hand so that one obscures the other. For the same reason we cannot formulate a series of tests which will apply in each case, but instead, we must consider each on its own merits; it is because of this that our preliminary tests will have been helpful, even if they have not given us any definite clue.

Deals with the Subject of Anode Voltage and Current Tests

Fortunately, for the purposes of our present tests, we can treat the complaints numbered 1 to 3 above in a similar manner, and so, for the time being, we will consider them jointly. Before testing the receiver properly it is essential that we should satisfy ourselves that the batteries, speaker, and aerial-earth systems are as they should be. I will not dwell too long on this part of the work, because most of the tests will be very obvious, but I would emphasize the fact that nothing should be taken for granted. Having made quite sure that the serial is functioning properly and that its switch contacts are clean, it is a good plan to replace the wires from the switch to the set, especially if they are in any way kinked or brought through the window in such a manner that they are trapped between the frame and the sill. Any odd lengths of wire may be used for the purposes of test, and they may be replaced by new ones later, if this is found necessary. Should any doubt exist in regard to the speaker it may be replaced by a pair of 'phones, after taking care to reduce the volume control to its minimum position. This test should only be applied in the case of a set having a small power valve, because if the anode current is high there will be a danger of damaging the 'phones. On no account should the test be applied to a set operating from the mains or from an eliminator, unless special precautions are taken against the possibility of receiving a shock. Suitable precautions are to connect the 'phones through a pair of large-capacity (1 mfd. to 4 mfd.) condensers, as shown in Fig. 7. The condensers will prevent the passage of D.C. anode current through the 'phones, and therefore, a by-pass resistance of some 20,000 ohms must be connected directly across the speaker terminals (also shown in Fig. 7). If this test indicates a fault in the speaker, try new connecting wires before rushing it off to the makers for repair.

Battery Tests

And now we can test the batteries. The first thing is to "break" and "make" the high-tension circuit, either by pulling out the negative wander-plug or switching the eliminator off, and then on again. As this is done there should be two distinct "plops" in the speaker; if not, there is probably either a run-down battery or a faulty connection. Next measure the voltage of the H.T. and L.T. batteries between the appropriate terminals of the set whilst the latter is switched on. Carefully make a note of the voltages and switch off; the reading for the L.T. voltage should remain exactly the same, and that for the H.T. should only be very slightly higher (the actual amount will depend upon the resistance of the meter; the higher the resistance, the smaller the change). It is best to make these measurements after the set has been in use for some time, so as to ensure that the batteries have "settled down" to their steady voltages. If the voltage of the H.T. battery is less than 60 per cent. of what it should be, the battery ought to be considered as definitely run-down, because it will not be fit for further service. After checking the total high-tension voltage, measurements should be taken between the negative terminal and
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First let us measure the anode current flowing to each valve in turn (and also the screening and priming grid currents where S.G. and pentode valves are in use), because this will provide us with much useful information and might, in fact, give us the solution to our problem.

It need scarcely be mentioned that great care should be exercised when testing inside the receiver to make quite sure that no wires can fall and cause a short circuit, and that the H.T. is disconnected before making any alteration. Also be careful that loose wires do not come in contact with metallized valves or tuning-condenser vanes. When the set is mains-operated, or even if it is fed from a H.T. battery of more than 100 volts or so, the fingers should be kept away from the working parts whilst the switch is on. Even after it is switched off it must be remembered that large capacity condensers will be charged for a considerable time after the set is switched off, and that it may be ignored entirely.

Grid Bias

After having satisfied ourselves that the H.T. and L.T. supplies are in good condition, we must measure the voltage between the positive, and each negative, grid-bias battery connection. If there is any reason to doubt the efficiency of the G.B. battery, it is wise to replace it at once, since a faulty one can cause considerable harm. When the set employs a system of automatic biasing it is not easy to measure the actual bias voltage developed, but a very rough indication can be obtained by applying the voltmeter between the ends of the bias resistance. This matter will be dealt with more fully in a later article in which special reference will be made to mains receivers.

Anode Current Tests

Once we have made quite sure that the accessories are functioning properly we shall have narrowed down our field of inquiry to the receiver proper. But even this is much too wide for exploration as a whole, so we must subdivide it into its various portions. We may split it up into the separate valve stages or into anode, grid, filament, and tuning circuits; as a matter of fact, we shall do both.

The corresponding battery lead is broken, that the wander-plug or terminal connection is dirty, or that there is a short-circuit inside the set. The latter is unlikely, because it would have been responsible for a low voltage reading on the whole battery.

Some of the measurements just referred to could not be made if the maximum voltage of the H.T. battery was greater than the highest reading of the voltmeter, and, in that case, similar results could be obtained by putting the positive wander-plug into a lower tapping and so measuring the voltage of one part of the battery, and the negative plug into a higher tapping whilst measuring the other portion. This method will be more readily understood by making reference to the sketch of Fig. 9. When high-tension is derived from an eliminator, voltage measurements are more difficult to take unless the voltmeter has a resistance of at least 300 ohms per volt. If a meter of lower resistance were employed the voltage registered would be appreciably less than that actually supplied to the set. For this reason the voltage tests should be omitted, and we shall see later how almost equally useful indications can be obtained in another way.

Making Contact

Unfortunately the true anode voltage cannot accurately be measured with any normal voltmeter, because it would be in shunt with the valve and so reduce the effective filament-anode resistance. In consequence, it will be necessary to arrive at the figure by estimation. Where the coupling component is merely a resistance, or series of resistances, the voltage drop can accurately be calculated by applying Ohm’s Law, which tells us that Voltage Drop is equal to the Current Flowing (in amperes) multiplied by the Resistance (in ohms); or more mathematically, V = IR. Since we shall be dealing with milliamperes rather than amperes, and since the milliammeter is likely to be used in the form of a battery with a very low emf, the formula can be simplified to read — Voltage Drop is equal to Current (in milliamperes) multiplied by the Resistance (in thousands of ohms), or V = IC (m.m.) R/1000. In the anode circuit includes a choke, transformer, etc., the voltage drop should be calculated so accurately unless the D.C. resistance of the anode component is known. It will, however, be sufficiently accurate in most cases to assume the resistance of the primary winding of an L.F. transformer, or of an L.F. choke, to be about 20 ohms whilst the resistance of an H.F. choke or tuning coil will be so low in proportion that it may be ignored entirely.

It should be remembered that when the

(Continued on page 1115.)
The DEVELOPMENT of the TUNING COIL (PART 4)


End Of Winding

In this concluding article of the series, let me start first of all by giving one or two simple hints in construction. It is strongly recommended that home-made coils should not be of the dual range pattern. If both long and short waves are required, wind a coil for each, fit them in the set at right angles to avoid mutual action, and use a wave change switch.

For the medium wave coils, the usual paxolin or ebonite tube may be used, but quite good results can even be obtained by using dry brown or cartridge paper or thin card, rolled up to cylindrical form and well coated with shellac varnish.

Small Details

Before commencing the winding, provide a means for fastening off the two ends of the wire. The conventional way is to drill two small holes near the points where the winding will start and finish, and to thread the wire through the holes at the starting point and end. Two or three winds for connection, making off the finishing end in the same way (see Fig. 1). An alternative is to fix terminals at the two ends of the winding, or small screws and nuts will serve equally well. Another successful and economical dodge is to get your local shoemaker to fix an eyelet at the points where the winding will begin and end. A loop with a smooth file will remove the black or brown enamel from the eyelets, and the wire can then be soldered to them, as shown in Fig. 2.

If a coil has to be tapped, holes must be pierced in the former at the tapping point, and a loop of wire drawn through and twisted up to form the tap (Fig. 3). Alternatively, the loop may be simply twisted up without being passed through a hole, but the former method is the neater. It is advisable to procure formers considerably longer than the actual length of winding, thus permitting brackets to be secured to them for fixing in the receiver. This is particularly necessary in the case of coils to be fitted in sets with metal bases, as it is fatal to efficiency if the winding comes too close to such a large mass of earthed metal.

A New Development

So much then for past and present considerations as far as coils and coil design are concerned. Can anything be said about the future? I always feel it is dangerous to prognosticate, but there is at least one development which appears to show promise of a very material character, and it is fitting to complete this short series by dealing with it. I have shown how the effective resistance of tuning coils plays a very important part in the performance of any wireless set. The lower the resistance, the greater becomes the stage gain coupled with an improvement in selectivity, and all commercial coils, within the limits of accepted methods of design, have endeavoured to aim at this ideal as far as mass-production methods allow.

To prevent interaction between the various tuned stages metal screens have been necessary, and this reduces the efficiency of the coil unless the "can" diameter is large compared with that of the coil. Many methods have been tried to counter these opposite effects, but the laboratory ideals have not been reached in their commercial counterparts. A German engineer, however, has produced a new magnetic material which has been named "Ferrocart," and by using this substance new types of coils are in process of development. Messrs. Colvern, Ltd., have secured the exclusive rights to manufacture and sell in Great Britain and Ireland components employing this material, but up to the time of writing the coils have not yet appeared on the market.

Magnetic Cores Not New

Readers will appreciate that the use of iron or magnetic cores for coils is by no means new; on the low-frequency side of the wireless set we have our chokes and transformers in abundance. Any attempt to use such components at high frequencies, however, has been productive of very high hysteresis and eddy current losses, and these have outweighed the decreased copper losses brought about by being able to use a small core of iron for a given inductance than if an air core had been employed.

It appears that this new magnetic material, Ferrocart, consists of minute particles of a high-grade magnetic material of such a structure that they in themselves are very free from losses. These particles are so separated and arranged in the completed core by a special insulating process that the formation of eddy currents and the losses resulting therefrom are reduced very considerably.

Sample Cores

I have been successful in obtaining samples of these cores from the Continent, and in Fig. 4 will be seen two of them. They are very similar to resemble "rings" some 2 in. or so in diameter, but in outward appearance, reveal little that gives a clue to the correct structure. By cutting one in halves, however, with a hacksaw, it was found that the whole core was made up of layer upon layer of insulating material, and the magnetic...
you to determine the most suitable capacitance of the L.F. transformer, but depend entirely on the character-even an average value, since it will resonate to cycles or so, at which a tremendous gain in amplification will result. It is impossible to state even an average value, since it will depend entirely on the characteristics of the L.F. transformer, but a little experimentation will soon enable you to determine the most suitable capa-

The coils themselves are built up as a toroidal copper wire-winding with a closed Ferrocart ring as a core, somewhat as suggested in Fig. 6, and more than one advantage arises from this form of construction. First of all, the toroidal winding in itself has quite a small stray magnetic field, but when it has a magnetic core as shown in the sketch herewith. This, in itself, gives a very definite improvement, but to obtain the optimum value of the coupling condenser. The latter can lie anywhere between .01 mfd. and 2 mfd., but at some particular capacity the circuit comprising the transformer primary winding and the condenser will resonate to a frequency of 50 cycles or so, at which a tremendous gain in amplification will result. It is impossible to state even an average value, since it will depend entirely on the characteristics of the L.F. transformer, but a little experimentation will soon enable you to determine the most suitable capa-

Fig. 5.—The layer effect of the insulating material containing the Ferrocart.

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One of the receivers made a few years ago gives very poor response to bass notes, and as a result they cannot possibly do justice to " heavy " music, whatever kind of speaker they are used with. I am often asked how an improvement may be effected in this respect, and since the matter will probably be of general interest, I will describe a very simple method which proves effective in the majority of instances. It consists principally of connecting the L.F. transformer(s) on the parallel-feed system as shown in the sketch herewith. This, in itself, gives a definite improvement, but to obtain the very best results some experiment is necessary to determine the optimum value of the coupling condenser. The latter can lie anywhere between .01 mfd. and 2 mfd., but at some particular capacity the circuit comprising the transformer primary winding and the condenser will resonate to a frequency of 50 cycles or so, at which a tremendous gain in amplification will result. It is impossible to state even an average value, since it will depend entirely on the characteristics of the L.F. transformer, but a little experimentation will soon enable you to determine the most suitable capa-

New Form of Tuning

It occurs to me also that a magnetic resonance may be developed shortly.

...material of this nature may lend itself very well to a new form of tuning. The inductance could be varied by altering the position of the core in relation to the coil, somewhat as shown simply in Fig. 7. Of course, the final details will not, perhaps, be so simple as that illustrated, but there does not appear to be any vital technical reason why such a scheme should not be put into operation. If that is the case, variable condensers for tuning purposes would become obsolete and we should return (with very material improvements, however) to our early (or pre) broadcasting methods of varying coil inductance when searching the ether for transmitting stations, the self-capacity of the coil, or, if necessary, an additional fixed condenser, forming the second element to give the oscillatory circuit of inductance and capacity. In any case, many developments are sure to emerge from the four walls of the laboratory in the course of the next few months. PRACTICAL WIRELESS readers can rest assured that this paper will be in the front rank in presenting all the details.

PRACTICAL WIRELESS, February 25th, 1933

Fig. 6.—A diagram showing the method of making up a Ferrocart coil.

Fig. 7.—A new form of tuning which may be developed shortly.

Improving Bass Response

City for your own set. Start by trying capacities of, say, .01 mfd., .1 mfd., .5 mfd., 1 mfd. and 2 mfd., if you have suitable condensers on hand. Having found the best of these, try connecting various smaller condensers in parallel until you obtain the desired effect. As mentioned in previous issues of PRACTICAL WIRELESS, the coupling resistance should have an ohmic value equal to twice or three times the impedance of the preceding valve. —JacB.
A Useful Soldering Dodge

The average enthusiast who prefers to solder many of the connections in his set, but who, through not owning an electric soldering-iron use the fire or naked gas light to heat the bit, which necessitates cleaning every time, will find this tip useful.

Instead of throwing away the next handful of short copper wire ends you scrape up from the bottom of your junk box, fashion them to a coat for the soldering iron end, as depicted. This simple job can be accomplished with a light hammer. By hammering the twisted ends round the bit to mould the coat, the fitting becomes perfect, not too tight or loose, to allow the coat to remain on the iron while it is being heated.

A method of fitting improvised condenser

A useful dodge for keeping a soldering iron clean.

Actually the iron itself takes a little longer to warm, but then, when hot, no time is wasted while cleaning. My practice is to leave the "coated" iron in the fire until the coil is red hot. I then find that the iron itself is just right for use with average solder.--W. Wymer (Leicester).

Plug and Socket Switching Device

Here is a switching device I use for parallel connect sockets 1 and 3, 2 and 4. For parallel connect sockets 1 and 2, or 3 and 4. When the set is not in use connect sockets 1 and 4. As an alternative to the wrench plugs the bases of four burnt-out or otherwise useless valves can be used. These could be labelled or painted: (1) Aerial, (2) Series, (3) Parallel, (4) Switch, and the pins on each base must be wired for their own particular purpose in switching.--Arthur Taylor (Knauford).

Improving Selectivity

The accompanying sketch shows how I have improved the selectivity of my straight-four wireless set. I was contemplating building a more modern set, but with this arrangement I have so greatly increased the selectivity, together

WITH OFFSET BETTER

A hand-as plug and socket switching device.

A condenser arrangement for improving selectivity.

with a stronger signal, that I have abandoned the idea. The modification is as follows:--

Remove the present .0001 differential reaction condenser in the reaction circuit and replace it by a .0005 mfd. differential reaction condenser. The .0001 is now used to make the set more selective by placing it in the anode circuit across the tuning condenser. Furthermore, a .0005 mfd. aerial condenser connected in series between the aerial and the high-frequency coil, to work in conjunction with the above arrangement, will prove an asset.--J. F. Osdees (Camborne).

Attractive Knobs for Your Set

The ebonite screw-caps fitted to bottles of brilliantine, seent, etc., are often most attractively moulded, and if adapted in the following manner make excellent knobs for switches, reaction condensers and other components. First thoroughly clean and dry the cap and remove the rubber washer usually fitted at the top of the cap. Melt a little lead or solder in an old spoon, and pour into the cap, making sure it is held squarely upright, to within an inch of the top. Allow the lead a few minutes to set and cool, carefully mark the centre of the lead filling, and drill to suit the spindle to which it is to be fitted. A small hole for the set-screw is then drilled through the side of the knob and tapped 6 or 4 B.A. A suitable set-screw can be made by cutting the head off a brass screw and cutting a

The latest batch is published below.

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A method of fitting improvised condenser

Anti-Interference Choke Coils

WIND 50yds. of insulated copper wire into a coil of 9in. diameter. Any round article having this diameter will do as a former. The number of turns, which will be about 65, may be piled on top of each other. The wire must be of a gauge able to withstand and carry the total maximum current it may have to carry at any time. (V.I.R. lighting cable is quite good enough.) Two coils are required, one in each side of the supply mains as indicated in sketch. Fifty yards make one coil, 100yds. therefore are required to make two coils. A 9in. coil is rather large and bulky, but they can be made very neatly by binding with insulating tape after the winding is finished. They will be of high-frequency type and have an inductance of approximately 600 microhenries each. When wired in the mains on the consumer's side, near the meter, they will deal effectively with high-frequency interference which so often travels over the electric supply mains.--Solsheen (Birmingham).

(Continued on page 1086.)

HAVE YOU RESERVED YOUR WIRELESS CONSTRUCTOR'S ENCYCLOPAEDIA YET? SEE LAST WEEK'S ISSUE.
Learning the Morse Code

Here is an idea for quickly learning the Morse Code. A large piece of cardboard is used, and the dots and dashes made up of strips of tin which are pushed through the cardboard. The dots and dashes made up of strips of tin which are pushed through the cardboard can easily tap out messages. -T. Williams (Stockton-on-Tees).

Holding Screws in Awkward Places

Various dodges and types of screw-drivers have been used by wireless constructors for starting screws in awkward corners. The sketch shows a very simple, but effective device for this purpose, made with a safety pin. Take the catch off the end and cut the other prong to the same length, then turn both prongs at right angles to the loop. Also turn the ends about a quarter of a turn in opposite directions, and bend both in to form an ellipse parallel with loop. The blade of the screw-driver passes through loop into the slot of the screw while the looped ends go under the head. When the screw has a good hold, press the clip together and it will release it, slide the clip back up the blade and carry on with screwing. -J. Cousegns (Hamble).

Wave Changing with Plug-In Coils

The accompanying illustration shows a method of wave-changing with plug-in coils which I have found to work very satisfactorily. A study of the diagram will show that the principle is similar to that employed in a number of well-known dual-range coils. Possibly minor difficulties will crop up, especially with regard to obtaining equally satisfactory reaction on both wavebands; but if the coil-holders are just placed loosely in position, being wired with flex, they can be moved about for trial and error purposes. Several values of reaction coils may have to be tried, and possibly some adjustments to HT+1, but the ideal position for the coils will soon be found, and then the usual connecting wire can be used, after screwing down the coil holders. With a .0008 aerial series condenser joined in series with the aerial fitted on panel, selectivity control will be simple. It should not be forgotten, when trying to find out the correct distance of the coils, that taking the aerial to the different tappings on the 60X coil tightens the serial coupling, so that only a small adjustment should be made at one time. In some districts it is just possible that selectivity on the long waves will be difficult to obtain ordinarily, but it is suggested that in this case the aerial be taken to a suitable tapping on the long-wave coil when changing to long waves. A 2-point switch could be utilized for this work. -E. Williams (Llandyly).
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CONCERNING PICK-UPS

By H. T. GODLEY, A.Rad.A.

Fig. 1.—The construction of a gramophone pick-up.

Fig. 2—Wiring the pick-up into the grid circuit.

Working Principle

The pick-up works on the principle of "electromagnetism." An "electro-magnet" is, in brief, a core of iron which becomes highly magnetized if a current of electricity is caused to flow through copper-wire wound round it. If, however, the iron core is not yet magnetized (as in the "permanent-magnet"), then if a fluctuating current is caused to flow through the copper wire (turned the "armature-coil"), then the magnetic flux or field strength of the magnet will vary in sympathy with the fluctuations of the current, and thus any piece of iron or steel within the magnetic field will be attracted to the magnet to a greater or lesser degree. As will be seen from Fig. 1, in the pick-up the armature-coil is not wound round the magnet but is situated between the ends or pole-pieces of the magnet, where the magnetic flux is at its greatest. The small piece of iron which is to be actuated by the magnetic field of the magnet (this piece of iron being "the armature"), is centred within the armature-coil and is mechanically linked with the gramophone needle. Thus, when the needle is moved from side to side by the wavy groove on the record, the armature also moves closer to or farther away from the magnet, causing the field of the magnet to become stronger or weaker accordingly and thus setting up a weak fluctuating current in the armature-coil. It will thus be seen that by these means the vibrations of the replaying needle are converted into speech currents suitable for amplification through the familiar receiving valves.

That is the principle of the pick-up, but to apply it in a practical, commercial form gives rise to many difficulties and provides scope for the most searching research. There are three main points to be considered in designing a pick-up, these being firstly, avoidance of mechanical noise, secondly, avoidance of excessive record wear, and thirdly, small size and weight. The first point presents little difficulty, as a permanent magnet suitable for the purpose is quite small and weighs only a few ounces. The first and second points are, however, inter-dependent.

Damping

To avoid excessive wear on the walls of the record groove, the needle must be free to move easily from side to side, but if it is allowed to move too freely natural resonances of the needle and armature will develop which will cause certain notes in
the reproduction to be amplified out of all proportion to the rest of the signals, and in order to prevent these resonances, it is essential to apply some restraining force or " damping " to the armature to damp out these resonances. This damping must not, however, be so great as to cause sluggish movement of the needle and therefore excessive record wear. If, too, the armature and needle are allowed to vibrate too readily, a point is reached where these vibrations will actually produce sound-currents, thus setting up an unpleasant " tinny " background. It will thus be appreciated that it is a most complicated procedure to determine the degree and to what extent, " damping " should be introduced, and it is in this respect that the choice between a cheap pick-up and an expensive one.

Voltage Output

A current developed across the armature-coil, although constantly fluctuating, naturally has a " mean," or average, value, and this is usually referred to as " the R.M.S. voltage output " (R.M.S. being root-mean-square), and this varies very considerably in different types of pick-ups, but usually is somewhere between two and three volts. In the needle-armature type of pick-up in which the gramophone needle is actually the armature, the R.M.S. output varies usually very low and, in fact, seldom exceeds one volt, and while it has the advantage of imposing little wear on the record, it is necessary to employ an additional stage of amplification to compensate for the low input from the pick-up. The R.M.S. output depends on many factors, but chiefly on the size of the gap between the armature and the pole-pieces, and the freedom of the armature. If the armature is heavily damped and the pole-pieces are set wide apart, then a weak output is to be expected, whereas if the armature is reasonably free and the gap is narrow, there will be a considerably higher output. The current developed across the armature is very much wider at one end of the detector valve-holder, and thus the same time permitting regulation of the volume from the loud-speaker. For those purposes, it is more desirable to use a transformer, which produces a voltage proportional to the resistance to be tapped off. The full pick-up energy is developed across the secondary of the transformer, and if the sliding contact is at the top end of the resistance, it will be clear that none of the resistance will be in circuit and the full voltage from the pick-up will be passed on to the detector valve. If, however, the sliding contact is moved half-way down the resistance, then one-half of the resistance will be between the pick-up and the valve, and thus reducing the energy applied to the grid. Gradual adjustment of the transformer control, therefore, permits gradual adjustment of the energy applied to the grid of the detector valve, thus avoiding distortion due to overloading, and at the same time providing an efficient volume control.

The resistance of the potentiometer is of considerable importance, as too low a value will have a detrimental effect on quality of reproduction. The armature-coil of the pick-up itself possesses resistance, as soon as the pick-up is in circuit—i.e., as soon as the switch is in the gramophone position. It will be seen, therefore, that by the turn of a switch the detector valve is cut off from the earlier part of the set, and the energy from the pick-up is impressed on to the grid of the valve for amplification and reproduction through the loud-speaker and the detector valve is additionally biased for the larger output, thus converting the broadcast receiver temporarily into a radio-gramophone.

Controlling Pick-up Output

Now, even with additional bias, in very many cases the output from the pick-up is too small to handle, with the consequence that if distortion due to overloading is to be avoided, some arrangement must be made whereby the input to the detector grid can be controlled, thus at the same time permitting regulation of the volume from the loud-speaker. For these purposes, it is more desirable to use a transformer, which produces a voltage proportional to the " square " of the input voltage, or to put it more simply, if the sliding contact of the transformer is a third of the way down, the apparent volume will not be reduced by a third or anything approaching it. This difficulty can now be overcome by using what is termed a " graded " potentiometer. In this component, the former upon which the resistance wire is wound, is not of the same width over its entire length as in the case of the ordinary potentiometer, but is very much wider at one end than at the other, it is " tapered." Obviously one turn of wire at the wide end of the former will contain a considerably greater length of wire than one turn at the narrow end and consequently will have much greater resistance. As the width of the former decreases uniformly down the entire length, so does the resistance of each turn of wire. By adjusting the dimensions of the former, it is possible to compensate almost exactly for the disparity between input voltage variation and volume variation, thus obtaining a " linear " characteristic so that the reduction of one-third of the pick-up energy will produce a reduction of one-third in volume and proportionately over the entire range. In fitting a potentiometer of this type, care must be taken to connect it the right way round.

(Please see page 1091)
Build the "Q.P.P. THREE-FOUR"

The vital sections of the Q.P.P. THREE-FOUR are the input and output stages upon which the circuit wholly depends for the remarkable advantages which the Quiescent P.P. gives to battery sets, viz:—

★ MAINS SET VOLUME AND UNDISTORTED COIL DRIVEN SPEAKER QUALITY with ordinary H.T. battery capacity.

★ 50% LESS H.T. CURRENT CONSUMPTION and subsequently a saving of one half of H.T. battery costs.

R.I. "Quiescent" components have been produced after months of intensive experimentation and research in conjunction with the valve manufacturers. They have only been released after the most rigid laboratory tests and are designed and built in a way to give the results for which R.I. have always been famed. You know before you buy that you are going to get the full benefits which "Quiescent" P.P. can give.

R.I. QUIESCENT P.P. TRANSFORMER
List No. D.Y.34. Primary inductance 30 henries without D.C., 20 henries with 1 m.a., 16 henries with 2 m.a.
Royalty 1/8 extra.

R.I. QUIESCENT P.P. CHOKE
List No. D.Y.35. For feeding into speaker direct or any existing matching transformer as commonly fitted to loud speakers.

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Your name will also be put on our mailing list for first news of the latest developments and components.
TWELVE YEARS OF RADIO PROGRESS

A Chat About the Developments which have Taken Place Since the Early Days of Broadcasting by OUR TECHNICAL STAFF

At the time of which we are now speaking the usual value of high-tension voltage was about 60 volts, and, in fact, valves were designed to function on a maximum of some 100 volts. The valves, by reason of their "plain" manes de filaments, had only a comparatively low emission, and so consumed a very small amount of high-tension current. In consequence, the high-tension battery usually had a life of several months. The low-tension supply probably offered the greatest difficulty because, as we have seen, the accumulator had to have a voltage of either 4 or 6 according to the valves in use. Contrary to present conditions, by the way, the 6 volt valves were noticeably more efficient since they gave a higher filament emission.

And since each valve required nearly 1 ampere of current, it can be seen that a simple three-valve set could only be operated for just over ten hours from a 30 ampere-hour accumulator before re-charging became necessary. Charging stations were few and far between, so that the wireless set was almost out of the question for those living in the country.

**Dull-emitter Valves**

Principally on account of the accumulator difficulty, numerous experiments were carried out by the valve manufacturers in an attempt to produce a valve whose filament could be operated from a smaller low-tension current; these experiments led to the introduction of the new universal dull emitter type. It appeared an impossibility to make a filament emit electrons unless it were heated to incandescence, but eventually means were found of coating the tungsten or nickel alloy wire with certain oxides which would give off an electron stream at very low temperatures. The first dull emitter required a filament voltage of 4 and a current of about a tenth of an ampere. They were found to be almost as efficient as the previous bright emitter types and in consequence inductance, but eventually means were found of making the filament gain in popularity and mass-production methods were set in operation.

The 1923-24 Receiver

We have now come to about the middle of 1923, so it will be interesting again to turn our attention to the state of amateur receiver design. The "unit" form of construction has gradually fallen into disuse, because it has been realized that the system has certain drawbacks, mainly associated with the unnecessarily long wiring and attendant introduction of self-capacity which is known to be the cause of losses in high-frequency amplification. The general appearance of the receiver has become similar to that depicted by sketches (a) and (b) in Fig. 6; these are two alternative designs, but the "desk-type" cabinets shown at (b) is a little more refined, since it houses all the batteries. The form of construction in each case is remarkably simple because all the components are attached to the same ebonite panel. An H.F.—Det.—L.F. circuit is most popular and high-frequency coupling is generally on the tuned anode system, the most important being that by careful design a small amount of voltage step-up could be obtained.

The general appearance of the receiver has also changed. There were then several types of speaker available, but the only kind in use was the tuned anode type. High-frequency transformer coupling offered certain advantages over the tuned anode system, the most important being that by careful design a small amount of voltage step-up could be obtained.

The great disadvantage was in the difficulty of applying reaction to the unit and it was principally due to this that the tuned anode eventually became more or less universal.

But to return to the main features of the set shown in Fig. 6. The valves were either bright or dull emitters (both kinds were then in use) and fitted into a simple three-valve holder. Whichever type of valves was used, filament rheostats were still employed for each, and these provided a means of obtaining a control of volume and reaction sensitivity. By this time small power-valves were obtainable in both dull and bright emitter types and in consequence greater high-tension voltages up to 100 or so were coming into general use. The value of grid bias was also being appreciated and the bias battery became a standard fitting.

**Loud-speakers**

A gradual change-over from "phones" to loud-speakers was also taking place, but the only kind of speaker available was of the horn type having a "moving iron" movement. We know now that this type of speaker is incapable of anything like realistic reproduction, but in 1923 the horn was the only kind of speaker then in use. The performance of the speakers was limited by the valves, low-frequency transformers, etc., then on the market.

(Continued on page 1091.)
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February 25th, 1933

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THE FOLLOWING DATA SHEETS HAVE ALREADY BEEN ISSUED:

- Data Sheet No. 1—Accumulator Charging - Dec. 17th, 1932
- Data Sheet No. 2—Coils & Coil Winding - Dec. 24th, 1932
- Data Sheet No. 3—Resistances - Dec. 31st, 1932
- Data Sheet No. 4—Mains Transformers - Jan. 7th, 1933
- Data Sheet No. 5—Wire and Wire Gauge - Jan. 14th, 1933
- Data Sheet No. 6—Chokes, H.F. & L.F. - Jan. 28th, 1933
- Data Sheet No. 7—Condensers - Jan. 28th, 1933
- Data Sheet No. 8—Battery Eliminators - Feb. 4th, 1933
- Data Sheet No. 9—Screws & Screw Threads - Feb. 18th, 1933
"Super" Sets

At this juncture it might be mentioned that although sets of the type dealt with were by far the most popular, there were many others in use by experimenters which all did their share in furthering the progress in this science. The super-heterodyne, which today often looked upon as a new development, was by no means a new idea and was frequently regarded as the set of the (near) future. An application was very limited at the time when the only valves obtainable were bright emitters, because eight valves were considered as a minimum, and their consumption of current was tremendous. But as the low-consumption valve came into being, the future of the super-het. seemed to be assured, at least so far as the efficiency of every component part was being concerned. Of the increasing demand, whilst the efficiency and the price of valves and other components were rapidly falling on account for the fact that the price of valves and other components were both reduced in length, and efficiency thereby increased. The change-over necessitated a re-examination of the whole system of reaction coupling and tuning, and the method of coupling employed for the H.F. stages because the designer was always confronted with the problem of obtaining the quality of reproduction from unwanted reaction effects. The greatest contributor cause of instability or semi-tuned. One to semi-tuned I mean anode and the grid of the H.F. valves, for when the anode and condenser were in tune (as they must be for maximum amplification) there was a tremendous energy across the valve capacity which resulted in self-oscillation. Valve designers had reduced this capacity to a minimum; the grid limits of the 'tuned condenser' were virtually abolished so the next move was with the set designer. Various methods of preventing feed-back were evolved, but all had the effect of reducing the amplification. One of these was to couple the valves on the 'weak capacity' or 'aperiodic' principle and thus greatly reduce the coupling circuits unaltered whilst tuning only the aerial circuit. This was satisfactory in preventing self-oscillation but also to have much amplification as a single valve properly tuned. In passing it is interesting to observe that this system is still in use for high-frequency amplification today.

Another rather better system which was developed by the manufacturers was that of coupling - the intervalve coupling of alternate valves, leaving the others untuned. Yet another way of attempting to obtain a measure of popularity, but it could not give the quality of reproduction which all did their share in furthering the progress in this science. The super-heterodyne, which today often looked upon as a new development, was by no means a new idea and was frequently regarded as the set of the (near) future. An application was very limited at the time when the only valves obtainable were bright emitters, because eight valves were considered as a minimum, and their consumption of current was tremendous. But as the low-consumption valve came into being, the future of the super-het. seemed to be assured, at least so far as the efficiency of every component part was being concerned. Of the increasing demand, whilst the efficiency and the price of valves and other components were rapidly falling on account for the fact that the price of valves and other components were both reduced in length, and efficiency thereby increased. The change-over necessitated a re-examination of the whole system of reaction coupling and tuning, and the method of coupling employed for the H.F. stages because the designer was always confronted with the problem of obtaining the quality of reproduction from unwanted reaction effects. The greatest contributor cause of instability or semi-tuned. One to semi-tuned I mean anode and the grid of the H.F. valves, for when the anode and condenser were in tune (as they must be for maximum amplification) there was a tremendous energy across the valve capacity which resulted in self-oscillation. Valve designers had reduced this capacity to a minimum; the grid limits of the 'tuned condenser' were virtually abolished so the next move was with the set designer. Various methods of preventing feed-back were evolved, but all had the effect of reducing the amplification. One of these was to couple the valves on the 'weak capacity' or 'aperiodic' principle and thus greatly reduce the coupling circuits unaltered whilst tuning only the aerial circuit. This was satisfactory in preventing self-oscillation but also to have much amplification as a single valve properly tuned. In passing it is interesting to observe that this system is still in use for high-frequency amplification today.

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BUILDING THE A.C. VERSION OF THE FURY FOUR

By F. J. CAMM

How to Construct this World-famous Receiver for Operating from Alternating Current Mains as a Radiogram. Further Constructional Details will be Given Next Week.

The Westinghouse A.C. Power Unit. The components required for this unit are as follows:

1. Westinghouse Metal Rectifier, Style H.T. 8.
2. Main Transformer with Metal Rectifier, style H.T. 8.
4. Metal Rectifier for the Workings A.C. Power Unit.

The Guarantee Given in Previous Issues also Applies to the A.C. Fury Four.

The Guarantee holds also for the A.C. version. It is important to note that the wiring of the A.C. version is different from the D.C. version.

For the WESTINGHOUSE H.T. 8 METAL RECTIFIER:


The following components are required for the A.C. version:

1. L E smoothing choke, 800 ohms D.C., 30-40 henries.
2. 200 ohms D.C., 30-40 henries.
4. Metal Rectifier for the Workings A.C. Power Unit.

The Westinghouse H.T. 8 Metal Rectifier for the Workings A.C. Power Unit.

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The Fury Four

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By F. J. CAMM

A.C. Power Unit. The components required for this unit are as follows:

1. Westinghouse A.C. Rectifier, Style H.T.S.
2. Mains Transformer for use with Metal Chassis, Style H.T.S.
3. Westinghouse A.C. Power Unit for operating the Battery Fury and Saxby Signal Company receivers.

Fury Four.

The Westinghouse A.C. Power Unit is the first time in the history of radio journalism that a veritable cataclysm of correspondence from enthusiastic constructors has been received. The fact that the "Fury Four" for the first time in the history of radio journalism is a complete receiver, is electrically driven, so that a constant and lasting high-tension supply is necessary. Without this supply the receiver is useless. The Guarantee given in Previous Issues also Applies to the A.C. Fury Four.

A.C. Power Unit.

The Guarantee holds also for the A.C. version. The electrical and mechanical work is as high-class as for the original "Fury Four." Every step in the manufacturing process is carried out to the highest standards to ensure stability and reliability. The Guarantee which should preferably be earthed. The Guarantee given in Previous Issues also Applies to the A.C. Fury Four.

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A.C. Power Unit.
A special word about the Peto-Scott Adaptagram cabinet. Although moderate in price it is attractively made, well finished, and is non-resonant, even at full volume. It provides ample room for the set, and additionally, should the reader at some future date desire to modify or add to the set, the roominess permits of this without having to hack the cabinet about. The turntable, of course, is disposed beneath the lid, and the lack of the cabinet can be entirely removed so that the set can easily be adjusted or removed. The mains part of the A.C. "Fury Four" is placed on the floor of the cabinet. It is quite one of the most useful cabinets supplied to the home constructor, and its trade name of "Adapta-gram" sums up its features and its adaptability.

An unsolicited telegram received from an enthusiastic builder of the "Fury Four."
easier to detect by the ear. The output coupling is a Varley Transformers, and this also is a component thoroughly fitted for the task of dealing with the alternate anode currents and maintains a really high load the whole time.

So far as the actual constructional work is concerned, the now standard method employed by us of sub-baseboard wiring is adopted by us of sub-baseboard wiring is used, and this assists in simplifying the wiring and accommodating some of the components below the baseboard. This naturally avoids crowding and assists in maintaining a neat appearance and a slow-motion drive condenser; a receiver.

maintaining a neat appearance naturally avoids crowding and assists in the components below the baseboard. This the wiring and accommodating some of the components below the baseboard. This naturally avoids crowding and assists in maintaining a neat appearance to the receiver. The panel is quite neat and contains the main tuning control, which is a slow-motion drive condenser; a reaction condenser; a wave-change switch; an off-on switch; and a tone control resistance.

With regard to the actual results, the receiver will give an output sufficient for the largest, of rooms, and may be found in the majority of cases to be really too loud for a living-room. So much depends, however, on the furnishings of the room that not very much can be said about this. A large, barely furnished room will naturally resonate and give a hollow effect to the loud volume, whilst a heavily dropped room will tend to soften the volume. The great advantage of having this volume available is, of course, that really low-or loud notes will tend to soften the volume. The great advantage of having this volume available is, of course, that really low-or loud notes will tend to soften the volume.

The output coil speaker.

For the detector stage, and a P. 220A in addition to the Q.P.-P. Three-Four, and the Q.P.-P. amplifier, full constructional details of a three-valve receiver which employs push-pull detector valves. This is a very neat and simple receiver, and will appeal very much to the reader who is at heart a real constructor, inasmuch as the tuning coil of the set is entirely home-made. Many readers have written to us asking for a receiver employing home-made coils, but there is a certain amount of difficulty in designing a receiver which will employ a home-made coil to the best advantage. The push-pull detector circuit contains certain features which unfortunately cannot be adopted with the majority of the commercial coils which are at present available, and therefore a special coil has to be made by the constructor. This is a very simple operation, and will be found within the capability of even the youngest reader. For the benefit of those readers who do not feel able to carry out the constructional work on the coil, or who, for some reason or other, wish to employ the ordinary type of two-pin plug-in coil, will be pleased to note that we shall be giving size numbers and other details which will enable the receiver to be built up with this type of coil. It may be mentioned that one of the principal differences in the coil unit for the receiver is the tapping of the reaction coil at its electrical centre. In this respect, of course, it resembles somewhat the old form of centre-tapped tuned anode coil.

The receiver is quite neat, and has an ebbonite panel eight inches by seven inches, and a baseboard only as large. Cossor valves are employed for the receiver, and these are 210 H.L. valves for the detector stage, and a P. 220A for the output stage. The volume is ample for all normal purposes.

so make sure of your copy by placing an order with your newsagent to-day—if you have not already done so.

Very little has been said in the past of the method of employing two valves for detection purposes. These two valves are arranged in a very similar manner to those used in a push-pull amplifier, but they are designed to act as rectifiers. There are a number of advantages to be obtained from this arrangement, and next week's issue of PRACTICAL WIRELESS will contain, in addition to the Q.P.-P. Three-Four, and the Q.P.-P. amplifier.
ELIMINATING THE LOCAL STATION

By E. Johnson

A Simple Wave-trap: The "Rejector"

A wave-trap, of which several kinds are in vogue, is a device whereby the offending station, in most cases the local, may be cut out, and the reception of all other stations unimpaired. The most popular type of all is undoubtedly the "rejector," as illustrated in Fig. 1. To be really effective the inductance must be large compared with the capacity of the trap. Theoretically, at resonance the tuned circuit should offer an infinite impedance to the signal it is desired to eliminate, and a negligible resistance to anything off tune. In order to approach as near this ideal as possible it is essential that the coil should have a low resistance. The actual impedance at resonance is given by the formula: \[ I = \frac{1}{2\pi f LC} \]

This difficulty may be overcome to a large extent by tapping down on the coil as shown in the next diagram. Probably the most effective device of this nature would be to wind a coil exactly to resonance without the aid of any external capacity at all, and arrange for suitable tapping points on the grid coil. When this is done, the H.F. resistance.

"Absorption" Wave-trap

The next type of wave-trap to receive our consideration is known as the "acceptor," depicted in Fig. 3. This consists of a coil and condenser connected in parallel with the usual tuned circuit. The acceptor trap differs from the preceding inasmuch as its primary purpose is to reduce the low impedance to the unwanted signal. As a point of fact the actual impedance is equal to the "ohmic" resistance of the coil, or more correctly, the H.F. resistance. Thus, at resonance the interfering station finds an easy path to earth, whilst all others are passed on in the usual way to the set. Once again the trap is most effective when the coil has a low resistance. Elimination is very complete with a small inductance and large capacity, in fact too much so; it repays to experiment with various sizes. If interference is not very bad the best results will be obtained with a large coil and very small condenser; tuning will then be very sharp, and it will be found possible to receive stations on a frequency close to that of the unwanted one with the minimum reduction in strength. Considerable field for experiment is open by trying various tapping arrangements, as shown in Fig. 4.

(Continued on page 110B.)
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IS REACTION NECESSARY?

An Informative Article Explaining the Uses of Reaction and How to Control It.


Applying Reaction

Property designed and handled, reaction is under perfect control, and may therefore be used to vary the sensitivity and selectivity of the set. There are two main methods of applying reaction. In the original and now obsolete method, the whole of the anode current of the detector valve was passed through a coil mounted side by side with the detector grid coil in such a way that the angle between the two coils could be varied, see Fig. 1. When the two coils were adjusted so that they were at right angles to each other, the magnetico coupling between them was a minimum, and the reaction effect was small. By swinging the reaction coil so that the angle made with the grid coil decreased, the reaction effect was increased.

This form of variable magnetic coupling is not now employed to any extent except in a few very old receivers. Even when, by careful adjustment of the anode voltage of the detector valve and the selection of a reaction coil having just the right number of turns, the control of reaction was comparatively smooth, it was somewhat difficult to apply reaction sufficiently gradually, especially when endeavouring to pick up a particularly elusive station. Moreover, as reaction was varied, so did the correct setting of the main tuning condenser vary, so that, in critical searching, it was necessary to adjust and readjust both reaction and condenser controls.

The Up-to-date Method

Several variants of the simple magnetic reaction were devised, but these are only of historic interest to-day. The up-to-date method of applying reaction, of which several slightly different forms exist, is to use a fixed amount of magnetic coupling between the grid and reaction coils, and to vary the amount of high frequency energy fed back to the grid by means of a variable condenser in the reaction circuit, see Fig. 2. Moreover, the reaction coil is not in series with the anode circuit but in parallel, a high frequency choke being included in the anode circuit to divert the high frequency component to the reaction coil. (This particular capacity reaction has many interesting features and in a subsequent article I propose to discuss some quantitative results I obtained in experiments carried out some years ago by this means, and with careful adjustment of anode voltage and the capacity of the reaction condenser, reaction control may be made as smooth and gradual as can be wished. What, then, are the charges which are laid at the door of our friend reaction, and that warrant its suggested discontinuation as a form of radio control?

One Complaint

In the first place, it is urged that reaction, when applied to excess, has the effect of making undesirable howling which spoils the reception in nearby receivers. To a certain extent this is true. If an excessive amount of energy is fed back to the grid circuit, the grid circuit becomes unstable and free oscillations will be generated which will more than make up for them. This means that the valve and its associated circuits, instead of consuming high frequency energy, will actually generate energy; the circuit becomes unstable and free oscillations will be produced.

Two effects now follow: first, distressing howls are heard in the speaker, and second, if the high frequency oscillations can reach the output circuit of the set, they will be radiated from the aerial and will affect the aerials of listeners over a wide area, giving rise to howling in their sets also.

It is not necessary to stress this point, because the anti-oscillation campaigns of the B.S.C. has almost completely eradicated this nuisance. Re-oscillation is only likely to occur from receivers of old type where the reaction coil is coupled direct to the aerial coil. A well designed receiver having at least one high frequency stage and efficient inter-stage screening...
is unlikely to cause re-radiation, even if the reaction control is seriously mis-handled. The reason for this "amplitude distortion" is that reaction is increased, so is the selectivity increased as has already been explained; in other words, the band of frequencies accepted by the detector valve for a given setting of the tuning condenser is narrowed down. Sharp tuning of this nature means a certain cutting off of the side-bands, and this inevitably means a loss of high notes. But sets of this type are not as a rule cheap instruments and the entertainment is as well as the amusement of the plutocrat.

For every listener who can afford an elaborate four- or five-valve straight receiver or a super-het., there are hundreds whose means will not go beyond a three-valve at the most—and even the best

A Simple Lightning Arrester

The accompanying illustration shows a simple, but efficient, lightning arrester made from two pieces of a hacksaw blade. The holes in the inside blade can be washed out while the metal is hot, as it cannot be drilled satisfactorily while cold. The blades are mounted between two sheets of mica, as shown, on a hardwood block, which can be fixed in a convenient position near the aerial switch.—S. T. Wicks (Chelsamford).

Using hacksaw blades for a lightning arrester.

Housing the H.T. Battery and Output Filter

The majority of battery sets where no provision is made for housing the batteries and output filter inside the cabinet containing the set, is usual to find that these are placed on the table at the rear or side of the set, which is both unsightly and a source of danger to the anatomy. This is especially the case when the mains unit is in use, whilst the loud-speaker is enclosed in a separate cabinet and placed on top of the set. The attached sketch shows a method of avoiding this isolation without the necessity of providing an additional box. The idea is to accommodate the battery and output filter inside the

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Simple Aerial-Earthing Switch

NOT caring for the usual type of earthing switch, I made one from an old tuner taken from a discarded crystal set. Cutting a square from the vulcanite panel holding the tuner, I adapted it by removing all the centre brass studs, leaving the two outside ones, and slightly bevelling them on the edges facing each other. The aerial lead was taken to the spindle at back of the turn of the knob itself. One lead was taken from the nut, securing one stud to panel, to the aerial terminal of set and a lead from the other stud to earth. A turn of the knob and the set is earthed. The panel holding the gadget was screwed to a point near the lead-in.—George H. Sparkes (Tottenham).

THE "FURY FOUR"

DOES MOST OF ALL
LAST week we saw how wireless waves are sent out and how they set up electric currents in the aerial circuit of your receiver. Now before passing on to consider how these currents are converted by your receiver into audible sounds I want to explain how the waves "carry" the speech and music.

The Carrier Wave

As soon as the broadcasting station is switched on, and before anyone speaks into the microphone, wireless waves are being radiated. These we likened to waves on the surface of water and as previously explained, they are all of the same height and follow one another at the same interval of time.

What happens when anyone speaks into the microphone is that the waves no longer remain the same height, but fluctuate in accordance with every variation in the tone of the speaker's voice. Of course, they do not vary in length (distance between each crest) but only in height. Naturally the length of the waves must not vary, otherwise we should not be able to tune them in. We have already seen that in the pendulum illustration. This means that the waves will still cause electric currents to surge up and down your aerial, but they will vary in strength according as the waves vary in height, these variations in turn having been caused by the fluctuating sounds of the speaker's voice.

I don't want to confuse you with meaningless diagrams, but a glance at Figs. 1 and 2 will show how the height of the waves varies while the length is constant. Fig. 1 represents the waves given out before any speech or music is imposed on them. They are all the same height and the same distance apart. Fig. 2 shows what happens when the announcer speaks or the band plays. They now vary in height.

How Fast the Waves Travel

It is perhaps as well at this juncture to make some mention of the velocity of wireless waves. Actually they travel incredibly fast, something like three hundred million metres per second. This means, for instance, that waves 200 metres in length sent out by a broadcasting station would strike your aerial at the rate of 1,500,000 per second. These in turn set up electric currents in your aerial circuit which surge up and down it at the same speed. Owing to their very rapid oscillations these currents are known as high-frequency.
What An Electric Current Is

The accepted theory of electricity is that all matter of whatever nature whether it be solid, liquid, or gaseous; when it is not entirely free from air, or anything else is composed of minute particles called atoms. Every schoolboy knows. But these atoms are not simply tiny pieces of one sort of stuff. They in themselves are composed of a centre core or nucleus of positive electricity. This nucleus is surrounded by a number of negative particles of electricity. These latter are our old friends, the electrons, about which we hear so much from scientists. It is these little fellows in each atom to electrically balance the positive nucleus; but if some of the electrons leave the atoms at one end of the wire and go to the other end, then the end to which they have gone will have a larger proportion of negative particles than normally and is, therefore, said to be negative. In the same way, the other end of the wire having a deficiency of negative particles will be positive.

Electric Currents In Your Receiver

If you look at Fig. 3 you will see how I have represented the currents flowing up and down the aerial circuit of your receiver. The little dots are electrons. First they travel to one end of the circuit as at (a) and then to the other as at (b). This is going on all the time your set is tuned to a station, and it is this average current to which the detector valve has to respond. Actually, there are two more currents between the detector valve in your set and the loud-speaker. They are used to magnify or amplify the currents before they reach the speaker, but we shall deal with those later.

How It Works

Having seen the reason for the detector valve let us study the practical side and then how it is connected by the wires. 

The connections are shown in Fig. 4. The speakers which we connect on the loudspeaker leads of your receiver are connected to a metal sheath known as the plate. There is another part of the detector known as the grid. This is a metal plate situated between the plate and the valve. It is called the grid because of the spiral of wire surrounding it. This grid is a metal sheath known as the plate. It is a spiral of wire surrounding the filament of the valve and helps to control the current which goes to the plate.

Condensers are used to store up electric energy in the following way. As you probably know is a thing like an electric lamp. It consists of a glass bulb filled with no air in it. In the middle is a material like that of a lamp but which does not glow brighter than a dull red. Surrounding the filament is a spiral of metal called the grid and surrounding the grid is a metal sheath known as the plate. These elements are diagrammatically shown in Fig. 5.

For the sake of clarity the tuning circuit is not redrawn, but the wires are shown. The tuning circuit in Fig. 4 is a continuation of Fig. 3 (b). Of course, these two illustrations are purely diagrammatic. If you wish to see what the parts actually look like there is a "behind the panel" drawing of our typical three-valve set in Fig. 7. You will notice the tuning condenser, the grid and grid condenser, the wire "G" leading to the first valve. Actually, this wire leads first to a fixed condenser called the grid condenser, before connecting to the holder of the valve. This condenser is rather different from the tuning condenser in that the plates can not be varied in relation to one another. They are "fixed," and to save space they are made of tin or copper foil, and separated by thin strips of some insulating substance, such as mica. This has much the same effect as spacing them in air in that it keeps them from touching one another, but has the advantage of taking up less room. This fixed condenser is represented on Fig. 4 by two heavy lines at "C." Condensers are always shown in this way on circuit diagrams, the two lines representing insulating substance, almost as if thin paper, although in practice they usually have more than two plates.

To return to Fig. 4, on the right of "C," the wire "G," passes through a condenser called the plate condenser. This is the first valve. A valve you probably know is a thing like an electric lamp. It consists of a heating wire within the bulb, with no air in it. In the middle is a filament like that of a lamp but which does not glow brighter than a dull red. Surrounding the filament is a spiral of metal called the grid and surrounding the grid is a metal sheath and plate. The filament is connected to the plate condenser. The plate condenser is divided into two parts, one of which is connected to the plate of the first valve, the other being connected to the filament of the valve, and the grid of the valve being connected to the control plate. The plate condenser is shown diagrammatically in Fig. 5. You will understand that it is difficult to portray them in their true relation to one another; so they are shown above the figure upside down.

(Continued at top of page 1108)
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other. Some early types of valve actually were arranged in this way.

Now let us see what goes on in the valve. The filament $F$ is heated all the time from a battery, and this makes it give off a stream of electrons. These little electrons are flying off from it in all directions. Most of them pass between the wire turns of the grid, as shown by the arrows and stick on to the plate, that is to say, there is a steady flow of electrons from the filament to the plate.

In fact, an electric current. It may at first seem strange that an electric current can flow through space like this, but it is nevertheless, a fact. Moreover, the plate is connected to the positive end of an electric battery, and so made positive. This has the effect of attracting the electrons from the filament, and so ensures that as many as possible get across. This attraction is due to the principle that like attracts Unlike, or, in this case, that positive attracts negative.

So far, we have two distinct electric currents flowing in our receiver—one the high frequency pulsating in the aerial circuit, and the other the plate current flowing steadily from the filament to the plate of the detector valve.

We have seen that the currents in the aerial circuit are due to the up-and-down movements of electrons, as in Fig. 3. Now when they are at the top end, as at (6), they travel along the wire "G" and crowd up against the left-hand plate of the condenser "C." (See Fig. 4.) These repel some of the electrons on the right-hand plate (like repels like) and sends them along to the grid. These electrons on the grid have a marked effect. Being right in the path of the electrons flowing from the filament to the plate, they repel some of these latter as in Fig. 4, and so reduce the plate current. This means that when the currents in the aerial circuit flow one way it reduces the plate current. Now when the aerial current flows the other way, as in Fig. 3 (a), the opposite thing happens. As there is now a deficiency of electrons on the left-hand plate of the grid condenser, electrons on the grid immediately rush along to the right plate of the condenser attracted by the positive state of the left-hand plate (positive attracts negative) as in Fig. 5. This rush of electrons away from the grid leaves it positive. It now attracts the electrons coming from the filament instead of repelling them. It actually helps them across to the plate and so increases the plate current.

What all this signifies is that every fluctuation in the current in the aerial circuit causes a corresponding fluctuation in the plate current. It is the plate current which is passed on via the other two valves to the speaker as it is more powerful than the aerial current. However, there is rather more in it than this as I have not so far explained the "detector" action of the valve—how it cuts off the current in one direction as previously mentioned. This I shall have to leave over until next week.

IMPROVISED MICROPHONES— (Continued from page 1109)

Microphones made up in this way are very handy and can be adapted to many uses: for instance, in a small dance-room where a radiogram is being used with records to obtain the dance music, the title of each piece can be announced through the mike. Also especially the absorption type, there is a tendency for "pulling" between the tuned circuits. Adjustment of either trap or receiver near the resonance point tends to drag the other circuit in tune also, which makes tuning a trifle difficult. This trouble may be obviated very largely by working with as weak a coupling as possible, and by making the connections in passing it may be remarked that the absorption trap makes a very good wave-meter if properly calibrated, and thus may serve a dual purpose. It is, of course, essential that both coil and condenser should be well made and rigid articles in order to preserve permanence of calibration.

No remarks are really necessary concerning the actual construction of wave-traps, excepting perhaps the coil. For medium wavelengths the inductance should be about 200 microhernies, and in cases where a long wave-trap is needed, 2,100 microhernies. Full data for winding such inductances has already been published in Practical Wireless Data Sheets No. 2. As most listeners will only need to concern themselves with the medium-wave band, 45 turns of No. 26 D.S.C. on a 3 in. former will meet the case. When the acceptor trap is used it will, of course, be necessary to use a larger coil as the tuning capacity is in series with the inductance. As a rough guide about 60 turns may be wound on.

ELIMINATING THE LOCAL STATION— (Continued from page 1100)
IMPROVISED MICROPHONES
This Article Explains the Use of Loud-speakesr, Headphones, etc., as Microphones

By GILBERT E. TWINING

It is not generally appreciated that with the wonderful amplification of the modern receiving set it is possible to press into service as microphones such parts as headphones, loud-speakers, and gramophone pick-ups. It must be understood that they are not quite so sensitive as the ordinary microphone, and therefore singing and talking must be done close up to them; in this way they will give excellent results.

Headphones
When using headphones as "mikes" it is better to use both sides of them—that is to say, both ear-pieces, and cup them in the hands. Make a point of speaking right into the receivers, as this will then impart the maximum amount of vibration to the diaphragm. The more sensitive the 'phones are, the better, for then a truer and stronger reproduction of the voice will be the result. In Fig. 1 is shown the best method of holding the 'phones in the hands. It would probably be an advantage to make small funnels or paper cups to fit the outside diameter of the ebonite caps of the 'phones, thus making the voice more effective.

Loud-speakers
As mentioned above, loud-speakers can be pressed into service as mikes, and they are an advantage over the headphones, for it is not necessary to speak quite so closely into them, although the best position must be obtained by trial. To obtain the greatest volume, however, the sound waves must be directed into the cone, enabling the maximum amount of movement of the armature to take place, but a little experimenting will soon indicate the right angle for these sound waves of speech and music to strike the diaphragm. Fig. 2 shows such a cone in use. To indicate how a speaker of this type is so much more sensitive and not so directional as the headphones it should be placed in another room which is occupied; it will be found to be quite possible to detect the general conversation going on, together with the scraping of chairs, etc., almost in the same way as the correct microphone would do.

Pick-ups
It is often possible to use the ordinary gramophone pick-up as a small microphone by fitting it with a light paper cone fastened to the needle with a small light chuck; the pick-up must be of a very sensitive nature, however.

The Adaption to the Set
If provision is made on the set for a pick-up, then it is a simple matter to connect the two leads from the pick-up to the grid circuit of the detector valve. In a three-valve set of the high-frequency detector, and low-frequency type the best arrangement is to fit a switch in the grid circuit of the detector valve. In a three-valve set the high-frequency input from the mike goes to grid-bias negative 114 volts. If the mike is to be used for some time, it may be worth while to also fit a low-tension switch in the high-frequency side of the set; for, as before stated, when the mike is switched in the high-frequency side of the set—and the input from the mike is thus connected through the switch to the grid of the detector valve—the other lead from the microphone is connected across the detector valve, and the detector valve is switched out—that is to say, not used, and therefore does not require low-tension current to the filament. It is possible to fit a two-pole switch for the mike and the low-tension current, so incorporating both operations at once (see Fig. 4).

(Continued on page 1108.)
ON THE SHORT WAVES

By J. GODCHAUX ABRAHAMS

be always on the air. Much of the disappointment experienced by listeners who are trying out a new short-wave set is due to the fact that they search for stations according to a mere list of wavelengths, and, consequently, may be endeavouring to tune in at a period when no broadcasting is taking place. It may be also that as many transmitters operate on different channels at various periods of the day or night, the wrong frequency for the time of day or night has been selected.

Working to a System

If good results are to be secured some system must be adopted. It is a good plan to divide the short-wave band (i.e., channels between, say, 12.15 and 80 metres) into definite sections, and to devote a sitting or so to each in turn. Casual twiddling of the condenser on the off-chance of picking something up seldom leads anywhere. As a general rule, you may take it that there are definite times at which to listen to stations in various parts of the world, on definite bands of wavelengths.

The following will give you a rough guide for the next month or so:

Midnight to 5:00 or 6:00 a.m. G.M.T.: U.S.A. stations (Atlantic Coast and midwest); South American States (30-60 metres); 60-100 a.m., Australia, New Zealand, U.S.A. (Pacific Coast) (30-50 metres). 10:00-14:00, European stations. 18:00-17:00, China, Japan, Java, etc. (30-50 metres); United States (16-28 metres). 17:00-20:00, South Africa, Africa, India (30-50 metres); United States, Canada (18-28 metres). 20:00-24:00, United States, South America, Europe (25-50 metres).

In view, however, of their particular suitability, certain wavelengths are used according to the time of day or night. During daylight hours, as a rule, searches should be made on channels from, say, 25 metres, towards twilight from 19-26 metres, during the early evening on and around 31 metres and during the night, 48-60 metres.

By International agreement, as in the case of the "medium," and "long" waves, certain portions of the short waveband have been allocated to broadcasting stations for radio entertainments, as against commercial and other transmissions. If you study a list of such broadcasters, you will find that they are comprised in the following sections, namely, 11.27-11.7 metres (26,000-26,600 kc/s) as yet seldom used; 13.9-14 metres (21,500-21,800 kc/s); 14.6-14.9 metres (17,300-17,700 kc/s); 19.55-19.85 metres (15,350-16,110 kc/s); 25.2-25.6 metres (11,000-11,700 kc/s); 31.2-31.6 metres (9,600-9,500 kc/s) and 48.8-50 metres (6,150-6,000 kc/s). There are few exceptions and it is below, between and above these bands that you pick up more signals, or "scrambled" telephony emanating from shipping, commercial, meteorological or public service stations.

In each of these bands you will find a number of transmitters at different times on the air, but it is most likely to point out at this juncture that amateur experimental stations may be heard talking to each other (telephony or telegraphy) on channels comprised between 130 metres (2,000 kc/s) and 175 metres (1,715 kc/s); 75 metres (4,000 kc/s) and 85.7 metres (5,500 kc/s); 41.1 metres (7,300 kc/s) and 42.9 metres (7,000 kc/s); 20.83 metres (14,400 kc/s) and 21.43 metres (14,000 kc/s) and also, but more infrequently, on the 50,000 kc/s band at 30,000 metres (50,000 kc/s) and at 60,000 kc/s bands reserved for them.

High-power Transmissions

Possibly, as a start, and as a matter of encouragement, it would be wiser to select a few stations which are most likely to be tuned in without difficulty. Try, for instance, for such powerful broadcasts as W3XAL W3XAL, (1930 m.) on 49.18 m. in the U.S.A.; GSA, Daventry (48.6 m. or even towards 10.0 p.m., G.M.T. W3XAL, Boundbrook (N.J.) on 49.18 m. It is more than likely that when searching for these—you and there is every chance you will log them at your first attempt—you will also pick up neighbouring stations such as Skamlebek, W8XX, Pittsburgh, Nairobi, Caracas, Lisbon, Madrid, and so on. Your search should be confined to a very small segment of the dial both above and below an identified and logged transmission. This will give you a true land-mark for finding other broadcasts in that particular section. Devote some time to the 24-50 metre band which is one of the richest to explore, as it includes not only a large number of European broadcasters but also stations working in the U.S.A., Australia, and Africa.

International Re-broadcasts

International broadcasts, or transmissions which are made by one State for the benefit of other countries, are now weekly features of the radio programmes; not only are they relayed by stations in the broadcasting band, namely, between 200-600
metres and 1,000–2,000 metres, but they are also taken by certain short-wave transmitters in order that they may reach beyond the limits of a continent. Special ceremonies provided by the Swiss stations are re-broadcast through Frangins; musical entertainments by Paris through Radio Coloniale Paris-Fontoise; from Berlin, by Zeesen or Naunx; from Madrid, by Aranjuez and so on. Moreover, a more or less regular interchange now exists between the United States and Great Britain, Germany, Holland, Switzerland, Italy, and even occasionally with Poland—and this policy is being steadily developed.

Special short-wave commercial and other stations as Rugby, Naunx, Rocky Point (N.J.), Hurlingham (Buenos Aires), etc., etc., are also used as channels for these broadcasts, and it is frequently possible to pick up these relayed programmes from such sources. Take the National Broadcasting Corporation of America, or the Columbia Broadcasting Corporation's programmes, as an example; these may be transmitted for European consumption through a number of channels which are given under in order of wavelength:

- 19.86 m. (9,570 kc/s) WLA, Lawrenceville (N.J.).
- 20.27 m. (9,405 kc/s) WQV, Rocky Point.
- 20.49 m. (9,350 kc/s) WND, Deal Beach (N.J.), also on 20.71 m. (9,171 kc/s).
- 20.69 m. (9,250 kc/s) WLD, Deal Beach (N.J.), also on 21.01 m. (9,040 kc/s).

- 19.84 m. (15,120 kc/s) HVJ, Vatican (Rome).
- 20.64 m. (14,354 kc/s) HJJ, Frangins (Switzerland).
- 24.9 m. (12,050 kc/s) PDV, Kootwijk (Holland).
- 25.20 m. (11,900 kc/s) FYA, Radio Coloniale (Paris).
- 25.51 m. (11,760 kc/s) DJD, Königs wusterhausen.
- 29.16 m. (10,250 kc/s) DJQ, Königs wusterhausen.
- 30.3 m. (9,890 kc/s) Prangins (Switzerland).
- 30.4 m. (9,868 kc/s) EAQ, Aranjuez (Spain).
- 31.14 m. (9,630 kc/s) HHQ, Prangins (also on 40.3 m.).
- 31.31 m. (9,580 kc/s) HBL, Prangins (Simultaneous broadcast through HBP, 38,476 m. (7,790 kc/s).)
- 38.65 m. (7,765 kc/s) PDM, Kootwijk (Holland).
- 40.63 m. (6,020 kc/s) DJC, Königs wusterhausen.

To these, of course, must be added the Downtrey Empire stations operating on 19,97 m. (21,470 kc/s); 18,88 m. (17,770 kc/s); 19,82 m. (15,140 kc/s); 25,28 m. (11,865 kc/s); 31,55 m. (9,510 kc/s); 31,65 m. (9,510 kc/s); and 49,59 m. (6,050 kc/s) bearing respectively the call signs GSH to GIA inclusive.

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**AND, Unlike Others, is backed by a Guarantee of FREE ADVICE!**

**WE SERVE OUR READERS!**

they may be conveyed through two or three separate channels, and you will come across another frequency used as an "observation post," namely, one reserved to the engineers for communication, and over which they compare notes in regard to the reception of signals, quality and so forth. On this side of the Atlantic the same procedure obtains, and the wavelengths most used for "broadcast" and "check" are as under:

- 16.10 m. (9,820 kc/s), GBU, also on 24.41 m. (12,920 kc/s).
- 16.38 m. (9,310 kc/s), GBS, Rugby, also on 33.25 m. (9,020 kc/s).

**PRACTICAL WIRELESS**

February - 25th, 1933

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Get a free copy of this handy little Booklet and enjoy the wide variety of descriptions of the Screened Goltone Coils.
Transmitting Circuits

As a number of readers continue to send in requests for a circuit diagram of a simple transmitter, it might help if I explain that a single-valve transmitter is fundamentally the same as a single-valve receiver. The only real difference is that the transmitting valve is constantly maintained in a state of oscillation, whilst the carrier wave (or steady oscillation) is modulated by impressing speech frequencies upon it. Perhaps the explanation is not quite clear, so let us look at the circuit of Fig. 1 which is, as you can see, an oscillating circuit by connecting the secondary winding at either of the points mentioned above. The two methods of connecting the microphone are known as grid-circuit and anode-circuit, modulation.

There are, of course, numerous other ways of modulating the carrier wave, but all are similar in principle to those we have considered.

Increasing the Range of a Milliammeter

Every wireless amateur knows the immense value of measuring instruments such as voltmeters, milliammeters, etc., when carrying out experiments or testing a receiver, but there are probably hundreds of readers who cannot afford to buy all the instruments they would like. A milliammeter is essential to anyone who takes more than a passing interest in his hobby, and for that reason is possessed by most enthusiastic amateurs. And since this instrument is similar in principle to all the others it can be employed for taking measurements of all kinds, provided that a few spare resistances of different values are available and that a little ingenuity is exercised. For instance, a milliammeter reading 0-10 milliamps can be used as a 0-10 voltmeter by connecting it in series with a 1,000 ohms resistance, or it can be made to read up to 100 volts by joining it in series with a 10,000 ohms resistance. Similarly, by choosing other resistance values (obtained from the formula—resistance equals maximum voltage to be measured divided by the full scale reading of the meter in milliamps, and multiplied by 1,000) any voltage can be measured. This idea formed the basis of the design of the Practical Wireless Multi-Meter described in Practical Wireless No. 21. But besides using the milliammeter for measuring voltages it can also be employed to measure higher values of current than for which it was originally intended. To enable it to do this, it must have a resistance joined in parallel with its terminals, and the actual resistance value is entirely dependent on the resistance of the meter. As an example, a 0-10 milliamp instrument can be made to read up to 20 milliamps by using a resistance equal to that of the meter, or it can be made to read up to 30 milliamps by using a resistance equal to half that of the meter, and so on. The conversion is therefore a perfectly simple
thusiasm is keener than it has ever been
its ostensible purpose of serious experiment.
years I find more to interest me at the
say that, although I have been experiment-
since broadcasting began.
are probably the most enthusiastic crowd
PRACTICAL WIRELESS don't, because they
and I am quite sure the regular readers of
building new sets and experimenting with
sooner or later the amateur must tire of
is rapidly waning.
interest in wireless.
in any medium-priced meter.
maximum degree
not give perfectly accurate results, but the
appropriate factor.
The method described does
to any desired multiplication factor. If
preferred, other readings could be marked
on the scale of the meter to apply to the
various ranges, but otherwise the reading
preferred, other readings could be marked
any desired
be set to an appropriate position to provide
any desired multiplication factor.

SCEPTICAL folk are constantly telling
us that wireless has gone nearly as
far as it can, and that public interest
is rapidly waning. They also say that
sooner or later the amateur must tire of
building new sets and experimenting with
different circuits. I do not believe it,
and I am quite sure the regular readers of
PRINCIPAL WIRELESS don't, because they
are probably the most enthusiastic crowd
of amateurs in the country. It is very
clear from the numbers of letters and
queries we receive every day that enthu-
thusiasm is keener than it has ever been
since broadcasting began. I can honestly
say that, although I have been experiment-
ning and building sets for at least a dozen
years I find more to interest me at the
present time than I did during any part
of my career as a wireless "fan." Oh,
yes, I started as an amateur and, although
I have since been engaged in various
branches of the wireless industry, I can
never bring myself to believe that I am a
"professional." It is true that I now
earn my living by radio journalism, but
that does not alter the fact that I am an
amateur at heart. I still take great delight
in working out a new circuit.

Listen to the Amateurs

BY the way, if any reader is seriously
contemplating the possibility of
setting up a transmitter (and applying for
the necessary licence) I would strongly
recommend him to make a practice of
listening to the amateurs who transmit
very frequently on Sunday mornings,
as well as at other times during the week.
They operate principally upon wavelengths
round about 160, 42 and 20 metres, and
you will probably learn a good deal by
listening to them and following the various
tests they happen to be making. Of
course it is no use trying to improve your
knowledge by wasting time on the few who
do nothing else but grind out gramophone
records all the time; they are the black
sheep who are only there for the station's
ostensible purpose of serious experiment.

The fact that Dubilier Condensers are specified
exclusively by the designer of the "Fury Four" A.C.
Receiver is not mere chance but is based on his
own knowledge of the merits of Dubilier Condensers.
Dubilier dependability is known throughout the
world in connection with the various
types of condensers—both
large and small—that are manu-
factured in Britain's largest
condenser factory.
Dubilier have always been conserv-
active in their claims and this in
itself is a safeguard to customers,
coupled with the fact of Dubilier's
long experience and condenser
research. It is impossible to buy
better condensers than those
made by Dubilier.
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One .0002 mfd. Type 665 6d. each
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Two 2 mfd. Type B.S. 2/6 each

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DUBILIER CONDENSERS

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Panel Mounting Washers : The "Selectone"

Sir,—On the fifth line from the bottom of column one on page 428 of No. 9 PRACTICAL WIRELESS Mr. Preston says, under the paragraph on "Panel-Mounting Bushes": "When insulating washers are required," etc. That’s just it, when are they required? I have a Set 9 L.F. set which has burnt out all sorts of things —a .0005 mica condenser in the aerial circuit, a bakelite tuning condenser, a transformer coupling the L.F. to the power stage, etc. I believe the set originally was designed for an ebonite panel, but I fitted a metal one, and properly insulated the reaction condenser with two bakelite washers and bush. Yet when I want to put a fuse bulb in the negative L.F. and earth lead it lights up, and stops the set. I take the bulb out and the set works all right. Perhaps an article on "when" insulating washers are required, and where, would be interesting to other constructors as well.

The "Selectone"

While this is not what I asked for in the letter of mine you published in No. 15, I am very much intrigued by the circuit published in No. 16, and shall make it up out of curiosity, but shall have to use ordinary L.F. transformers resistance-fed instead of the new ones specified. Getting the components together, I notice you say: "I Bulgin G.B. battery." I take it this stands for "pair clips." The wooden chassis also shows two side pieces. These must be as long as the baseboard is wide—viz., Sin., yet are specified "2 hardwood pieces 14 x 3 i x 3 in," which I presume ought to read "3 in. by 3 in.

Topping Accumulator

Sir,—Pressure of business has curtailed my reading time recently, so I have only now read Mr. Burchell’s letter in your issue of the week ending December 31st, entitled “Topping Accumulators.” I would like to draw your attention to the fact that Mr. Burchell’s remarks re "careless operators at charging stations (so called)" are absolutely unfounded. Accumulator manufacturers advocate and instruct charging operators and car owners, etc., to "maintain the level of the electrolyte 3 in. above the plates by the addition of distilled water," and this procedure is carried out at all charging stations.

NOTICE.

The Editor plans to publish in PRACTICAL WIRELESS a number of articles on the principles of various apparatus used in wireless telegraphy, and it is intended that these articles will be written on one side of the paper only, and should contain the name and address of the author. The Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to PRACTICAL WIRELESS, Strand, London, W.C.2.

PRACTICAL WIRELESS that which it deserves—every success.—R. S. MENGES (Schorbrough).

DO YOU KNOW?

-THAT special double valves are now obtainable which combine the function of detector and volume control valve.
-THAT the first thing to do when tracing a blown fuse in a mains receiver is to screen every other valve, etc., and take the fuse bulb out and the set works all right.
-THAT the on-off switch in a battery receiver should be examined every month and the contacts cleaned if found necessary.
-THAT the shelf-life of a battery may not be overlooked when using a Q.P.P. circuit.
-THAT a 1 to 1 output transformer often proves most valuable in an unstable receiver.
-THAT an ordinary flash lamp bulb will serve for the above purpose.
-THAT the value of the smoothing condenser in a mains eliminator should not be increased above that recommended by the valve or metal rectifier manufacturers.

Congratulations: D.C. Mains Sets

Sir,—I should like to congratulate you on the essentially practical character of your periodical. From my experience of journals dealing with the construction of wireless sets, during the past ten years, I have no hesitation in giving yours full marks as the best of the bunch. There is no way in which, if the maintenance or adjustment might be made, from my own point of view, and that is that more sets designed for D.C. mains should be included.

The Wireless Press seem to agree to ignore a very large part of the total population of this country who are, and will be for some years yet, supplied by D.C. mains.—F. S. W. (Richmond).

A Tuned "Cage" Aerial

Sir,—In answer to various readers’ inquiries I have had much pleasure in giving the following details concerning my "Cage" aerial, mentioned in January 7th issue. Ever since wireless has been practised we have all followed like geese our leaders who stated that an outdoor aerial is the "ideal" aerial. Well, we know to-day that a closed circuit consisting of a coil and a condenser can be tuned to a wavelength, or, in other words, we fix its resonance. Then couple this to the tuning arrangement of a set by means of a high resistance or neutralizing condenser. I prefer the latter. As it was imposed upon me to take away a circular aerial, I tried a frame aerial, but owing to its directional properties it was not an unqualified success. I then enclosed it in cage form, fixing two 9in. discs 12in. apart, and the results were satisfactory. Having a three-gang condenser lying idle, I wound the cage with three windings, using a condenser to each, and took a common connection from one side of each condenser and coupled it to the set by means of a neutralizing condenser, keeping, of course, the connecting wires between condensers of cage and set as short as possible. The tuning is not so difficult as it at first appears, but unless the three windings are fairly accurate, tuning is comparatively flat.—V. DELLEBCQUE (Horsley).

A Veritable Gold-Mine of Information

Sir,—I have received my copy of Encyclopedia, for which many thanks. I must say it is a veritable gold-mine of information, and should be treasured by amateur and professional alike. I shall treasure it to the end of my radio days.—E. NASH (Stoke Newington).

February 25th, 1933
Vibrating Reed Accumulator Charger

Str.-On your "Radio Wrinkles" page of December 3rd last you publish a vibrating reed accumulator charger made from an electric bell. This arrangement is rather wasteful in that as the current working the coils is running to waste. I enclose a diagram of charger designed and constructed by myself which this waste does not occur. The coil is worked by current passing through a 25-watt lamp, then through coil and over the contacts, and so on to the accumulator. This makes a very effective trickle charger, and if more amps are desired extra lamps can be switched on. In adjusting the reed the contacts must be just touching, otherwise the current will not commence to flow. Adjust brass weight on reed till it is in tune with phase of supply (the weight in my case is the leg of a valve straddled over the reed). When once in tune no sparking will take place at contacts. The contacts can either be magneto points or copper and carbon. Once adjusted, the charger requires no further attention.—GEORGE MITCHELL (Sunderland).

WHAT IS WRONG?

(Continued from page 1052.)

The currents measured by the method outlined above will be those flowing in the anode circuit of all valves except the detector grid-leak, a small positive bias will be applied. The currents measured by the method outlined above will be those flowing in the anode circuit of all valves except the screen grid one, and in that case it is the screening grid current which will be indicated. To measure the anode current of an S.O. valve it is necessary to connect the ammeter between the anode terminal, on top of the valve, and its connecting wire, as shown in Fig. 12. The priming grid current to a pentode is measured by connecting the meter between the terminal on the valve cap (or on the valve body if a plug-in type is used), and its connecting wire; this is also illustrated in Fig. 12.

Diagram illustrating Mr. Mitchell's letter.

INVISIBLE COBWEBS

By "PUSH-PUSH"

I got quite a shock the other evening. My next-door neighbour dropped in for a chat and he had with him a new detector valve he was just taking home for his set. Well, somehow we finished up by trying the new valve in my set.

Now, I had regarded my valves as quite up to scratch and I'd have sworn their performance was as good as ever. Yet that new valve made its presence felt in a way I was not expecting the book is far better than any other book of this nature I have yet seen.

I am sure my opinion will not differ from any other of the lucky readers who have seen this book. It is a valuable and wide ranging book of this nature and it will take up the valuable space of the only wireless enthusiast I have read. I am sure my opinion will not differ from any other book of this nature I have yet seen.

I am proud to be the owner of it.

 expectations, and I am proud to be the owner of it.

ADOVE THE LOCAL AND GET MADRID

No more dual programmes. Enjoy foreign concerts while your local station is working or when being "swamped" or interrupted with a powerful station. Just a PIX in your mailer.

PRINTED IN ENGLAND FOR PRACTICAL WIRELESS LTD.

February 25th, 1933

PRACTICAL WIRELESS

1115

The Lighter Side

Str.-I must admit your excellent journal is the only paper published that caters entirely and wholly for the radio enthusiast, and would like to say I agree with your correspondent, Mr. A. P. West, of Liverpool, in the January 28 issue, re studios and artists. My contention is that those readers interested in such items have a wide range of papers, and magazines to choose from for this information, and why should they want to take up the valuable space of the only journal we radio enthusiasts have to rely on now. What have studios and artists to do with PRACTICAL WIRELESS? How can we improve our sets and knowledge of wireless by reading such items?—E. STEWART-WALKER (Ilford).

GOT quite a shock the other evening. My next-door neighbour dropped in for a chat and he had with him a new detector valve he was just taking home for his set. Well, somehow we finished up by trying the new valve in my set.

Now, I had regarded my valves as quite up to scratch and I'd have sworn their performance was as good as ever. Yet that new valve made its presence felt in a way I was not expecting the book is far better than any other book of this nature I have yet seen.

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No more dual programmes. Enjoy foreign concerts while your local station is working or when being "swamped" or interrupted with a powerful station. Just a PIX in your mailer.
THE HIRE PURCHASE SYSTEM
By a Solicitor

In these days when there is hardly a firm in the country which does not offer to sell its goods on what is generally known as the Hire Purchase System or Instalment Plan, it is important that every one should have some idea as to what this means and what rights and obligations the purchaser is put under when entering into such an agreement.

As a general rule, when the hire purchase agreement is perused, it will be found to be a hiring of the goods for a certain period worked out upon the price of the goods, and the amount of periodical payments, and it is not until the last payment has been made that there is an actual sale or agreement for the possession of the goods. It is a matter of changing cartridges at 3½d. each, because the eventual replacement is merely a matter of changing cartridges at 3½d. each.

Apart from the above there is usually nothing in a hire purchase agreement which could not be found and included under the terms of a lease or licence. It will be seen, too, that practically all these agreements contain a clause that the goods can be returned, subject of course to various penalties, at any time before the payment of the last instalment, and although this may be set up as an advantage—as it undoubtedly is in many cases—it is in fact assure that there has been no actual sale, and that the goods belong to the seller or hire until the final payment, and do not pass to the buyer or possess the same, until that event happens.

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Huddersfield Radio Research Society

The Huddersfield branch of the A.A.R. and T.S. visited the Manchester Studio on Saturday, February 4th, for the performance of The Lancashire Muzzle.

Everyone enjoyed the show, and a good deal of surprise was shown by several members and friends at the method adopted by the artists. It gave a very interesting object lesson on the art of broadcasting. Another visit to Warrington Transmitter Station is to be arranged at an early date. These visits are not confined to members, and anyone is invited to accompany the party. Further particulars from the Hon. Secretary, Mr. W. H. Parr, 12, Bonsall Road, Forest Gate, S.E.

T. H. J. Peace, W.R.T., 3, Bonsall Road, Woodford, Grange.

Woodford, Wanstead and District Radio Society.

On Thursday, the 2nd inst., Dr. A. B. Perrysome, B.Sc. Radio G.E.F.Y., of Leytonstone, gave a talk to the Leytonstone, Woodford and District Radio Society on the Latest short-wave circuits. Several of the local amateur transmitters were present. Very clear details were given by the lecturer of home-made circuits, and values for short-wave super-heterodynes. The screened grid valve was said to be an excellent detector for this kind of reception. A pre-stage of high frequency was strongly recommended. Some details were also given of the Stenode Receiver, which proved most interesting. Hon. Secretary, Mr. H. O. Cross, 7, Rudyard Road, Forest Gate, E.

Ilford and District Radio Society.

This society is enjoying a successful twelfth year of working, and, of late, have had quite a number of first-class lectures and demonstrations at their weekly meetings. On January 26th Mr. H. L. Ranson lectured on "The measuring of the performance of a receiver," and described the procedure in the laboratory when testing a new receiver for selectivity, sensitivity, and response. Then he demonstrated in a practical manner the points mentioned, and by means of a valuable instrument from the laboratory, namely, a standard Signal Generator, he tested an A.R. receiver of commercial make. A curve was plotted on the blackboard, and the members could see both from this and the meters, how the response of the receiver changes with wave length, and other conditions. The lecture and demonstration proved most popular with the members. At the last meeting, which was a "Prize Evening," the Society's apparatus was given a final run prior to being rebuilt immediately, and there were visitors from the Croydon Radio Society present.

Details of the Ilford Society may be had from the Hon. Sec., Mr. C. E. Largen, 16, Clements Road, Ilford.

Slade Radio

"L.F. Amplification" was the subject chosen by Mr. A. F. Poynton for his lecture at the meeting of the above society held recently. After describing how an amplifying valve works, he went on to explain transformer coupling and how a transformer operates, reactance of transformers, and how it is determined. Core materials and permeability were followed by parallel, also resistance fed transformer coupling. Resistance coupling and how it works followed, together with details of voltage of resistance and leak. A few words on transmitters came next, and this was followed by choke coupling. Coming to the output valve, several different types were tried and compared. The pull-push method was described together with the push-pull type of Class B amplification. This concluded a very interesting lecture, which was followed by those present. Hon. Secretary, Hon. Assistant, J. Sutcliffe, 32, Mulberry Street, Moldgreen, Huddersfield.

British Experimental Short-Wave Station

As most transmitting amateurs are probably aware, the Radio Society of Great Britain are now handling their own members Q.S.L. cards only, and that all applications in future from non-members of the Society for Q.S.L. cards should be made to the undersigned, accompanied by a stamped addressed envelope, and not to the Radio Society of Great Britain. All communications should be sent to F. Postlethwaite (G5KA), 41, Kilnams Road, Goodmayes, Ilford.

This is the Pick-up for the Fury Four Radio Gram


Registered Design No. 773897.

This season's outstanding range, all conforming fully with modern screened practice. Designed for baseboard or chassis mounting. Note particularly the high inductance values and competitive prices.

List No. MIDGET SCREENED H.F. CHOKE

H.F.8

Small and neat, can be incorporated in the smallest receivers and will give excellent results. Tested inductance 198,000 mH. Self capacity 3.5 mmF.

H.F.9

H.F.10

A splendid general-purpose component for use with modern high efficiency valves. Tested inductance 255,000 mH. Self capacity 2.5 mmF.

SUPER EFFICIENT H.F. CHOKE

H.F.8

This is the Pick-up

M.C. 22 PERM-MAG MOVING COIL SPEAKER

HAVE YOU HEARD THE AMPLION M.C. 22 PERM-MAG MOVING COIL SPEAKER?

AMPLION (1932), LTD., 82/84, ROSOMAN ST., LONDON, E.C.I.
PICTURE RAIL INSULATORS

THE erection of an indoor aerial is not always the convenient process which it is at first sight. The wire, of course, may be laid up the picture rail, or may even be laid to the wall. It is always advisable, however, to keep the wire away from the walls, in order that it may be turned in the light wall than it lift. This would, of course, look a little unsightly. Messrs. Rongbuk have produced a neat insulator which greatly facilitates the erection of the indoor aerial, and incidentally requires no tools whatsoever to erect it. It consists, in effect, of the upper part of an ordinary picture hook of the type which hooks over the picture rail. Attached to the upper part of this is a lakeside rod a few inches long, at the end of which is fixed a small nut. By taking these fixtures on the picture rail at suitable intervals, the wire is held neatly in place, and is attached to the insulator by pressing down the spring, and generally w'the hook, and then releasing the spring. It is thus firmly held. The insulators are 1d. each.

ANTI-BREAK THROUGH CHOKE

A VIBLY common fault which most listeners experience, in the tuning of medium-wave stations at the lower end of the scale when the receiver is switched over to the long waves. With some types of dual-range coil it is, in fact, impossible to use the full 30 degrees of the scale on the long waves owing to this nuisance. A very simple remedy, however, is the inclusion of a special choke in the aerial lead, between the aerial and the tapping on the tuning coil used for long waves. The inductance should be round about 800 to 1,000 microhms, and a very neat commercial form of this choke is manufactured by Messrs. Igranic. This is called the Igranic Anti-Break Through Choke and sells at 4s. 6d. It is thus firmly held. The insulators are 1d. each.

THE NEW LEWCS POTENTIOMETER

THE Lewcs potentiometers are now well known to constructors, and have been used extensively and severly in the receivers produced by us. The latest type is known as a "fixed" potentiometer, being, in fact, the only one of its type on the market. This is a wire-wound potentiometer with a value of 1,500 ohms in each cell, and the 3-ohm value has been adopted to prevent ionisation when used on the 500 volt D.C. mains. The complete block only measures roughly 4 by 3 inches, and is set up into two main, high so that it takes up less room than the separate condensers would. The type 150 is on the right, and consists of 30 separate condensers. This new potentiometer has been adopted for testing use on the new T.C.C. condenser blocks, which are nothing more nor less than a number of separate condensers housed in one case, with one common terminal joined inside to one terminal of each condenser. The terminal marked is the one, and the remaining side of each condenser is taken to the separate terminal appropriately marked. The illustration below shows three of this new block introduction by the T.C.C. people, and these are the B.M.12, the H10 and the H7A.12. The first named is wound on the black, and this contains two half and two half 150 ohms of the 500 volt D.C. mains. The other in the picture block only measures roughly 4 by 3 inches, and is set up into two main, high so that it takes up less room than the separate condensers would. The type 150 is on the right, and consists of 30 separate condensers joined in series so as to provide a total capacity of 330 ohms. This novel method of building up the required potentiometer has been adopted to prevent ionisation when used on the 500 volt D.C. mains. The complete block only measures roughly 4 by 3 inches, and is set up into two main, high so that it takes up less room than the separate condensers would. The type 150 is on the right, and consists of 30 separate condensers joined in series so as to provide a total capacity of 330 ohms. This novel method of building up the required potentiometer has been adopted to prevent ionisation when used on the 500 volt D.C. mains. The complete block only measures roughly 4 by 3 inches, and is set up into two main, high so that it takes up less room than the separate condensers would.

MOUNT EVEREST EXPEDITION

A MOUNTAIN the many appliances carefully selected by the Mount Everest Expedition is significant that Siemens' Full O'Power Batteries, etc., have been chosen for the transmitting and receiving apparatus. These have been especially selected not only to meet the particularly rigorous conditions of transport. A description of the duties of the various batteries supplied for the purpose will, no doubt, be of great interest to our readers.

Base Camp (1900 feet) At Approximately 4,000 feet.

This camp is at the foot of the Rongbuk Glacier, and to have work back to Darjeeling and forward to Camp 3. At this camp there will be three Full O'Power H.T. batteries as follows:—

1 of 150 volts to supply a current of 15 milliamps.
200 ft.
150 ft.
90 ft.
30 ft.

For these batteries the Super Radio Full O'Power Batteries, size V.5 60-volt units, are to be employed; these are packed in boxes not exceeding 40lbs. gross weight each.

Camp 3. At Approximately 21,000 feet.

This Camp is at the head of the Rongbuk Glacier and in the immediate vicinity of the final effective operations. The conditions here are extremely difficult, and the temperature is likely to go down as low as 24 degrees F. below Zero. At this camp the question of weight is of the greatest importance, as the maximum weight per package can only be 150 lbs. The L.T. element consists of two separate units each containing 0.5 amperes at 2 volts, and for this duty large Siemens' cells are supplied, and these need only be energised when the installation is set up. The H.T. batteries will be of 150 volts capable of a current discharge of 30 milliamps, and as weight is such an important factor the "Power" type Full O'Power batteries, size V.3 (45-volt units), are to be employed for this purpose. These batteries have round cells as compared with the square cells of greater weight in the Super Radio batteries mentioned above. For this installation also a 9-volt Grid Bias Full O'Power Battery, size V.1.5, is required. The installation at this Camp is required for reporting back to the Base Camp.
FUSES FOR MAINS USE

**As I am building a mains set for use on D.C. mains, I wish to incorporate fuses to avoid damage to the house wiring. Can you tell me where to put these fuses so that they will not interfere with the supply of voltage to the set? I suppose I could use ordinary fuse wire as a fuse and to avoid fire perhaps I could fit a small asbestos holder, or strip of that material sold for this purpose.**

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**If it were put to some odd valise, use the nearest commercial value. Erring on the side of over - sizing, the value of resistance required (in ohms) will be the value of resistance required in the anode circuit of the L.F. valve of your set (providing it does not pass more than 10 ma), and then to bind it tightly with thin wire. If it should work out to some odd value, use the nearest commercial value.**

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**If all wires coming from one point were to join two wires which come from the same point, the wiring can be shown in a clear, systematic manner on the side of the vacuum tube holder.**

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**Please note also, that all sketches and drawings which are sent to us, should bear the name and address of the sender. Send your queries to The Editor, PRACTICAL WIRELESS, Grosvenor House, H. I., Southampton St., Strand, London, W.C.2**

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**SPECIAL NOTE**

We wish to draw the reader's attention to the fact that the Querries and Enquiries Service is intended only for the solution of problems or difficulties which arise from the obstruction of receivers caused by faults, from articles appearing in our pages, on general wireless matters. We are unable to give advice on (1) Supply circuit diagrams of complete sets. (2) Suggest alterations or modifications of only receiving sets. (3) Suggest alterations or modifications of commercial receivers. (4) Advice over the telephone.

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**AUTOMATIC GRID BIAS**

"I wish to incorporate an automatic grid bias with an automatic bias arrangement. The method I have found is to use a condenser and an old piece of the condensed plate of the valve. This is quite true that ordinary fuse wire could be used, with a backing of asbestos, but a much more satisfactory job could be done if you purchase one of the special fuses and fuse mountings made by Billing-Lee or Billing. A fuse in each mains lead should be used, and to avoid fuses, some other form of circuit protection is advisable, with ready-removable cartridge type fuses. There is no doubt that this is the best about. The bias is much more satisfactory than the ordinary arrangement."

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**REPAIRING PHONE CORDS**

"I am trying to repair a phone cord, which is sent to us, should bear the name and address of the sender. Send your queries to The Editor, PRACTICAL WIRELESS, Grosvenor House, H. I., Southampton St., Strand, London, W.C.2"
ELEKEX SHORT-WAVE CONVERTERS

J. RAYTON & SONS have recently put on the market a new range of Short-Wave Converters known as the "Duplex," and we have just received a handy instruction book concerning these units. With one of these converters an ordinary set is quickly transformed into an efficient short-wave receiver. A popular model, which retails at £25 6s., has a range of 15 to 60 metres and is housed in a small cabinet of small dimensions, the front of which carries the tuning condenser dial, reaction, and switch. Convenience of the cabinet is increased by the position of the tuning condenser, which is visible from the front through a window, the whole of which has been taken from the back of the cabinet. For the benefit of owners who wish to make use of their moving-coil units in a new form in the cabinet housing their broadcast set, Model LK, the complete set is available, in either polished oak or walnut, for £6 and £4 1s. respectively.

1. Write legibly, in full. Give your full name and address.

2. State type of receiver used, and whether trans- mitter was heard on headphones or on loud-speaker.

3. State approximate wavelength or frequency to which receiver was tuned, and to which transmitter was tuned between which two stations (of which you have the control numbers) the transmission was picked up. Do not forget to add whether a.m. or p.m.

4. Give date and time of reception, and, if you can, some indication regarding the language, if heard.

5. State whether and what end was given and/or kind of interval used; telegraphic signals, musical notes, etc., between items.

6. To facilitate classification of reports, append a non-reply to your inquiry.

BROADCAST TO Reply Queries to Broadcast Query "Flash" (Radio-Press, B.B.C., 3,000 diecate/p.)

C. BOLL (Sheffield) : (a) GOLF (Radio-Press, B.B.C., 3,000 diecate/p.)

JOHN B. STATION (Woolston) : PPU, Rio de Janeiro (Brazil), on 974 long wave, etc., i.e., possibly Langenberg (B.M. 1460) or possibly Poste Parisian; (b) QAS (Radio-Press, B.B.C., 3,000 diecate/p.)

J. H. GOODCLIFFE, 97, Sheaf Gardens, Leeds: (a) G2CW, experimental transmitter, Leith; G6SR, experimental transmitter, Leith; (b) Possibly quarter harmonic of Poste Parisian, possibly on 41 m.; (c) Experimental transmitter at Edinburgh.

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As a keen Radio enthusiast, you naturally keep yourself posted in all the latest developments of this new and fascinating branch of Electrical Science.

But, as you are doubtless aware, equal progress is being made in other departments of Electrical Science and its application to modern life. You should, therefore, read the PRACTICAL ELECTRICAL ENGINEER, for it is the purpose of this Magazine to record and explain, by means of illustrated articles written by leading Engineers, the latest developments taking place in every branch of Electrical Engineering.

A glance through the Contents of the current issue will show you the wide field covered by this live, new monthly. Get a copy to-day and judge for yourself its supreme value to all interested in Electrical Progress.
Write for the new series of leaflets describing the complete range of Lewcos World-famous Radio Components.

Brilliant in design and performance, the two Lewcos precision-made components illustrated—the Super H.F. Choke (Price 6') and the Potentiometer (Price 3' to 8')—are fine examples of the high quality and reliability of all Lewcos Radio Units.

Descriptive of these components illustrated Refs. W78 and W79 are included in the series now available.