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Wireless Weekly

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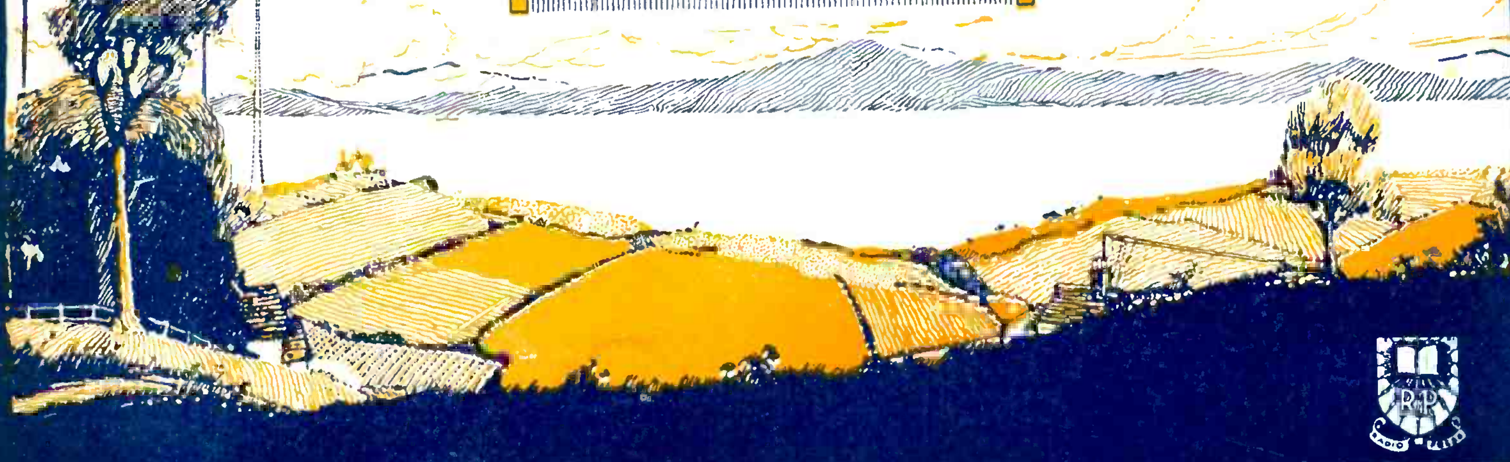

The Negadyne

By A. D. COWPER, M.Sc.

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A Memorable Presidency

THE Radio Society of Great Britain is to be congratulated upon the acceptance by Sir Oliver Lodge, F.R.S., of the position of President for the forthcoming year. Sir Oliver Lodge's decision is one more proof of the prestige of the leading amateur society, and will do much to strengthen its position.

The constitution of the Radio Society of Great Britain provides that no President may occupy the position for more than two consecutive years. While we have no quarrel with the rule itself, we think that experimenters throughout the country will view with regret the fact that under this rule Dr. Eccles has had to vacate the Presidential chair. His two years of office have been marked by many notable changes in the Society, and only those closely associated with the organisation have even an approximate realisation of the immense amount of work he has, personally, done in improving the status of the amateur.

First and foremost the new constitution owes very much to Dr. Eccles, who has not merely presided at numerous committee meetings, but has given of his own very valuable time many weeks in perfecting it. The General Committee of the affiliated societies—one of the most important advances in the amateur organisation—owes its inception to him, while as an *ex officio* member of all committees, he has given freely his expert advice on innumerable points.

So far as licences are concerned, the strong and yet tactful attitude he has adopted has contributed much toward the clearing up of many anomalies. Much of this success has been due to the fact that Dr. Eccles is held in high regard both by the authorities and the amateurs who have entrusted their interests to him.

Within his period of tenure of this office Dr. Eccles has seen the Society take its own offices in Victoria Street. The organisation necessary for the successful conduct of this part of the Society's activities has been the subject of his personal supervision throughout, and to this alone he has given up many hours each week.

With such an example before them, experimenters throughout the country should seriously consider whether they are giving adequate support to the parent and to the affiliated societies. We have criticised freely, and shall continue to do so, the activities of the Radio Society of Great Britain, believing that such criticism is helpful. We feel too keenly the need of well-organised effort on the part of the amateurs to pass by without comment the various developments. Our criticisms in the past have received full support from our readers, and we feel sure that they will join with us in thanking Dr. Eccles, on behalf of the amateurs of the country, for the great assistance he has given to the movement during his period of office.

CONTENTS

The Calculation of the Natural Wave-Length of an Electric Circuit

By JULIUS FRISH, M.Sc., M.I.E.E

An article of value to all who prefer to design their own apparatus.

I SHALL endeavour in this article to show how to calculate the natural wavelength of an electric circuit with the minimum of mathematics and without assuming much previous knowledge of electricity.

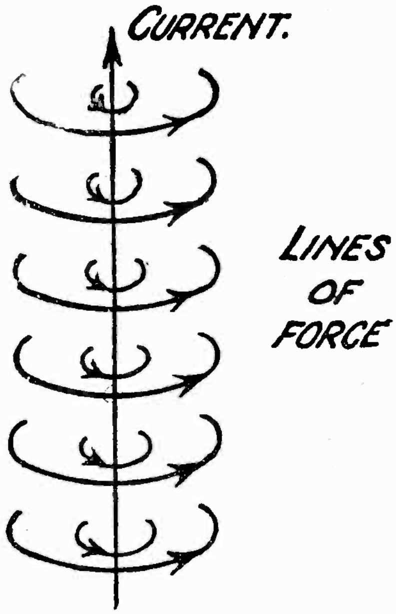


Fig. 1.—Distribution of field around a straight conductor.

The centimetre-gramme-second (" C. G. S.") method of measuring length, mass and time will be adopted. Also to save space a million will be written 10^6, a thousand 10^3, and so on.

The first thing to be noted is that in wireless work both frequency and wavelength are spoken of. The relation between these quantities is, of course, that velocity equals wavelength × frequency; just as the velocity of a train equals the length of a truck × the number of trucks coming out of a tunnel per second.

Velocity of Electric Waves

The velocity of electric waves is the same as that of light, i.e., about 300,000,000 (3×10^8) metres per second, so that a frequency of a million per second would give a wavelength of $\frac{300,000,000}{1,000,000}$ or 300 metres.

Magnetic Field

It is found experimentally that when a current flows in a wire the space round the wire has magnetic properties, and is called a " magnetic field." (See Fig. 1.)

A magnetic field is a portion of space in which a magnet, a compass for instance, is attracted or turned in some definite direction. The strength of a magnetic field is measured in a unit called " lines of force per square centimetres."

It is found experimentally that if a conductor of electricity is moved in a magnetic field so as to cut the lines of force at right angles, a voltage is generated in this conductor proportional to the rate of cutting lines of force. This gives us the unit of the " volt " which is the result of cutting 10^8 lines per second.

Lines of Force

Further, it is not necessary to be too insistent on being able to

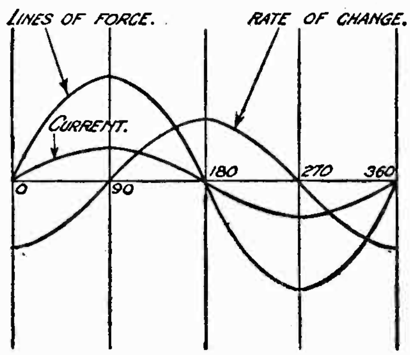


Fig. 2.—Illustrating the relation between magnetic field and its rate of change.

see the lines of force cutting the conductor; they may be just inserted or withdrawn from a turn of wire or loop in the electric circuit, so that the above definition may be stated by saying that if the lines are varied through a turn or turns of a circuit, each turn has a voltage generated in it equal to the rate of variation of the lines through it, a varia-

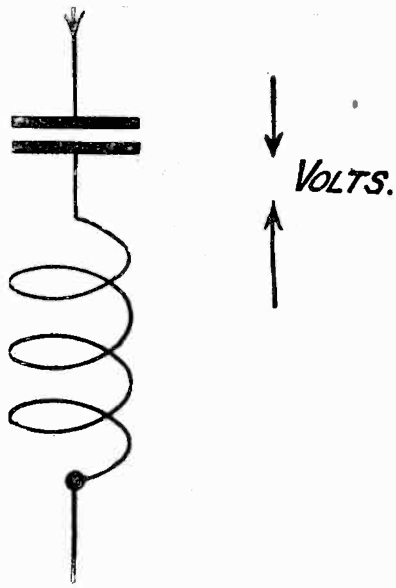


Fig. 3.—Relation of voltages produced across a coil and a condenser.

tion of 10^8 lines per second making a volt in each turn.

It follows from these two statements that a current can never vary, however slightly, in an electric circuit without causing a voltage in that same circuit, which voltage always tends to oppose the change of current, i.e., when the current starts to decrease in an electric circuit (and all electricity must flow in a circuit) the number of magnetic lines through that circuit is diminished and thus generates a voltage in the circuit in such a direction as to tend to keep the current flowing.

Self Induction

This tendency is called the " self induction " of a circuit; when it is wished to accentuate the effect, the wire forming the circuit is wound in a coil so as to make the lines due to each turn cut all the other turns.

The self induction of each turn is the number of lines going through that turn for each ampere in the circuit, the self induction of the whole coil is the sum of that of each turn; and as the lines through each turn are generally those made by all the turns, the self induction of a coil increases as the square of the number of turns.

Self induction is measured in units called henries and equals :—

Number of lines through the coil when one ampere is flowing × turns in the coil $\div 10^8$.

A micro henry is one-millionth of a henry.

Now imagine such a coil carrying an alternating current, i.e., a current which varies harmonically from a maximum in one direction to a maximum in the opposite direction. The lines are a maximum when the current is a maximum, but their rate of change is a maximum when their number is going through zero (see Fig. 2), so that the voltage across the coil generated by these self-made lines is a quarter of a wave behind the current.

Condensers

The next phenomenon I want to introduce you to is quite different. It is what happens when you connect a battery, say, to a condenser which consists of two parallel plates near to, but not touching, each other. If you were very quick, you could find that at the moment of contact a little electricity flowed into one plate and out of the other, but unless the battery were of a sufficiently high voltage to spark across between the plates, this flow of electricity would stop almost immediately. The quantity of electricity which flows into a condenser is proportional to the voltage applied to its plates, and the capacity of a condenser is defined as the amount of electricity which flows into it for each volt applied across it. It is very like pumping gas into a steel bottle, the capacity of the bottle could be measured by the quantity flowing in for each pound to the square inch pressure applied. Capacity so defined is measured in farads.

Now apply an alternating voltage to the condenser plates, the electricity forced in during the positive half of the wave will come out during the other half, and so a condenser appears to let an alternate current flow through it and to stop a continuous current; though it would be more accurate to say an alternating current flows in and out of a condenser, not through it.

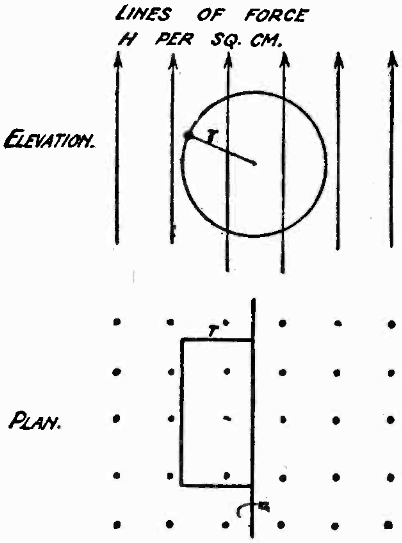


Fig. 4.—Illustrating the method of rotating the coil for obtaining an expression for self-induction.

Here again the voltage across the condenser plates will be a maximum when the current is zero, as at that moment electricity has been flowing into it for half a wave and is just going to reverse and come out again.

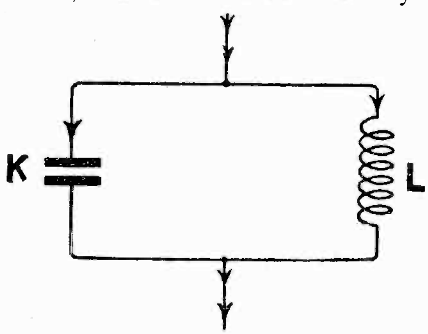


Fig. 5.—Division of current through parallel paths.

So that if we put a self induction coil and a condenser in series and make the same alternating current flow through both, the voltage on the condenser and on the self induction will be a maximum when the current is going through zero, but they will be in opposite directions; the volts on the self induction will be opposing the current which is just growing up from zero, whereas the pressure in the condenser will be aiding the growing current as it is in the direction to let the stored up electricity out again.

It is seen that the frequency of alternation of the current has an opposite effect on self induction to that which it has on capacity. At no frequency, *i.e.,* a continuous current, self induction is no hindrance, as the self-made lines of force, however numerous, do not vary. Continuous current is, as we have seen, entirely interrupted by a condenser.

Rate of Change

On the other hand, as the frequency gets higher the effect of the self induction increases as the rate of change of the lines becomes greater. The condenser, however, has less and less to do, for if the current or rate of flow of electricity is the same, the time during which it flows in any direction is less, and therefore the quantity of electricity it has to accommodate is less the higher the frequency.

As explained above, all electric circuits must have some self induction, which impedes the flow of an alternating current, but if to such a circuit we add the right amount of capacity a voltage will appear at its terminals equal and opposite to that made by the self induction, and will therefore neutralise the effect of the latter and let the alternating flow of electricity surge round the circuit with the least possible obstruction.

Natural Frequency

In fact, could we eliminate *resistance* from the circuit, which plays the *rôle* which friction takes in mechanics, electricity once started oscillating at the appropriate rate would continue to do so for ever. This then would be the natural frequency or " note " of the circuit, and such a circuit would respond to this note and to no other.

It follows that for every circuit containing self induction and capacity there must be one particular frequency at which each nullifies the effect of the other. Or, putting it another way, there must be some values of self induction and capacity which balance each other for any particular frequency.

Having now explained the way the thing works, it only remains to put in the arithmetical constants to enable us to make all the necessary calculations.

Example

The maximum volts at the terminals of an inductance of L henries is calculated in this way :—

Imagine a rectilinear coil rotating in a uniform magnetic field about one of its sides as axis, place the coil so that the two sides of length r centimetres each adjacent to this axis revolve in

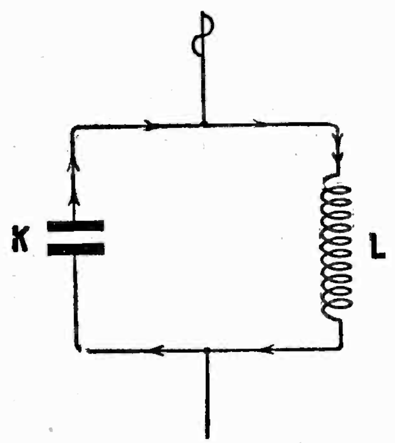


***Fig. 6.**—True direction of current flow in an oscillatory circuit.*

the plane of the lines and so do not cut them (see Fig. 4), so that the volts would only be generated (by cutting lines) in the remaining side of length l centimetres. Let the magnetic field have H lines per square centimetre, and let the coil rotate at n revolutions per second. The speed of the side l through space $= 2\pi rn$ centimetres per second. The maximum rate of cutting lines would then equal $H \times l \times 2\pi rn$ per second. This, divided by 10^8, is the volts in the coil.

$H \times l \times r$ is the maximum number of lines through the coil. Therefore the volts $=$

$$\frac{\text{maximum lines}}{10^8} \times 2\pi n.$$

Now instead of revolving the coil in a magnetic field keep it stationary and put an alternating current in it. This current (of maximum value C amperes) will make lines of force through the coil, which will vary in just the same way as the lines did when it was revolving. By the definition of the henry, L is the number of 10^8 lines for one ampere, so LC is the maximum number of 10^8 lines for a current whose maximum value is C amperes. n, the revolutions per second, is the frequency, written $\sim$, therefore the maximum volts at the terminals of the inductance $L = 2\pi \sim LC$.

Condenser Discharge

Taking now the case of the condenser, if the current varies harmonically and its maximum value is C, its average value over half a wave is, from the mathematics of harmonic motion, $C \times \frac{2}{\pi}$ In half a wave the condenser changes from full in one direction to full in the opposite, so that from empty to full takes a quarter of a wave, or $\frac{1}{4\sim}$ seconds, in which time electricity equal to $C.\frac{2}{\pi}.\frac{1}{4\sim}$ flows into it. The voltage at its terminals will therefore be $C.\frac{2}{\pi}.\frac{1}{4\sim}.\frac{1}{K} = C \times \frac{1}{2\pi \sim K}$ where K is the capacity in farads.

Resonance is attained when the volts on the self induction and the volts on the condenser are equal (and opposite), as in Fig. 3, *i.e.*, when $2\pi \sim LC$

$$= \frac{C}{2\pi \sim K} \text{ from which}$$

$$\sim = \frac{1}{2\pi} \sqrt{\frac{1}{LK}}$$

Now the wavelength $=$ velocity $\div$ frequency $= 3 \times 10^8 \times 2\pi \sqrt{LK}$ metres $= 18.85 \sqrt{LK} \times 10^8$.

If L_1 is in *micro*-henries and K_1 in *micro*-farads, the wavelength $= 1885 \times \sqrt{L_1 K_1}$ metres.

It will be seen that the effect of self induction is greater the greater the self induction, whereas the greater the capacity of a condenser the *less* effect it has on the circuit. If the two are put in series so that the same current flows through each, the volts at the terminals of the self induction are proportional to the self induction of the coil, but the volts on the condenser are greater the *less* the capacity.

Constant Wavelength

Thus to keep the wavelength of a circuit constant, if the self induction is increased the capacity must be proportionally decreased.

All the above is on the assumption that the self induction and capacity are in series, in which case the current in each is the same, but the pressure across each is controlled by its individual value.

If, instead of this, the two are placed in parallel in a circuit, as in Fig. 5, then the opposite is true; each has the same volts across it, but the current divides according to the values of L and K.

The expression in the last column can again be used, but in this case the currents, which were alike and both called "C" when in series, will now in general be different, and we can write

$$2\pi \sim LC_L = \frac{C_K}{2\pi \sim K}$$

When they were in series the volts on each were opposite in direction, and could be made of equal magnitude by adjustments either of the values of L and K or of the frequency. Now they are in parallel they share the

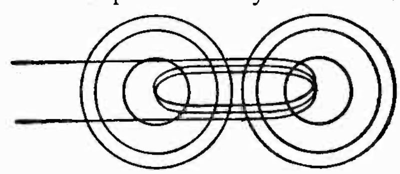


***Fig. 7.**—This arrangement of turns gives the highest self-induction.*

same volts, so the currents are, at any instant, opposite in direction, and can likewise be made equal in magnitude by similar adjustments; for instance, $C_L = C_K$ when $2\pi \sim L = \frac{1}{2\pi \sim K}$ *i.e.*, when

$$\sim = \frac{1}{2\pi}\sqrt{\frac{1}{LK}}$$ which is seen to be identically the same frequency as that which did the trick when the two were in series.

Deception

So you see that the arrows in the nice little picture (Fig. 5) are all wrong! There need be no current in the outside circuit at all, only an alternating voltage of the right frequency, for the currents in L and K to be enormous. As before, were it not for resistance, the currents would be infinite. This parallel circuit can therefore be "tuned" in the same way as the series circuit, and exactly the same expressions for wavelength, etc., hold good.

A word should now be said about connecting two condensers or two inductances together. This may be done in series or in parallel.

1. Two equal condensers in series, capacity half that of either alone because, of the voltage available to charge them, only half is across each and therefore only half the electricity goes in.

2. Two unequal ditto of capacities K_1 and K_2. Capacity in series $= \frac{K_1 \times K_2}{K_1 + K_2}$

3. Two or more condensers in parallel capacity the sum of the individuals.

4. Two or more inductances in series—the sum of all.

5. Two inductances in parallel.

$$\frac{L_1 \times L_2}{L_1 + L_2}$$

The capacity of a condenser depends on the total area of its plates and inversely on the distance apart of the plates, and also on what is between them.

$$K' = \frac{kc\,A}{d} \times \frac{9}{10^8}$$

K' is capacity in microfarads.

A is the total area of the space

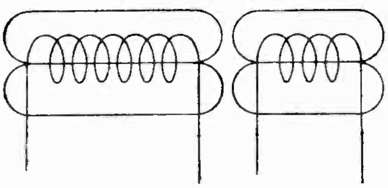


Fig. 8.—Separating the turns reduces the self-induction.

between the plates in square centimetres.

d is the distance apart in centimetres.

kc is the "specific inductive capacity" of what is between the plates; for air $kc=1$, for other substances it varies somewhat, but for certain glass it is about 7; for paper about 2; for mica about 6.

Aerial to Earth Capacity

In the same way an aerial has a capacity to earth approximately equal to some constant × its length ÷ some function of its height above the ground. The self-inductance of a coil depends on its diameter and on the number of turns squared; it also depends on whether the turns are all bunched together so that all the lines of magnetic force link all the turns, also the lines would then have the shortest possible return path outside the coil.

If the turns of wire are, on the other hand, spread out in a single layer along a tube, the strength of the magnetic field is not much increased by the number of turns, as each turn, though bringing its extra magnetising force, also brings an equivalent extra length of magnetic circuit to magnetise.

For the bunched coil, the self-inductance in microhenries is *approximately* $\frac{ks \times d \times T^2}{100}$, when *d* is the diameter of the coil in centimetres T is the number of turns. ks=one for air and other non-magnetic substances (i.e., everything except iron, nickel and cobalt). For iron *ks* decreases with the density of the lines of force, but is always many thousand times that for air.

For long single layer coils, *l* centimetres long and having T turns, $L' = \frac{d^2\,T^2}{100\,l}$ microhenries *approximately*.

In the same way the loop consisting of an aerial, earth wire, and earth has self-induction which is proportional to the length of the aerial and increases with its height.

A New American High-Power Broadcasting Station

PLANS are now complete for the erection of an American broadcasting station with a power equal to that of 5XX Chelmsford.

It is hoped that the new station will commence operations on or about April 1 of this year, and under favourable conditions, should be heard in this country.

WCCO is the call sign of the new station, which will be situated 18 miles north-west of Minneapolis. The aerial towers will be 200 feet high, and of the three-legged type, set in concrete bases.

The studios, of which there will be three, are going to be situated in Minneapolis, and special telephone lines have already been laid between the city and the broadcasting plant.

When WCCO is completed, it will be one of the most powerful stations in the United States, and will be international in its scope.

The programmes to be broadcast from WCCO are going to be of a novel character, and will be a departure from the usual type of wireless programme.

In this connection, it may be interesting to note that there are several American broadcasting stations which provide programmes of a nature unfamiliar to British listeners. WOR-Newark, has a morning gymnasium class each morning at 7 a.m., as does KDKA-Pittsburg.

Many of the American radio stations commence operations at 10 a.m. or earlier, American time, and continue at intervals throughout the day until 11 p.m.

Some American stations not very well known to British amateurs are WGR-Buffalo on 319 metres, WSB-Atlanta on 429 metres, and WEBH-Chicago on 370 metres.

THE SET FOR FAMILY USE

For general family use a loud-speaker is usually essential, and few loud-speaker sets have proved so popular as "The Family Four-Valve Set," by Percy W. Harris (Radio Press Envelope, No. 2, price 2s. 6d., or 2s. 9d. post free). This set is provided with a simple "on and off" switch, so that any member of the family can bring it into use when it has once been adjusted.

The Negadyne

By A. D. COWPER, M.Sc., Staff Editor.

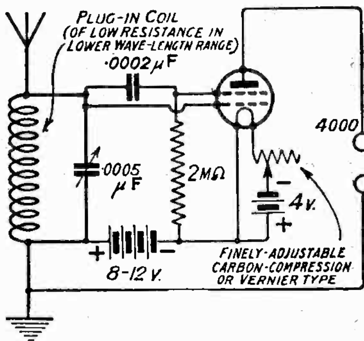


Fig. 1.—The "Negadyne" circuit.

SO-CALLED "negative resistance" or reaction effects (up to and beyond the point where self-oscillation commences when a tuned oscillating circuit is present) can be obtained in a number of ways besides the familiar method of direct magnetic coupling of a "reaction-coil" with the grid-tuning-inductance of a triode. Besides the various methods of electrostatic reaction available, and such arrangements as the Hartley oscillator, etc., possible with an ordinary three-electrode valve, there are, amongst others, the familiar American "dynatron" arrangement (using in effect *two* anodes), and the "negatron" device worked out by J. Scott-Taggart several years ago, for which a special type of valve is necessary, but in which self-oscillation is obtained with the use of a *single* inductance arranged as part of an ordinary oscillating circuit.

The "Numans Oscillator"

Recently a Dutch investigator has devised a very simple method of obtaining self-oscillation (and therefore the so-called "negative-resistance" effects) by the use of a four-electrode valve of the type developed some time ago in Holland and France for use in ordinary receiving circuits with but moderate plate-potentials. An interesting account of this has been given in our contemporary, *Experimental Wireless*, No. 15, Vol. II, under the name of the "Numans Oscillator." A complete explanation of the *modus operandi* of the negative-resistance effect does not appear to have been published yet: a suggestion is given elsewhere, based upon a determination of the actual characteristics of four-electrode valves operating under the conditions obtaining in these circuits.

Connections to the Grids

The essential point is that, in place of connecting, as usual, the inner grid of an ordinary four-electrode valve directly to a tapping-point on the high-tension battery (or, as in some circuits, to the L.T. plus on the positive side of the filament-resistance), and using at the most a magnetic coupling to the A.T.I. of a coil inserted in this circuit (as in certain Dutch circuits), in these "negative-resistance" circuits the grids are connected directly together by an ordinary grid-condenser, and a tuning inductance (together with its tuning condenser

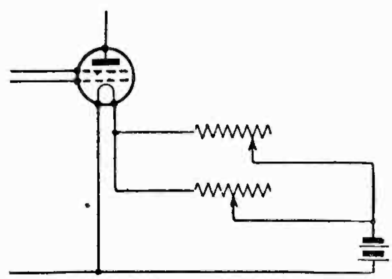


Fig. 2.—The reaction control.

to complete a proper oscillating circuit) is placed across the *combined* grids and the "earth" or filament. The inner-grid is given a steady mean positive potential by means of a small H.T. battery, of the usual size adopted in an efficient four-electrode receiving circuit (5 to 12 volts or so), the resulting grid-current flowing either through the tuning-inductance or through a special radio-choke. The grid-condenser serves to keep this comparatively high positive potential from the outer grid, the customary grid leak to the L.T. positive maintaining its mean potential slightly positive with respect to the negative end of the filament in practical "Negadyne" circuits.

An essential feature is the provision of a steady positive plate-potential to the outermost electrode, the "plate" of the four-electrode valve, by the same small H.T. battery which serves to maintain the inner-grid potential and mean grid-current; this battery is sometimes tapped for fine adjustment of both potentials. The plate current to this outer positive electrode is controlled by grid-potential and by the usual process of grid-condenser and grid leak rectification of H.F. oscillations on the outer grid.

Applications

It occurred to the writer, as soon as the details of this simple negative-resistance circuit were available, that, in addition to the various applications suggested for heterodyne wave-meters, coil calibrations, etc., there was a suggestion here for an effective single-valve reaction-circuit, if only this powerful direct reaction effect could be got under control.

Simple Reaction Control

Experiments with an ordinary Dutch type of four-electrode valve not only amply confirmed the original statements as to the power and immense wave-length range of this oscillating circuit, given suitable inductances and capacities, but soon showed that the necessary fine control over reaction effects and oscillation could be obtained in the simplest way possible, giving an effective and at the same time an absurdly simple and easily-tuned receiver, when directly connected to the usual outside aerial and earth. The resulting circuit, for which is suggested the expressive name of the "Negadyne"—to recall the fact that it is essentially a negative-resistance circuit—is indicated in Fig. 1, which also gives the essential constructional details to reproduce it.

This article throws interesting light on the little understood principles of 4-electrode valve working and gives practical circuits evolved in the course of the research.

Filament temperature

The fine control over reaction required in a practical receiving circuit is provided very simply by fine adjustment of the filament temperature. A really finely adjustable carbon compression type of filament resistance is indicated; or, if available, the so-called "vernier" type of filament resistance with a separate fine adjustment. An effective alternative is provided by putting two filament resistances in parallel, as, e.g., an ordinary wire resistance in parallel with a 30-ohm carbon-compression type, as indicated in Fig. 2. The first is then set at a value just below that which will permit self-oscillation, and fine adjustment is carried out on the second.

The H.T. battery

The small high-tension battery has, in practice, the same value for both inner-grid and outer plate-circuits, and for ordinary Dutch types of four-electrode valves obtainable here, and also for the Marconi-Osram D.E.7 type (developed for a very different type of circuit), a value of from 8 to 12 volts is required, though some results can be obtained at times with only 4 volts (one flash-lamp battery). Naturally the highest value which will give satisfactory results and good control will be chosen, so that a satisfactory output is obtainable.

Oscillation

The grid-condenser and grid leak are of usual values; the value of the latter is anything but critical, and it is entirely unnecessary to have it "variable." As there is, if anything, rather an embarrassingly powerful reaction effect available, there is no need to use loose-coupled circuits or small series aerial condensers merely to give free oscillation, except on the very short waves.

Plug-in coils

With ordinary plug-in coils (preferably those of reasonably low resistance on the shorter waves), ranging from a six-turn coil to No. 1,500, controlled oscillation and excellent sensitive reception resulted, on practical trial of the circuit; and powerful oscillation was obtained down in the audio-frequency region even with the telephones themselves shunted by a small capacity, or with an intervalve L.F. transformer winding.

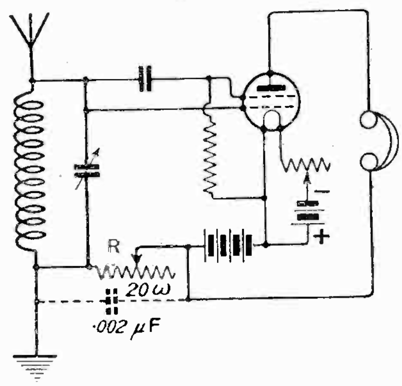


Fig. 3.—An alternative method of control.

Simplicity of control

The advantage of being able to use any size or form of tuning inductance, without a separate reaction coil, and with no other reaction control than a filament resistance, is fairly obvious.

An alternative method of control some may like to try is indicated in Fig. 3, where R is a non-inductive resistance variable up to 20 or 30 ohms—*i.e.*, another filament resistance of the carbon compression type.

Results

With the circuit of Fig. 1 it was an easy matter to go round as many of the main B.B.C. stations as one wished for, on the single valve and on a poor low 70-ft. test aerial in the country. Three or four of the B.B.C. relay stations were tuned in, and several of the Continental stations, Madrid in particular coming in with his usual strength. WGY, 380 metres (Schenectady),

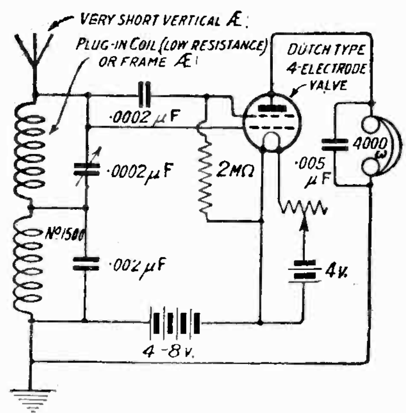


Fig. 4.—A single-control super-regenerative receiver.

was picked up on the low aerial before one a.m., and followed intermittently for over an hour on the high regular aerial (some 100 ft. long, single-wire). Religious addresses, interspersed with choir-singing by female voices, were quite distinct, as far as the swaying of the aerial in the wind, and consequent detuning effect allowed. Another fainter station on about 360 metres was also heard, but not identified. It may have been WRL, or any one of the many lower-powered stations on that wavelength. A 25-turn coil of No. 18 wire was used here, and 8 volts H.T. The valve was the ordinary Dutch pattern with $3\frac{1}{2}$ volts on the filament.

A Simple Super Arrangement

Fig. 4 gives working details of a single control super-regenerative receiver which is surely the simplest and easiest to operate of any! The adjustment of the relative intensity of H.F. and quenching-frequency oscillation is produced solely by adjustment of filament temperature, as the quenching oscillation starts first with cooler filament, and the only subsequent adjustment over quite a range is that of the tuning condenser. A very short aerial, or earth lead alone, should be used, unless a small frame-aerial be preferred. The possibilities for portable sets are obvious. Moderate loud-speaking was given at 35 miles from 2LO by this, with a 2-ft. square frame-aerial (of 10 turns spaced at $\frac{1}{4}$ in.), and with only 4 volts H.T. on the single 4-electrode valve.

JOTTINGS BY THE WAY

By Wireless Wayfarer

And Yet Again

BEFORE really getting down to business, I cannot refrain from giving you a piece of news about our old friend the loud-speaker joke. You may remember that I traced its history several months since, showing how it was first made by myself two years ago; how, after making a glorious round of our own weeklies and those on the Continent, it travelled across the Atlantic and won a prize quite recently in one of Uncle Sam's scientific papers. It still keeps cropping up, usually in its original form—Who was the first wireless enthusiast? Adam, because a loud-speaker

. . . Adam was first in the field . . .

was made from his spare parts—though sometimes there are slight variations of the theme. I really thought, though, until the other day, that its popularity was dying out, for I had seen it in very few publications for some weeks. Apparently, however, it has taken on a new lease of life, for only a few days since one of our own dailies gave it a prominent place as something bright and novel. The only thing that worries me is the thought of the scores of people who must have received payment for my joke. Really, it ought to have brought me in a steady income all this time if only I had had my rights. Life is full of little things of this kind.

The General's Hour

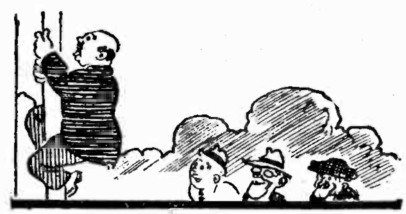
For some few weeks past General Blood Thunderby, the world-famous President of the Little Puddleton wireless club, has been going about as though he owned the place. He has treated the other members of the club with what I may call a condescending courtesy, letting it be plainly seen from his manner that he regarded them as beings on a plane altogether lower than his own. It has, in fact, been quite obvious that for some reason, until lately unknown to the rest of us, our warrior was growing daily more pleased with himself. Most of us hoped that it was merely a passing phase, though Scrabbits, the hatter, was heard to announce that he hoped that the General would go on getting prouder and prouder, since he had grown out of his hat three times in the past fortnight.

The Secret

We simply could not make out what was at the bottom of it all, until one day the secret leaked out. The *Little Puddleton Gazette* had decided to publish a series entitled "Visits to Famous Amateurs' Dens," and the General had been informed that he was to be the first person visited. This fact and the editor's promise to send copies of the first article to all the greater papers of the world so puffed up General Blood Thunderby that he became scarcely fit for ordinary mortals to talk to. As soon as we knew the secret we tried to take him down a peg or two, pointing out that each of us was on the *Gazette's* list for a visit. He assured us that he was perfectly aware of the fact, but there was all the difference between being the first, and merely one of the also rans. If we were to believe him, it was to be a case of General Blood Thunderby first and the rest nowhere.

No Soul

I should explain that Muggleson, the editor of the *Gazette*, is one of the two men in Little Puddleton who have no claims to fame as wireless experts. He has, of course, a receiving set, but this is merely the broadcast type, and he is content to listen night after night simply to 2LO. He maintains that what he wants is music worth listening to, and he sees no point in spending his evenings with Svsktziska or

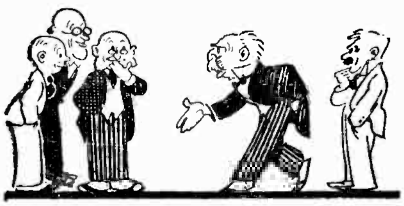


. . . In these days of "cat" burglary . . .

Przemzyl, since he cannot appreciate music that consists chiefly of spark signals, atmospherics and mush. This shows that the man has no soul. What real wireless man cares a tuppenny hang about the quality of the music so long as it comes from some vast distance? Anyhow, neither Muggleson nor Winkleby, who is his chief reporter, sub-editor, compositor, proof reader, sales manager and office boy, has what one might call a very deep knowledge of the only subject that is really worth knowing. I would like very much to have been present during the visit to the General's station, which was conducted by Winkleby. The General had, of course, written his own account of the wonders of his installation, but as this would have occupied seventeen pages of the *Gazette* the editor decided that it could hardly be used.

The Interview

We had all been waiting for Winkleby to make his little journey to Simla Villa. Last Thursday afternoon Gubbsworthy dashed into the club, crying,



. . . *We nudged each other and smiled* . . .

"He's gone." This was the signal for a little band of picked men to make its way stealthily into the grounds of Simla Villa. Poddleby, who, despite his tendency to adiposity, displayed an amount of agility which is rather suspicious in these days of "cat" burglary, swarmed up noiselessly on to the verandah.

Foul Work

Arrived there, he gently detached the lead-in from its terminal, and did the same with the earth wire. Then he replaced them, but not quite in their proper positions, for, when his dirty work was done, the lead-in was attached to the lower terminal and the earth lead to the upper. We then crouched in the bushes and awaited results. They were not long in coming. First the trumpet of a loud-speaker crashed through the window, and, though flung at random, smote Gubbsworthy shrewdly upon the ear. It was followed at intervals by such miscellaneous jettison as a high-tension battery, a lot of naughty words, two variable condensers, and Winkleby's hat. Finally the French window was flung open, and Winkleby was seen making a hasty retreat before the General's wrath by shinning over the verandah and dropping into the garden.

So He Said

The General did not appear at the club for a couple of days. When he did so he manfully strove to retain his former pose of superiority, but it was obviously an effort for him to do so. We asked how the "visit" had gone off. "Splendidly, my dear fellows, splendidly," roared the General. "It generally happens when somebody comes round to hear your set that it won't work half as well as it ought to. When young Winkleby came round to see me I was able to give him a real treat. Seldom has my apparatus been so wonderfully efficient. Any station that he liked to name I brought in in a moment at full loud-speaker strength. You will hardly believe it when I tell you that I got WGY at five o'clock in the afternoon." We didn't.

Discretion

We nudged each other; we smiled; we exchanged meaning glances. The General became livid with fury, and, as there were lots of heavy bits and pieces lying about on the club wireless table, we discovered

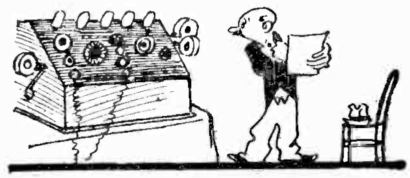
pressing business elsewhere, thinking discretion the better part of valour.

The Blow Falls

And yesterday, my friends, No. 1 of the "famous stations" series appeared in the *Little Puddleton Gazette*. I cannot give it you in full because it occupied several columns. These are the general lines that it took: "Little Puddleton has always stood in the forefront as regards wireless. It has ever been the endeavour of the members of its famous club to never in any circumstances, or however discouraged by reverses, let the grass grow under their feet.

The Club Motto

The motto of the club has always been Cicero's noble and inspiring word, *Excelsior*. . . As President of the club, General Blood Thunderby owns a set as fine, if not finer, as any in the world. . . . The General's receiver is a "five-lamper," in which grids are used for the purpose of distance amplification. The filaments of the lamps are lit up by a 100-volt 6-ampere hour battery, whilst the high-tension unit supplies a steady



. . . *There are lots of knobs* . . .

current of 10 millikilowatts to the aerial tuning rheostat. Perfect purity of tone is obtained on the no-frequency side of the set by the use of resistance-mendacity coupling. . . . There are lots of knobs. . . . Vernier condensers are used for regulating the filament current. . . . Any station can be brought in at will. During my visit I heard the operator at KDKA speaking fluent French, whilst amongst the German stations WBZ and 5WA were perhaps the best. . . ." This, I think, will take some living down. General Blood Thunderby has gone for a holiday on the Riviera.

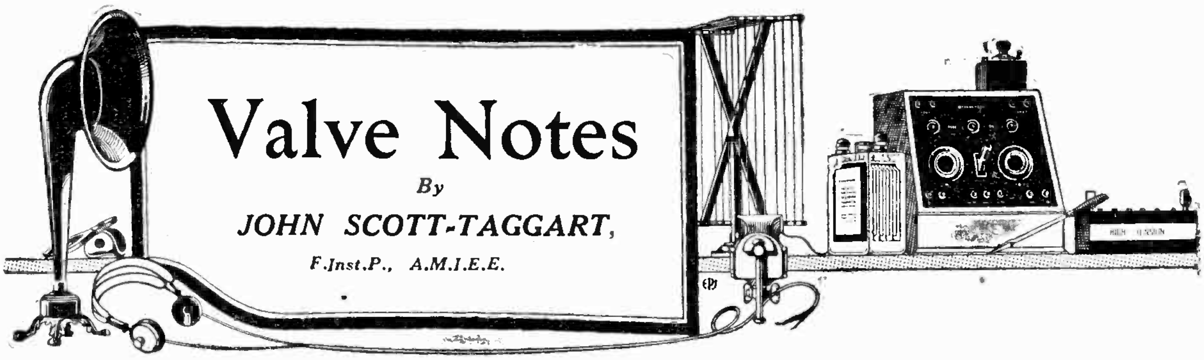
WIRELESS WAYFARER.

The R.S.G.B.

Sir OLIVER LODGE, D.Sc., LL.D., F.R.S., who has accepted the Presidency of the R.S.G.B., for 1925, will deliver an Address before the Society at a meeting to be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m., on Wednesday, the 21st, January, 1925. Tea will be served at 5.30 p.m. The title of the address will be "Matter and Radiation."

* * *

An Informal Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m. on Wednesday, the 14th January, 1925, when Mr. Stanley Ward will give a talk entitled "Some notes on Short Wave Reception."



Valve Notes

By

JOHN SCOTT-TAGGART,
F.Inst.P., A.M.I.E.E.

Inverse Duplex Circuits

SOONER or later the average experimenter will want to try to use more than one valve in a dual capacity. He will, in fact, want a double dual or treble dual circuit, and he will naturally want to know the best way of getting the effect he desires.

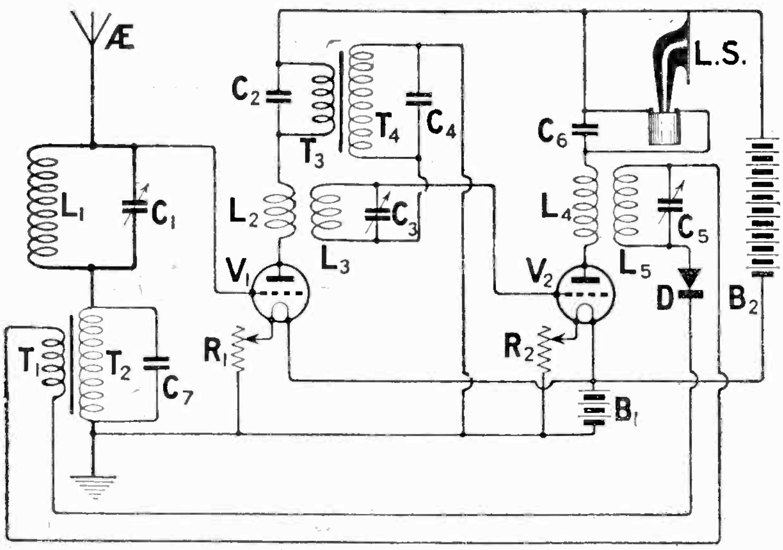


Fig. 1.—A circuit in which the two valves are being used as simultaneous high- and low-frequency amplifiers.

Let us take, first of all, the case of two valves being used as simultaneous high- and low-frequency amplifiers. It will simplify matters if we use a crystal detector for rectifying, and a suitable circuit is illustrated in Fig. 1.

An Example

In this arrangement I have shown the first valve coupled to the next by means of an air-core transformer L2 L3, the grid circuit of the second valve V2 being tuned. In the anode circuit of this valve we have the primary L4 of another similar transformer L4 L5. The secondary L5 is shunted by a variable condenser C5, and the crystal detector D and the primary T1 of the step-up iron-core transformer T1 T2 are shunted across the oscillatory circuit L5 C5. It will be seen from the diagram that the high-frequency oscillations will be amplified by both valves before being applied to the crystal detector. The resultant low-frequency currents are now fed into the primary of the transformer T1 T2, and thus into the grid circuit of the first valve by the now well-known method of connecting the transformer secondary in the aerial circuit. The amplified low-frequency currents in the anode circuit of the first valve pass through the primary T3 of a second step-up iron-core transformer T3 T4, a fixed condenser C2 of, say, .001 μF or .002 μF capacity being shunted across the primary winding to by-pass the H.F. currents. The secondary T4 is connected in the grid circuit of the second valve, the position of this secondary being such that it is at the earth potential side of the circuit L3 C3.

The second valve now acts as the second stage of low-frequency amplification, and the final low-frequency currents pass through the loud-speaker L.S., which is shunted by a fixed condenser C6, which may have a value of .002 μF.

Low-frequency Oscillation

I would like to raise a general objection against circuits of this kind, unless they are very properly designed and operated. The danger of low-frequency oscillation is so great that even when stabilising devices are used, trouble may occur, and in any case the use of these stabilising devices often means that, instead of two stages of high-frequency amplification, we are only getting the effect of one, thus nullifying the whole effect of using both valves as dual amplifiers.

The Second Valve

There is one objection which may be raised to the circuit of Fig. 1, and that is that the second valve is largely overworked, compared with the first valve. It will be seen that the E.M.F.'s applied to the grid of the second valve are those produced by the incoming signals, and those of the low-frequency currents produced by the rectification of these incoming high-frequency currents. In both cases the currents have already been amplified before being fed into the grid circuit of the second valve; the high-frequency currents have been amplified by the first valve and the low-frequency currents also have been amplified by the same valve. The first valve, on the other hand, has a comparatively light task, because

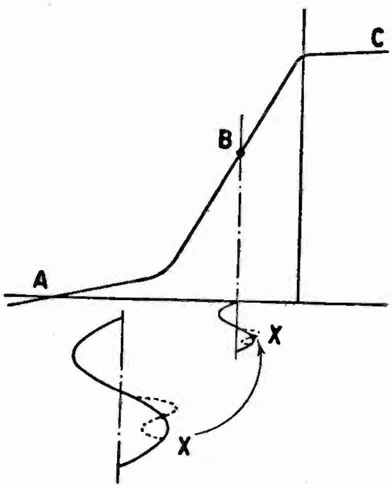


Fig. 2.—Showing imposition of the H.F. component on the L.F. current.

the high-frequency currents applied to the grid circuit are simply those due to the incoming signals, and are consequently not nearly as strong as those applied to the grid circuit of the second valve. Also, the low-frequency currents fed into the grid circuit of the first valve are those produced directly from the crystal circuit, and are consequently much weaker than the corresponding low-frequency currents applied to the second grid after amplification.

Graphical Explanation

An examination of Fig. 2 will show what may happen, due to overloading a dual amplifying valve. The curve ABC shows the anode current characteristic curve which shows, graphically, what happens to the anode current at different grid voltages. The operating point should be near B, half-way along the steep, straight portion of the characteristic curve, and this curve should lie to the left of the vertical line, or ordinate, through zero grid volts, to avoid that fatal distortion effect which is responsible for so much buzzing.

Below the curve will be seen a complete cycle of low-frequency alternating current, and a point X on the positive half-cycle. Obviously, when signals are being received, the high-frequency oscillations in the grid circuit will vary the grid potential above and below a normal value, this normal value not being the steady grid potential (which should always be negative) but the particular potential given to the grid by the low-frequency currents. Consequently, at all points on the low-frequency cycle high-frequency oscillations will be super-imposed, and the maximum voltage on the grid is obtained when the positive half-cycle of the high-frequency current adds itself to the positive half-cycle of the low-frequency current. If, for example, the positive half-cycle of high-frequency current is 1 volt, and the low-frequency positive half-cycle is 2 volts, then the maximum voltage applied to the grid of the first valve will be 3 volts.

Grid Potential

With a suitable valve this will not give very much trouble, because the straight portion of the characteristic curve will be long enough, but if the valve is unsuitable, or the normal operating point on the curve is badly chosen, distortion may occur through the grid potential rising or falling to such values that the representative point on the curve goes round one of the bends. This will cause loss of signal strength, distortion and buzzing of the reflex circuit.

If we suppose that an amplification of three times is obtained both for the high- and the low-frequency currents, we will see that the grid of the second valve in Fig. 1 will be given a maximum positive half-cycle of 6 volts in the case of the low-frequency currents and 3 volts in the case of the high-frequency currents. This means that the grid potential of the second valve is varied from its normal value to 9 volts more positive, and then 9 volts more negative. This means a sweep of 18 volts on the grid of the second valve, which is three times that on the grid of the first valve.

An entirely different valve operating under different conditions would be required to accommodate this big increase in grid voltage variation. In ordinary actual practice the voltages experienced are very much less than those stated, and, provided the incoming signals were not too strong, the Fig. 1 arrangement would give quite good results.

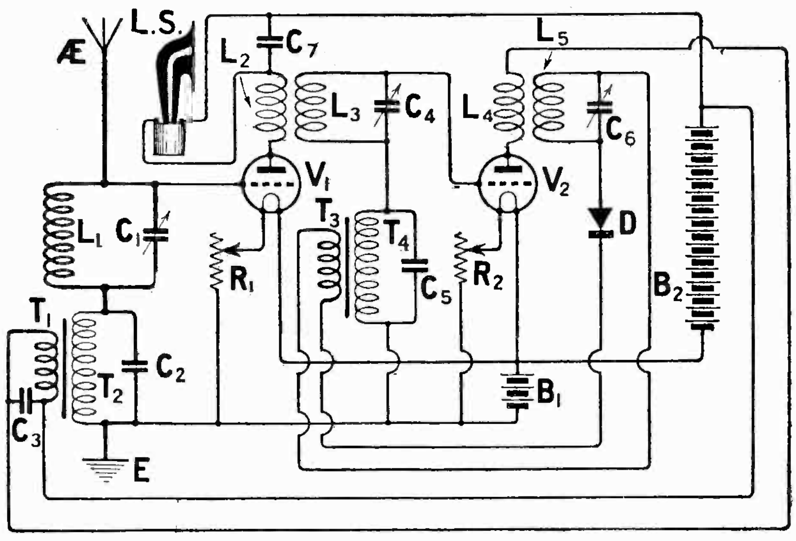


Fig. 3.—A modification of the Grimes Inverse Duplex circuit.

Grimes Inverse Duplex

It is, however, possible to experience considerable trouble with this type of circuit, and consequently the arrangement of Fig. 3 is to be preferred. This circuit is generally called the Grimes Inverse Duplex circuit, and the principle of the arrangement is that instead of one valve being overworked, both valves are worked to more or less the same extent.

(*Continued on page* 450.)

Converting your Set to T.A.T.

How to utilise the latest development in High-Frequency Amplification.

By R. W. HALLOWS, M.A., Staff Editor.

A VERY important contribution to the study of the problems of high-frequency amplification was made recently by Mr. John Scott-Taggart in his new T.A.T. system, details of which appeared in November *Modern Wireless*. The name is an abbreviation of "tuned-aperiodic-tuned," for the scheme consists essentially in the alternation of tuned and aperiodic high-frequency couplings. It is well known that a valve in a high-frequency circuit in which there is little damping will oscillate readily if both its plate and its grid are tuned sharply to resonance. In the T.A.T. method no high-frequency amplifying valve has both its plate and its grid sharply tuned. If the grid is tuned, the plate is untuned, and if the grid is untuned, the plate is tuned.

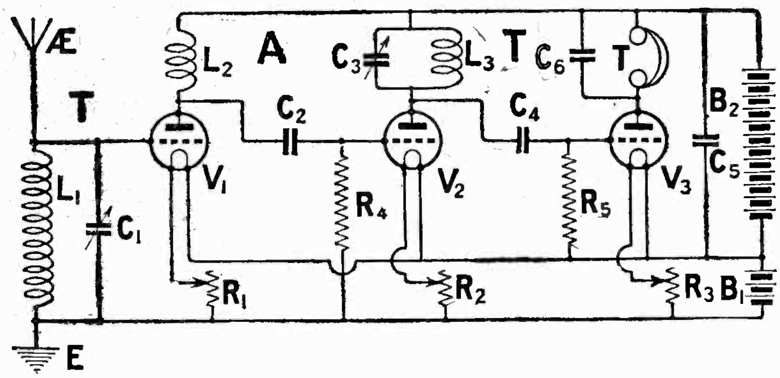


Fig. 1.—A three valve T.A.T. circuit using tuned anode coupling.

Amplification

Naturally, the degree of amplification obtained by two high-frequency valves in such a circuit as that shown in Fig. 1 is not so great as it would be if the plate of V1 and the grid of V2 could be tuned. But actually the loss is not nearly so great as it might at first sight appear. If, instead of the choke coil between the plate of V1 and H.T. plus, we wire up a circuit consisting of an inductance of appropriate size with a condenser in parallel, we shall find that it is impossible to hold the set down unless considerable damping is introduced by means of a potentiometer. Now damping, besides reducing signal strength, has also a disastrous effect upon selectivity.

Now using T.A.T., it is quite possible to employ four or even six stages of high-frequency amplification without the set becoming too much of a handful, and though we do not get the full amount of amplification theoretically possible from each valve, we do obtain from a number combined in this way a degree of amplification very difficult to obtain in any other way.

Converting Existing Sets

The present article is written with a view to suggesting to those who already possess sets with two tuned stages of high-frequency amplification a very simple way of converting them at will to T.A.T. It should be noted that the method is applicable equally to sets with tuned-anode coupling and to those employing high-frequency transformers. The very simplest way of employing T.A.T., though not by any means the most stable—this, by the way, is a great aid to searching with two tuned H.F. stages—is to use ordinary anode coils or transformers and to set the variable condenser of the first anode at zero. Provided that the "natural wavelength" of the inductance or the transformer primary is some way from that to which the set is to be tuned, it will be found quite an easy matter to pick up a desired signal (provided that it is fairly strong) without the occurrence of oscillation.

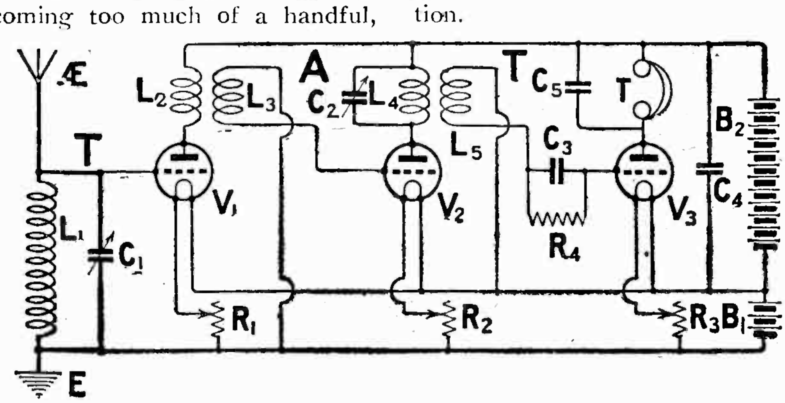


Fig. 2.—A T.A.T. circuit in which H.F. transformer coupling is employed.

To obtain the full stability given by the T.A.T. method, the coupling between V1 and V2 should be as nearly aperiodic as possible; and the best way of ensuring this, if reactance capacity coupling is used, is to employ a choke coil wound with resistance wire. Where transformer coupling is fitted, the tuned transformer should be replaced with one wound to a very high resistance. If the existing tuning condenser for the first anode has a small minimum capacity, no harm will be done by leaving it connected up and setting it at zero. If, on the other hand, it is of doubtful quality, it would be advisable to provide some simple means of cutting it out altogether. This can be done, as shown in Fig. 4, by means of a switch or of a swing hook fixed to one terminal and engaging when desired with a second.

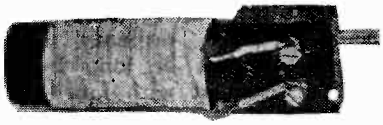


Fig. 3.—A photograph of a choke coil made on the lines suggested.

The conversion of tuned-anode sets, either temporarily or permanently, is a very simple matter. All that one has to do is to make up a resistance wound choke coil with the number of turns suitable for the wavelength which it is desired to receive. Unlike the inductance wound with copper wire, that whose turns are of resistance wire has no well-marked natural wavelength; it responds almost equally well to a wide band of frequencies. By using fine Eureka wire it is not difficult to make a coil which will give almost the same efficiency on all normal wavelengths used by broadcasting stations; that is, between 300 and 500 metres.

Constructional Details

In making both inductances and transformers that are aperiodic there is a convenient rule which should be noted. Using a former 1 in. in diameter, the number of turns required either for a choke coil or for the primary and secondary of an aperiodic transformer is approximately one per metre. For broadcasting the optimum wavelength should be taken as 400, which is roughly midway between the extremes used, in this country at any rate. When speaking of broadcasting, by the way, I did not take into account the long-wave stations, such as 5XX or Radio Paris, or the very short ones, such as KDKA on 68 metres. I refer merely to the ordinary band of wavelengths lying between 300 and 500 metres.

Choke Coil

The Fig. 3 photograph shows a very simply-constructed resistance wound choke coil. The former is a piece of ebonite rod 1 in. in diameter and 4 in. in length. In the centre of each end a 4B.A. tapped hole is made and a short piece of studding is inserted to act as a centre for winding purposes. Close to one end two 4B.A. screws are inserted, as seen in Fig. 5, each being provided with a tag which can be made of thin sheet metal or from a piece of wire. The wire used should be No. 40 double silk-covered Eureka. The end of this must be soldered to the "in" tag. If you are not familiar with wire of this fineness, the idea when you first handle it of soldering it to anything may come as rather a shock. Actually it is a much simpler job than might be imagined. Put a tiny spot of flux on the tag, and take care that the point of the iron is well tinned before soldering operations are begun. Get the bit quite hot, and you will find

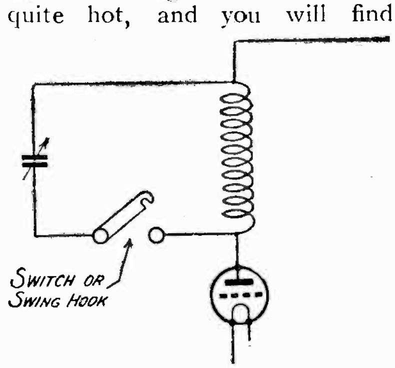


Fig. 4.—A suggested arrangement for cutting out the variable condenser in a tuned anode circuit.

that the soldering of the wire to the tags is accomplished without any great difficulty. Now bring the wire across to the place at which the windings are to begin, running on two or three turns. When these are in place secure them by means of a small dab of sealing wax, as shown in Fig. 5. Then proceed with the winding. There is no need to count the turns for the exact number is not vastly important. No. 40 double silk-covered wire makes 142 turns to the inch. If you deduct 10 per cent. from this number to allow for the fact that your turns will probably not lie so closely as those put on by a professional, you have in round figures 130 to the inch. For 400 turns, therefore, the length of the windings should be approximately 3.1 inches.

Insulation

A transformer can be made in exactly the same way, except that four screws with tags are required instead of two. Between the primary and secondary

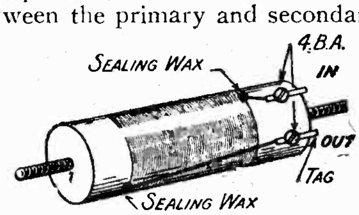


Fig. 5.—Showing method of securing the wire in the choke coil.

windings there should be a layer either of Empire cloth or of waxed paper. The choke coil is fitted to an ordinary plug and socket mounting by the simple process of making a 4 B.A. tapped hole in the top of the latter and screwing into this the piece of studding nearest to the tagged screws. Short lengths of wire are then soldered to the tags and taken to the screw contacts of the mounting.

The Finished Winding

The second piece of studding is, of course, removed when winding is finished. The best way of mounting the transformer is to use a valve leg template and to screw four valve pins into one end. The connections to these pins must be the same as those of the tuned transformers which have been in use on the set.

Resistance Wire

Actually the choke coil shown in the photograph was made from a broken-down Marconi aperiodic transformer. These components, which are occasionally obtainable from dealers in surplus goods, are wound to an optimum wavelength of 600 metres. They cannot, therefore, be used as transformers or as choke coils for broadcast reception as they stand. They are wound with wire very much finer than that referred to above—I believe it is either No. 47 or No. 50 Eureka; anyhow, it is considerably finer than a human hair. To convert one of these transformers to a T.A.T. choke, proceed in the following way:

H.F. Transformers

Strip off the primary winding first of all, then remove the insulation covering the secondary. The secondary winding has a length of 2.2 inches, and, as this gives an optimum wavelength of 600 metres, about one-third of it must be removed to make the coil suitable for broadcast reception. Strip off the required number of turns, and then make fast with sealing wax, as described previously. Remove the two screws at the top of the former. You will probably find that, either in stripping off the primary or in reducing the secondary to the required size, you have broken the fine wire running to one of the remaining pair of screws. Solder this on again—the job is much simpler than it sounds—and bring the top end of the windings down to the other screw contact. There

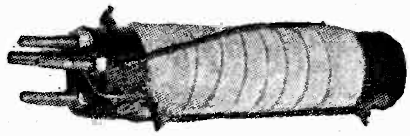


Fig. 6.—Photograph of a transformer made by the author.

is a threaded hole in either end of the former into which a 4 B.A. tap can be run easily. Make a similar hole in the plug and socket mounting, and fix firmly to it by means of a short piece of studding. Connect up the two screw contacts with those of the mounting, and the job is finished.

Protection

Both choke coils and transformers wound with fine resistance wire should be given a protective coating of sticking plaster. This is simply wound on puttee-wise, and once it is in place there is very little chance of injury to the windings or to their contacts with the tags.

By means of these aperiodic chokes and transformers any existing set with two separately tuned stages of high-frequency amplification can be converted at will to T.A.T. I venture to prophesy that those who try two stages of T.A.T. in place of two ordinary H.F. stages will not be long before they experiment with four!

□ □ □

Radio Notes and News

A Rand wireless amateur has established communication with America, says a Johannesburg Exchange telegram. This is the first known time that African signals have been received in America.

* * *

M. Leon Deloy, the noted French radio amateur of F8AB, reports that he has tried receiving messages from American amateurs with a loop.

"We have made several attempts to receive American amateurs on a loop 30 metres by 10. Reception is a little less strong (with our ordinary receiver—a high frequency valve and detector) than on an aerial.

"The reception of American amateurs on waves of 75 to 80 metres and of KDKA is remarkably good. At 11 o'clock at night on December 11 we received with one high-frequency valve, detector and one low-frequency valve both amateurs and Pittsburgh, and with a loud speaker we heard the signals throughout the whole house."

M. Leon Deloy, reporting on his recent experiments, stated:—

"Continuing the study of the daylight experiments with very short wavelengths, we have succeeded in making ourselves heard at eight o'clock in the evening, then at 7 and finally at 6 o'clock, Greenwich time, by our correspondent at Hartford, Connecticut, U.S.A. These results were obtained on waves of 35 and 48 metres. The power used was in the neighbourhood of 500 watts. The intensity of the reception in America was R2 at 6 o'clock on 35 metres; R5 on 35 metres and R6 on 48 metres at 7 o'clock; and R7 on 48 metres at 8 o'clock. Reception was effected on two valves. We have every reason to believe that until this time not a single amateur station in Europe had been received in America during the day; or at 6 o'clock, Greenwich time, which is about 1 p.m. for our correspondent. Our signals covered about seven-tenths of the distance from Nice to Hartford, or about 4,500 kilometres in full day. These results, its seems to us, are due in a great measure to the employment of waves much shorter than are usually used."

* * *

One of the best known Italian radio amateurs has a model transmitting and receiving set in his home at Bologna, known as station ACD. The equipment is entirely home made, and it is the first Italian station to communicate with the United States. Mr. Adriano Ducati, the amateur, is now travelling in Argentina to study radio conditions there and to prepare exchanges of messages with Argentine amateurs.

* * *

According to the *Daily Chronicle,* the London office of a Dutch valve manufacturing firm has received news that on January 8 the station at Hilversum, Holland, will begin transmission as a high-power station. Famous orchestras and artists have been engaged to perform daily at Hilversum, which will work on a wavelength of 1,050 metres, and will employ the call-sign HDO. The programmes are to be framed to interest British listeners.

Random Technicalities

By PERCY W. HARRIS, Assistant Editor.

Some Notes of general interest to the Home Constructor and Experimenter.

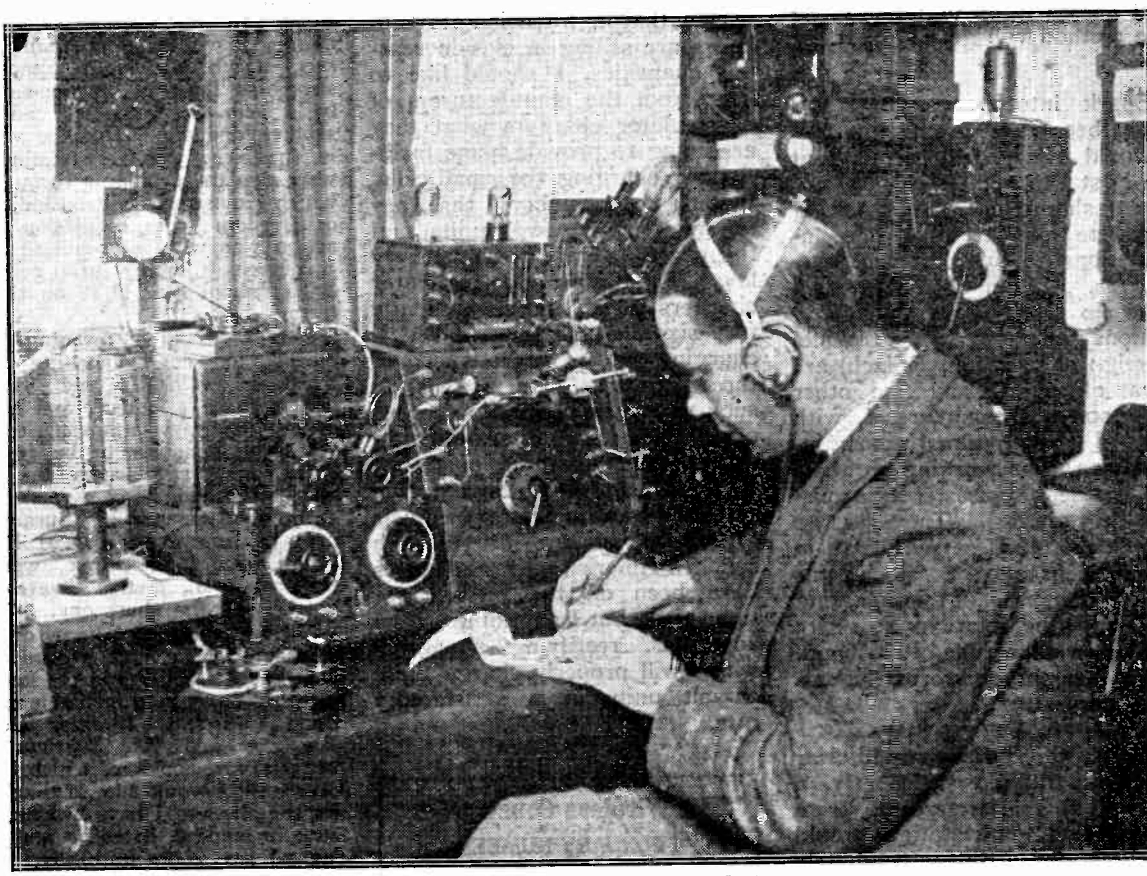
I SUPPOSE the gales of the last few weeks have done more damage to wireless aerials than any since broadcasting in this country began. Many masts which proudly reared themselves above the houses a few weeks ago are now prostrate in the garden (in many cases in the next garden too), while gimcrack affairs which have been the source of worry to many fond parents for months past still stand up as perkily as ever.

* * *

I have been led to wonder whether this is due to the fact that many of the amateurish-looking masts are very lightly stayed, if they are stayed at all, while the more elaborate affairs have guy ropes tight all the way round and secured at several points. If any single guy rope should fail, the whole structure collapses, as the tension on the remaining guy ropes "pulls it off its perch." An unstayed mast, if properly secured at its base, will sway in the wind by reason of its flexibility, and will take up a strain in the way a stayed mast often cannot do. My own fifty-footer at the bottom of the garden is unstayed and is still quite secure, although during the height of the gale I have watched the top of it bend about in an alarming fashion.

* * *

Speaking of masts reminds me that some twenty-five years ago, when the Poldhu station was first erected, the aerial system was supported upon a ring of masts with a series of interlacing stays which had, if nothing else, the merit of ingenuity. Unfortunately, the designer of this system overlooked the fact that the breaking of any one stay



The well-known amateur Mr. E. J. Simmonds, of Gerrard's Cross, who was the first to establish two-way communication with Australia, is seen here with some of his apparatus.

might upset the balance, and, as a matter of fact, it had not been standing very long before a fierce gale blowing across The Lizard broke one of the mast stays, whereupon the whole structure fell to the ground with a loud crash. After this the wooden lattice towers were erected, and these stood for many years until just before the war, when they were supplanted by steel masts of a more modern type.

* * *

Whenever Mr. Shaughnessy has been tackled on the matter, he has always stated that the Post Office were doing their best to eliminate harmonics and mush from their arc stations. So far as harmonics are concerned, these have been very considerably reduced, but the mush is as bad as ever, and I am sometimes inclined to think, worse. The serious student, who would listen to continental broadcasting, is driven nearly frantic each evening by the filthy mush from Northolt and Leafield, a form of interference which is so broad that no wavetrap or other selective method will get rid of it.

* * *

Spark interference, too, has lately been very prominent, and I would like to feel certain that the Post Office is really watching ship to shore working, and taking adequate steps to keep these installations on their proper wavelengths. As an old operator, I have no difficulty in identifying stations giving rise to the trouble. Foreign ships (often French) are great offenders, and the other afternoon a French vessel, with quite a sharply-tuned spark installation, was working right on top of the Manchester transmission (375 metres). There was no question of lack of selectivity in my own instrument, as it was quite capable of eliminating properly tuned stations 10 or 15 metres on either side of the band, even when the interfering signals were very strong.

* * *

If only the stations would clear up their traffic expeditiously, a lot of this interference from badly-tuned spark stations would be eliminated. But unfortunately many new operators seem to think that it is necessary to call a dozen times and to send their own call another dozen times, even when the station with which they are communicating is practically in sight. I have heard a ship call a coast station continuously for about a minute when the weakest call would have done all that was required. Again a number of vessels have taken to the habit of repeating their messages a second time without waiting to see whether the first transmission had succeeded. It is over a dozen years since I had charge of a ship board installation, but my hand still itches to get hold of the key knob, and tell these careless "ops" what I think of them.

* * *

The British coastal stations are admirably handled. The North Foreland station, "one of the busiest in the world," shows a pretty economy in Morse signalling when handling its traffic. The French stations, as ever, seem all over the place, both in wavelength and operating.

* * *

Now that high-tension accumulators are selling in ever-increasing quantities, I should like to hear from the manufacturers of accumulator chargers what they are doing to provide home facilities for charging the small cells. It must be remembered that they are made up in 24-volt units, and the charging rate must be very low. The ordinary accumulator chargers which serve excellently for six-volt batteries, with a charging rate of perhaps two or three amperes, are useless in such cases, unless we dissemble our batteries and charge them in a number of parallel banks so that the charging current will split up into a number of channels giving only a low rate to each cell. In America such appliances have been on the market for some time, but I am not aware of any A.C. rectifying apparatus which will properly charge these 24-volt units at a satisfactory rate.

* * *

APPRECIATION OF THE W1 RECEIVER.

SIR,—After trying many circuits 2-, 3- and 4-valve reflex and otherwise, I rewired my set finally as a W1, 3-valve set (Radio Press Panel Card No. 1), varying the original layout by doing away with the 1 and 2-valve terminals, using it as a 3-valve set only. I tune only by means of a Sterling Baby Loud-speaker; I also have separate H.T. leads to each valve.

With 30 volts H.T. on the detector, which is a repaired Cossor valve, and the filaments turned only just on, all B.B.C. main stations, including Belfast, and many relay stations are heard easily all over the house, while all the German broadcasting stations, Brussels, Copenhagen, Vienna and Madrid are almost all equally loud. French stations, both high and low wavelengths from Petit Parisien to Eiffel Tower, are, upon occasion, almost as loud, and quite as clear as Chelmsford and London. C.A.T. is used on wavelengths up to about 1,000 metres.

On Tuesday evening (December 16) an unlogged German station came in on approximately 280 metres much stronger than Brussels, which is usually almost as strong as London. It appeared to be a very tragic sketch, and the sobbing and sighing of the woman in the piece was very distinct, as were also the sybillants throughout, which seems to be a good indication of freedom from oscillation. Reaction was with a 75-coil at about 55 degrees from the aerial coil, and I had about 45*v*. H.T. on the detector.

Later in the evening, and during the early morning hours I received WGY and KDKA, very faintly, it is true, and accompanied by heavy atmospherics, but still loud enough to be readable (X's permitting) across the room and easily readable at 2 yards away from loud-speaker. Surely this must be a record for a D. 2L.F. set! These results, of course, were on the 300/400 metres wavelength bands, not the short one.

Having learnt all I know of wireless—and I have made a good round dozen successful sets in the last few months—from your valuable magazines (*Wireless Weekly, Modern Wireless,* and *The Wireless Constructor*) and books, of which I have nearly all, I would like to thank you for the pleasure I have had and still have in reading, listening and making.—I am, yours faithfully,

PERCY VARLEY.

Kingston-on-Thames.

Supersonic Heterodyne Reception in Theory and Practice

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

Operating the 5-valve Supersonic Heterodyne Receiver.

THE builder of a supersonic heterodyne receiver need have no fears of trouble in tuning, particularly if the set is of such a simple design as that which was described in my article appearing in the December 24th issue of *Wireless Weekly*. Full constructional details were given in that issue of a 5-valve set which will give loud-speaker results on several stations, particularly if a little assistance is given from an ordinary aerial.

Few Controls

There are three controls only in the set, and one of these is permanently adjusted to a certain value. Looking at Fig. 2 on page 368 of *Wireless Weekly*, December 24, 1924, it will be seen that there are three condenser knobs, C1, C3 and C5. The first knob, C1, tunes the frame aerial circuit, while C3 controls the local oscillator. The variable condenser C5 tunes the long-wave input side of the second valve. The reason why this condenser (C5) is variable is that it is essential that the tuning of the circuit L6 C5 in Fig. 7 is similar to that of the circuit L8 C7. Unfortunately, these long-wave transformers are not usually very well matched, and, moreover, the fixed condensers, in any case, would not be sufficiently matched to be serviceable. In American designs they appear to have used fixed condensers across their transformers, but in actual practice this leads to serious inefficiency with the ordinary components available, owing to one of the circuits being out of tune with the other. The remedy is either to make your own transformers and take off, or put on, turns so that a fixed condenser across it will tune to the desired wavelength, or to provide a variable condenser across one of the transformer secondaries.

This is what I have done, so that the condenser C5 in Fig. 7 is merely for the purpose of setting the tuning of the circuit L6 C5 so as to be equal to that of L8 C7. The wavelength to which these circuits are tuned is probably about 10,000 metres on this particular set.

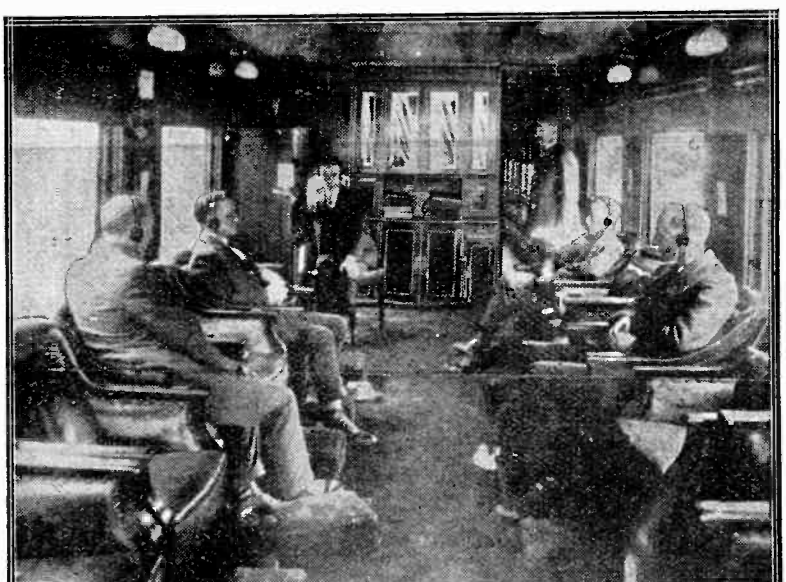
Operation

When first tuning-in the receiver, the condenser C5—i.e., the right-hand condenser in Fig. 2—may be set to what you would expect to be .0005 μF, the condenser itself having a value of .001 μF.

As regards the oscillator, no trouble at all should be experienced with this, provided all contacts are properly made. There is no trouble about the possibility of reverse reaction, or anything of that sort. It is, of course, vital to see that all the contacts of the valves and coils are correctly made. While speaking about this question of contact, it is important to point out that the low-capacity type of valve-holder and transformer holder, such as those used in this set (H.T.C.) is liable to break contact, and this may be due either to the little metal strips which press against the valve pins not pressing hard enough, or having a dirty surface, or, what is perhaps more difficult to trace, the little tongues of metal may be loose and there is no proper contact between them and the points to which connection is made on the valve-holder ring. We have had several faults of this kind in our test department in connection with other sets, and I have experienced the same trouble myself.

Contacts

Provided care is taken to be on the look-out for bad contacts of this kind, the holders are otherwise of excellent design. It is, however, necessary to see that these little metal strips press firmly on the valve pins or transformer pins, and also to see that there is good contact between



Our photograph shows passengers on one of the C.N.R. expresses listening to the Company's broadcasting station, CNRA.

them and the points to which connections are made.

It is as well to see that the little metal strips have not been pressed in through the constant insertion of valves. It is an easy matter to pull them out a little if there is fear of bad contact.

Coils

Coils should also fit very securely into their coil-holders.

Operating the set for the first time, I inserted a No. 25 coil in L2 (Fig. 7), while in L3 and L4 I connected two 75 coils. All three coils were of Tangent manufacture, and with this type of coil it was found that the condenser C3 would cover the whole broadcast waveband (300 to 500 metres). If with other coils the wavelength range is different, it is a convenient matter to substitute two other coils, but both should be of the same size. This is not absolutely vital, but the rule is a good one to follow in the case of a beginner.

It will be seen from Fig. 7 that the oscillations are induced from the coil L3 into the coil L2, the coupling being fixed. The degree of coupling, however, can be varied by altering the size of the coil L2. For example, if it is desired to obtain only loose coupling between the receiver circuit and the oscillator circuit, a small coil could be inserted in L2. I found, as a matter of fact, that a No. 25 coil was too big, although perfectly good results were obtained with it. I consequently inserted a home-made coil of 15 turns, and also tried 8 turns.

The best results were obtained with 15 turns for the coil L2. It is a simple matter to take turns off a No. 25 existing make of coil, or the coil manufacturers may be asked to supply 15-turn coils.

Method of Tuning

There are one or two scientific methods of tuning which could be adopted, but which would take some time. If a wavemeter is available, or there is a nearby broadcasting station, the transformer L5 L6 (the left-hand one in Fig. 2) may be pulled out and telephone receivers may have their two contacts placed in the top and bottom holes of the transformer holder, so that the telephones are now in the anode circuit of the first valve. Under these conditions the aerial condenser may now be tuned until the loudest signals are obtained.

Telephones

The telephones may now be disconnected from the anode circuit of the first valve and the long-wave transformer inserted. The oscillator C3 is now adjusted until signals are heard in the telephones, which should be connected across the proper terminals. If nothing whatever is heard try a different adjustment of the condenser C5. This should be done systematically, unless you hit on a good adjustment straight away. The systematic way of doing it would be to try a different adjustment of C5 every few degrees and turn the condenser knob C3 backwards and forwards to see if signals are heard. If nothing is heard move the condenser dial C5 round a few degrees and try again with C3. This procedure may be followed until signals are heard. The moment signals are received adjust the condenser C5 until the loudest results are obtained. It should be possible to tune out the incoming signal by means of C5 alone, a certain point on the dial giving the maximum results. Unless you obtain this effect you are not getting the supersonic-heterodyne effect at all, i.e., if the tuning on C5 is absolutely flat and signals come in about the same strength all the way round with, perhaps, a little louder results when the condenser is at zero, then the receiver is not working as it should, and the fault is very likely in the oscillator, which is probably not oscillating.

Variable Condensers

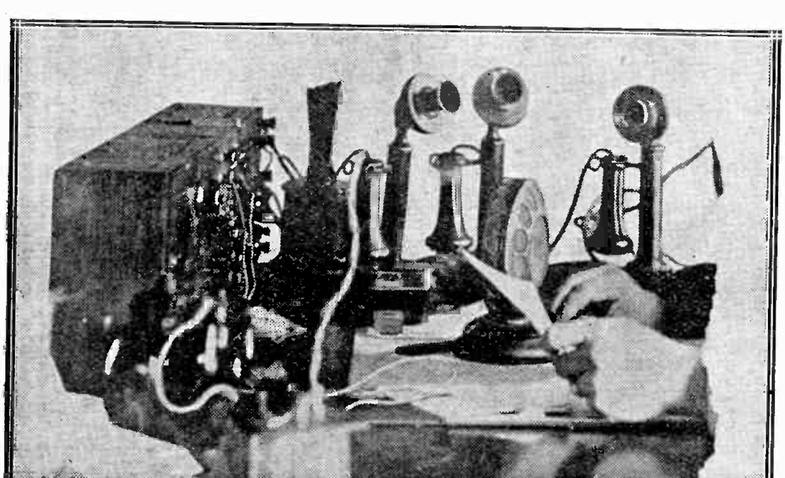
Assuming, however, that the oscillator is working all right and that maximum signal strength is obtained on a certain adjustment of C5, then you can try altering the tuning of the aerial condenser C1 and the oscillator C3.

You may experience some little difficulty when first tuning in the receiver, but after ten minutes there should be no difficulty at all. The golden rule is to adjust C5 to the best position the moment you receive signals. You have then only two controls, and these should be varied together: that is to say, if you desired to receive a station on a longer wavelength, the aerial condenser is turned to a higher value, and the oscillator condenser is likewise tuned to a longer wavelength.

Interference

It will be found that there are two points on the oscillator condenser dial at which you will receive signals, and that in between these two points (exactly halfway) you may hear a "plonck." This plonck is due to the coupling between L2 and L3, and the worse the plonck the worse the interference you may be causing to neighbours.

With a frame aerial the amount of this interference is not very much, and when signals are actually being received there is no interference at all, because the local oscillations are of a fre-



Part of the apparatus at CNRA showing the microphone.

quency widely different to that of the incoming signals. When searching, however, interference is quite likely, and great care must be exercised. To keep the plonck down to reasonable limits, or to cut it out altogether, which, of course, is the best thing to do, a smaller coil L2 is employed.

Oscillator Adjustments

It will be found, for example, that a No. 25 coil will give a good loud plonck in between the two points at which signals are received. Just about the plonck position you may hear what sounds like signals, but which is really due to you heterodyning the carrier wave and the incoming signals at an audible frequency, this being passed on through the receiver and giving weak signals. These, however, are horribly distorted and weak, and you should immediately come off that adjustment and work on one of the two adjustments of the oscillator which gives good, clear, loud signals.

Aerial Tuning

The aerial tuning is the most likely to be deceptive, because under certain conditions you may get louder signals when the aerial is out of tune than when it is in tune. If you have followed the theoretical articles I have written on the subject in preceding issues of *Wireless Weekly* you will appreciate why this is so. An experiment which will illustrate the phenomenon is to take out the coil L2 and to short-circuit the coil-holder. In these circumstances the local oscillations have to be forced into the differently tuned frame aerial circuits. The local oscillations may not be strong enough, and to get them strong enough the frame aerial circuit has to be detuned by means of the condenser C1, so as to bring the tuning more into line with the tuning of the oscillator. This, of course, will detune the circuit for the incoming signals. If the signals are weak you will not be likely to fall into the trap of wrongly tuning your aerial condenser, but when strong signals are being received it is often possible to obtain the signals with the aerial condenser quite out of tune, due to the effect just mentioned. The tuning of the aerial circuit may appear erratic when signals are strong and full loud-speaker results are already being obtained. The reason is that stated above.

Oscillating

If the coil L2 is made too small the plonckng will disappear, but the signal strength will be reduced to too great an extent, and a happy medium has to be found, and this, in my experience, is a No. 15 turn coil. The little plonck which may be noticeable is apt to be disconcerting to the beginner, and he may think that his oscillator is not working properly, and that it is conking out. It must be remembered, however, that the plonck part on the oscillator condenser is not used, and that even though the plonck may be obtained, perfectly good results will be obtained on either side of the plonck point. This plonck point, as a matter of fact, is where the aerial condenser is in tune with the oscillator condenser, and serves as a means of telling when these two circuits are in tune. You should, however, keep off the plonck point to avoid causing interference to nearby receivers.

The Frame Aerial

The frame aerial is that designed by Mr. Fuller, the details having already been published in these series of articles.

Miscellaneous Points

As regards the types of valves to use, I have no special recommendations; either bright or dull emitters may be employed. The high-tension voltage will depend upon the type of valve used, but about 80 volts is sufficient for general purpose valves.

It is a good plan when first tuning in the receiver, and you are not accustomed to its operation, to join the normal outdoor aerial to the earth terminal or lower frame terminal of the receiver, no earth being connected to the set at all. This will bring up the signal strength very greatly in many cases, and also increase the range of the receiver.

You should also try simply connecting an earth lead to the lower frame aerial terminal. This often increases signal strength.

Do not forget to turn the frame aerial in a suitable direction to pick up the station to be received. Merely pointing the frame at the station is not sufficient, because very often the waves become deflected by surrounding objects, such as houses, trees, etc. The turning of the frame aerial should be accompanied by correct tuning on C1 and C3, and the wavemeter, of course, is invaluable for a preliminary setting.

If more powerful results are obtained, ordinary aerial tuning may be employed, in which case I would still prefer to leave the frame in circuit and to connect between the aerial and earth of the external antennæ system an inductance coil which may be placed inside the frame aerial so as to induce currents into it. A few turns wound round the frame will do excellently. This, however, should not be done unnecessarily because of the interference I have already spoken of. It is also possible to connect an ordinary earth lead on to the lower frame aerial terminal (the frame being in circuit) and connecting the aerial through a .0001 μF fixed condenser to the upper frame aerial terminal on the set.

Interruption

In most cases, however, it will be found that the set being so sensitive a great deal of undesirable signals will come in when the outside aerial is employed.

While it is quite true that an outdoor aerial will often give louder results than a frame aerial with a supersonic heterodyne receiver, yet in most cases the main aerial will be discarded because of the interference which is brought in.

CAPT. PLUGGE TO BROADCAST FROM 2LO.

Capt. Leonard F. Plugge, Member of the General Committee of the Radio Society of Great Britain, will broadcast from 2LO, on Thursday, January 8th, at 7.10 p.m. The subject of his address will be "The Importance of an International Agreement on the use of identification call signs by European Broadcasting Stations."

This transmission will be simultaneously broadcast from all stations including the high powered station of Chelmsford on 1,600 metres. Reports of reception and expressions of opinion will be acknowledged if addressed to:—

The Secretary, The Radio Society of Great Britain, 53, Victoria Street, LONDON, S.W.1.

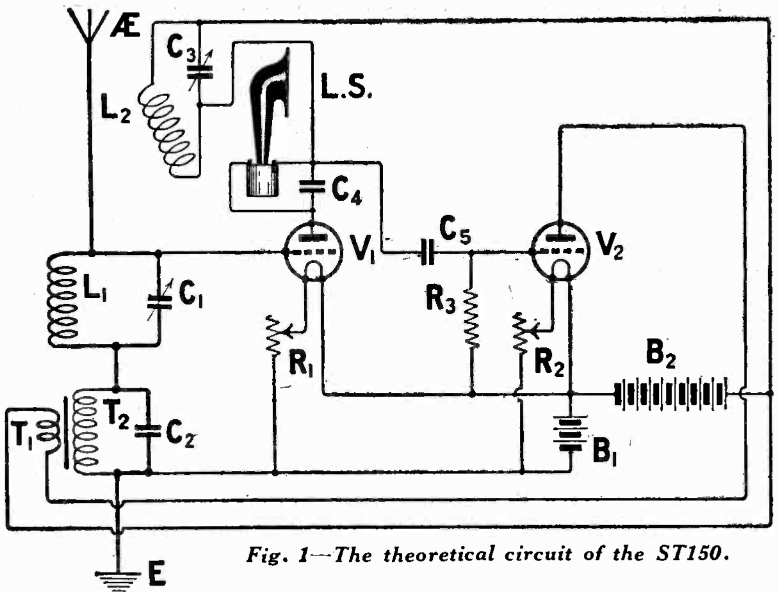


Fig. 1—The theoretical circuit of the ST150.

ST150 Circuit on the Omni Receiver

IN Fig. 1 is shown an interesting two-valve reflex circuit, which in "More Practical Valve Circuits," by John Scott-Taggart, F.Inst.P., is numbered ST150. The first valve amplifies at both high and low frequency, while the second valve acts as a detector.

The aerial is tuned by the coil L1, and variable condenser C1 of .0005 μF capacity, the incoming oscillations being applied direct to the grid of the first valve V1. These appear in amplified form in the anode circuit of V1, which is tuned by L2, and C3 of .0005 μF. The loud-speaker L.S. is not affected by these H.F. currents, which are by-passed by the fixed condenser C4, whose value may be .002 μF. The H.F. currents are communicated to the grid of V2 through the fixed condenser C5 of .0003 μF. The grid leak R3, whose resistance may be 2 megohms, is connected across the grid and filament of V2, the resultant low-frequency pulses in the anode circuit of this valve passing through the primary winding T1 of the L.F. transformer T1 T2. The secondary winding T2 of this transformer is placed in the joint aerial and grid circuit of the first valve, and the low-frequency currents induced in it by the primary T1 are communicated to the grid of V1, which accordingly amplifies at low frequency. The amplified L.F. currents in the anode circuit operate the loud-speaker L.S. (which may be replaced by telephones), and pass thence to the high-tension battery, the coil L2 offering no impedance to low-frequency currents. C2 is an H.F. by-pass condenser of .001 μF capacity.

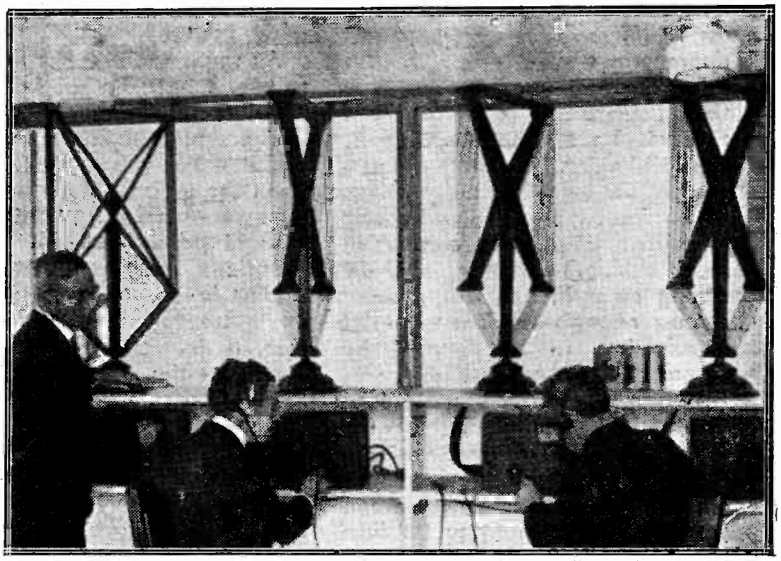
ST75 Circuit

The circuit resembles that of ST75 in many respects, and it is interesting to note the respective advantages and drawbacks of the two. The wiring key for circuit ST75 was given in the issue of *Wireless Weekly* for October 1.

Connections Required

The connections for wiring up the circuit shown are given in the following list:—

51—17	23—39
15—17	23—41
25—26	41—42
25—30	33—34
30—37	33—24
29—38	6—22
29—52	21—24
17—12	4—19
4—31	27—14
31—47	27—35
43—40	



A loud speaker in each apartment and four plug sockets in the walls simplify radio for tenants in one of New York's newest block of flats. A central station on the top floor boasts four radio sets and an operator. Four stations are tuned in, and every tenant has the choice of plugging in on one of them. Our photograph shows two of the sets being tuned.

Another Circuit which those readers who have built the Omni Receiver will be able to experiment with.

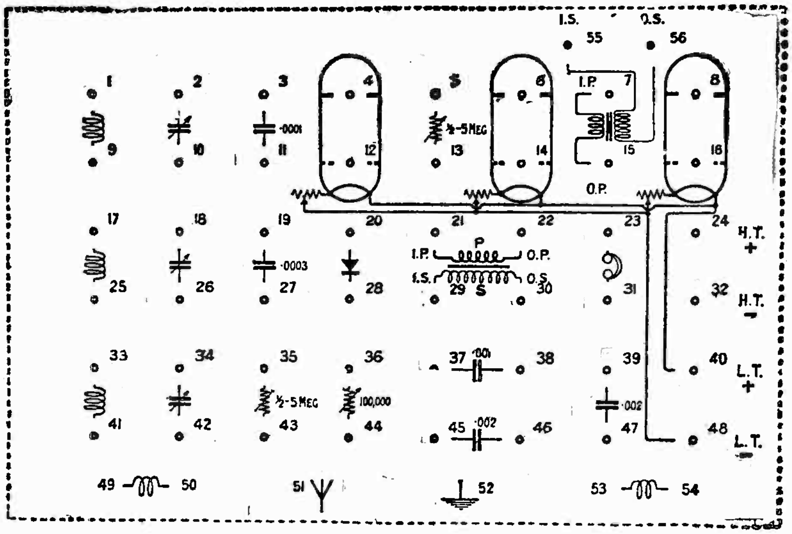


Fig. 2.—The terminal board.

Coils

The aerial coil L1 is plugged into the centre socket of the three-coil holder on the left-hand side of the cabinet, while the anode coil L2 is inserted in the front moving socket of the same holder. Suitable sizes for the usual broadcast wavelengths are :—Aerial coil, No. 35 or 50; anode coil, No. 50 or 75. The most suitable sizes should be found by experiment.

If it is desired to tune in 5XX, a No. 150 coil should be employed for aerial tuning and a No. 250 for the anode.

Operating the Receiver

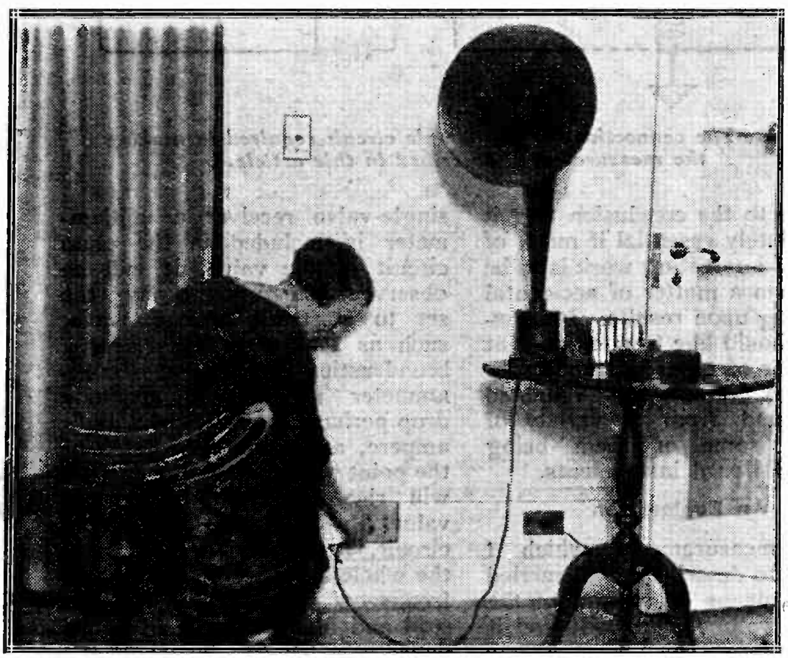
After connecting the batteries, etc., to the set, tuning may be commenced. It should be noted here that the use of a loud-speaker instead of telephones is advised with this circuit. If telephones are employed, however, they should be well insulated. Tuning is effected by variation of the capacities of C1 and C3, and by adjustment of the coupling between L1 and L2. The latter controls reaction, and care should therefore be exercised while making this adjustment.

If the receiver will not oscillate, even with the coils close to each other, it is probable that the connections to one of them need reversing. The leads to L2 may be reversed by disconnecting 23—41 and 33—24, and joining 23—33 and 41—24. If, on the other hand, it is found difficult to prevent oscillation when aerial and anode circuits are accurately tuned, it may still be beneficial to reverse the connections to one of the coils in order to obtain reverse reaction.

Experiments

Several interesting experiments will occur to the reader, such as variation of the voltage applied to the anodes of the valves, the application of separate H.T. voltages to the two valves, the introduction of grid bias on the first valve, etc. The effect of increasing the capacity of C4 condenser by connecting in parallel with it another .002 μF condenser may also be tried. The following extra connections become necessary for this experiment :—39—46 and 47—45.

The grid leak R3 should not be forgotten. Various values may be tried by adjusting the knob on the front of the panel. In general, the value will not be found at all critical however.



Our photograph shows all the equipment necessary for tenants to enjoy radio in one of New York's block of flats. *See opposite page.*

Some Simple Measurements

By G. P. KENDALL, B.Sc., Staff Editor.

The experiments which Mr. Kendall describes in this interesting article may be carried out by every experimenter who is the possessor of a milliammeter.

THE choice for any article of such a title as that which you have just read appears to call for a word of explanation, for I am fully aware that readers of technical publications are very apt to feel, and with some justification, that the use of the word "simple" in connection with the subject of measurements is only too often an example of "the pride which apes humility." Who does not retain memories of youthful sufferings from text books whose titles contained the word "elementary"? In commencing this article, therefore, which it is intended shall be the first of several upon similar lines, I want to give an earnest assurance that I have not taken the attractive adjective in vain, but that the whole of the experimental work involved is really and truly simple, and within the powers of anyone possessed of reasonable patience and just a little experimental skill. No mathematics whatever will be involved, since the experimental results will be read directly from the dial of a simple measuring instrument.

Measurements

The subject of measurements is very commonly regarded by the majority of experimenters of only limited means as entirely beyond their reach, and no doubt such a view is true of much of the more advanced work, where unusual and costly measuring instruments are required and a good deal of auxiliary apparatus. The experimental work which I propose to describe is such as can be carried out by anyone by means of one simple measuring instrument alone, and that an instrument which is very commonly possessed by experimenters who have passed out of the novice stage. The instrument in question is a milliammeter, and any good specimen will serve, provided that it possesses an open scale for readings of the order of two milliamperes, and further the scale should be clearly marked in tenths of a milliampere. This means that a fairly good instrument must be obtained, but its sphere of usefulness is so extended in wireless work that no one who decides upon the necessary expenditure will regret it. On the contrary, he is more likely to come to the conclusion that it is absolutely essential if much of his most interesting work is to be other than a matter of accidental stumbling upon results. In passing, I should like to mention that a number of types of good milliammeters are now to be obtained secondhand from a variety of dealers, some of them being Disposal Board instruments.

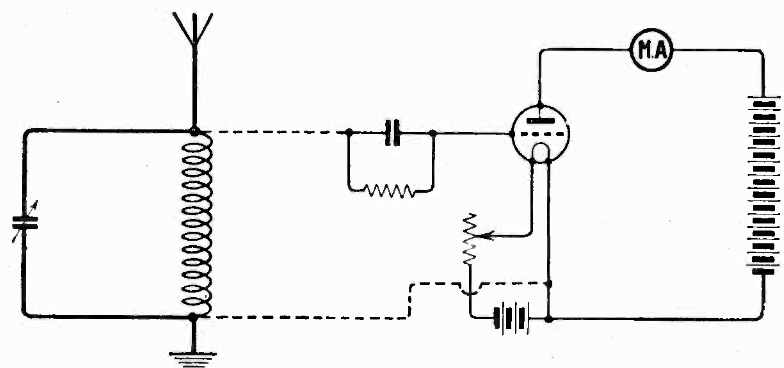


Fig. 1.—The connections of the simple circuit required in making the measurements described in this article.

An Explanation

The measurements which I propose to describe are all carried out by means of a form of the Moullin voltmeter circuit, and it is perhaps as well that a few words of explanation should be given on this very simple but extraordinarily useful arrangement. The original instrument is simply a calibrated valve detector circuit, with some means of indicating plate current, and its operation is extremely simple. Most of my readers will no doubt know that when signals are applied to the grid and filament of the ordinary grid condenser and gridleak rectifying valve, there is a drop in plate current, which varies in some proportion to the strength of the incoming signal. Thus, if in a simple single-valve receiver a milliammeter is included in the plate circuit of the valve, it will be observed that upon tuning the set to a strong carrier wave, such as that of a fairly nearby broadcasting station, the milliammeter needle will suddenly drop perhaps a quarter of a milliampere, and upon either side of the point of resonance the current will rise again to its normal value. By calibrating this simple circuit, it is possible to regard the whole arrangement as a high-frequency voltmeter, since the grid and filament leads from the detector valve can be connected across any circuit in which high-frequency oscillations are flowing, and it will be possible after a preliminary calibration to estimate by means of the measured change in the anode current the voltage applied across the valve.

Comparative Results

This is the common laboratory use of the circuit, but I have found it possible to use a very much simpler procedure, which gives entirely satisfactory results from the point of view of the experimenter who aims at purely comparative results. For example, in comparing a series of different types of commercial tuning coils, one does not really wish to know so much what voltage is produced across them by a given signal, as rather what coil is better than another, and which gives the best results in any particular set of conditions.

Signal Strength

What I have done, therefore, is to measure by means of a fine reading milliammeter, the drop in anode current when tuned to resonance with a strong carrier wave, reading this in tenths of a milliampere, and arbitrarily calling this " signal strength." Such readings, of course, are not directly proportional to the high-frequency voltage across the tuned circuit, but exaggerate the differences between any given set of high-frequency voltages, just as occurs in actual practice whenever a valve detector is used. Since we are merely seeking comparative results, however, it need not concern us that our readings do not bear an exact proportion to the high-frequency voltage which we are measuring, although it is as well to realise clearly that we are merely obtaining a means of making reliable comparisons.

H.F. Oscillations

What we require, then, is merely a milliammeter, a convenient valve detector unit which can be connected across any tuned circuit upon which measurements are to be made, a reasonably constant high- and low-tension supply voltage for the valve, and a powerful carrier wave to produce the high-frequency oscillations in our tuned circuit. My own experiments lead me to believe that the carrier wave from a main broadcasting station will serve perfectly well for this purpose up to some ten or fifteen miles, provided that an outside aerial is used, but those who are less fortunately situated than myself will no doubt have to provide this constant source of signals for themselves, and I propose to give at a later date a few notes upon the use of a local oscillator for the purpose. In connection with the question of the strength of the carrier wave, a word of warning is necessary as to the actual valve circuits which can be employed. It will be realised upon consideration that reaction must be entirely eliminated if anything like true comparative results are to be obtained, in the great majority of the tests which we shall be considering, and therefore it is generally best to regard high-frequency amplification as strictly taboo and to use the valve detector directly across the circuit under measurement. An example of the masking effects of reaction will be seen in connection with the measurements upon the effect of variation of coupling between the primary and secondary coils of a loose-coupled tuner which will be described in a future issue.

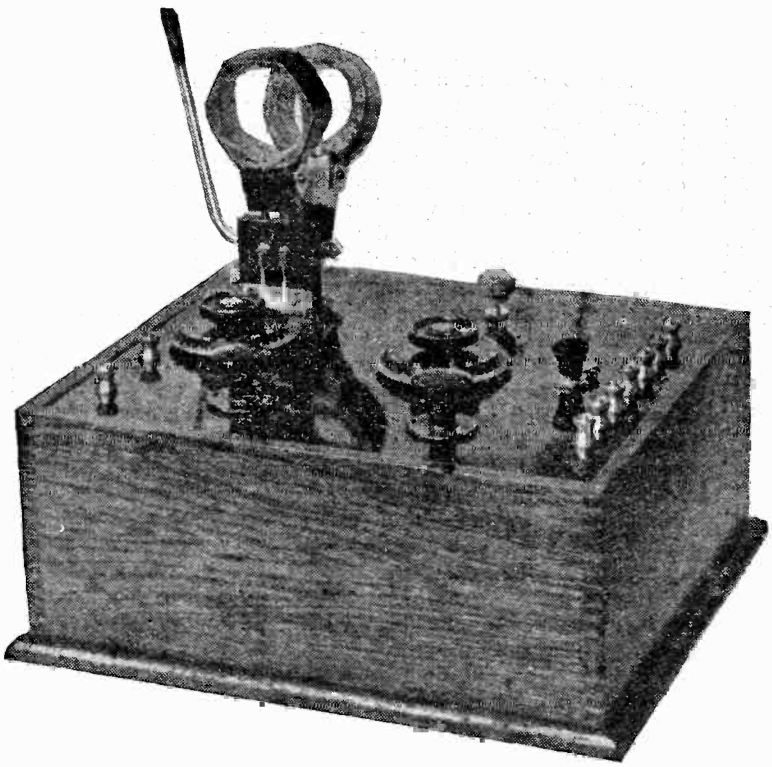
The First Experiment

The first experiment is one of interest to every user of plug-in coils, and concerns the quality of the material used for the manufacture of coil plugs by certain firms. In making a series of comparisons between a number of commercial coils, I had occasion to suspect the quality of the plugs of a certain well-known make, since these coils seemed to be showing up extremely unfavourably, and I was at a loss to account for this upon examination of the method of winding, the gauge of wire, and so forth. To test my surmise I put a standard Burndept No. 75 coil upon one of these suspected plugs, and placed the band round the coil. This band is one of the type whose ends are held down by two screws which are inserted in the actual electrodes of the plug, so that the band is shunted across the coil itself, and if of poor insulation will have a very deleterious effect upon signal strength; a measurement of signal strength was now taken, giving the figure 1.2.

Plugs

The coil was then taken off the suspected plug and mounted upon a good one, upon which no band was used, and the remarkable reading of 3 was then obtained. In confirmation, one of the coils which had given such poor results was again tested, and one end of the band was disconnected. It was then found that the reading rose from the previous 2 to 2.1, and the coil was next removed from its own plug and remounted upon the same one as was used in taking the comparative figures for the Burndept coil, and the figure 3 was again obtained, indicating that the coil was of perfectly sound construction, but that it had been completely spoiled as to performance by the bad method of mounting.

This example will serve to show how extremely useful this very simple method can be, and I hope to go on at a later date and show how it can be applied in a large number of ways to the problems which arise regarding the efficiency or otherwise of a great variety of tuning arrangements, coils, condensers, and so forth. Next week I will describe a simple unit which can be applied to these measurements, which is intended for the experimenter who does not already possess a suitable valve detector unit, and which forms, incidentally, an extremely effective and simple wave-meter for the measurement of the wavelength of a C.W. or telephony transmitter. At the same time instructions will be given for the use of the instrument in making the measurements which we have been considering in a general way in this introductory article.



The valves are mounted inside.

Two=Valv[e] of Nove[l]

By JOHN W

An interesting receiver which e
broadcasting to be heard u

THE method of obtaining high-frequency amplification requiring least adjustment and care, both in design and operation, is probably that employing the resistance-capacity principle. The disadvantage of this method is that it is ineffective upon wavelengths much below 1,000 metres, although in certain cases high-frequency resistance amplifiers have been made to operate satisfactorily upon wavelengths as low as 600 metres. The method as commonly employed is certainly of little use upon the broadcast wavelengths used by British stations, but when one considers the reception of Chelmsford or Radio-Paris, whose wavelengths are respectively 1,600 and 1,780 metres, the resistance-capacity method may certainly receive favourable attention. Probably the most popular coupling method for a high-frequency amplifying valve on the shorter waves is that known as the "tuned anode," and when carefully made a receiver operating upon this principle may be made to give excellent results.

Another aspect to be considered when designing a receiver for the home is that of keeping all damageable parts out of the way, it being especially desirable to protect the valves by enclosing them.

A useful receiver for the reception of short- and long-wave stations may be made upon the lines of the set illustrated in the photographs.

Tuned Anode

The tuned anode system is employed for the reception of short-wave stations, while by moving a switch the resistance-capacity method is brought into action for the longer-wave signals, the only other alterations necessary being larger aerial and reaction coils, and an increase in the H.T. voltage applied to the first valve. As will be seen in the photographs, the only components appearing on the top of the panel are those controlling the receiver, the valves, anode coil, etc., being mounted on the under side out of harm's way.

By consideration of the circuit diagram, it will be seen that either series or parallel connection of the aerial tuning condenser may be employed as desired, by manipulation of the aerial lead. Parallel connection is effected by joining the aerial to terminal P, earth to E, while terminals S and E are joined by a piece of wire. To obtain series tuning, the link between S and E is removed, and the aerial lead joined to terminal S, P being left free, while the earth lead remains joined to E.

Switching

The valve V1 acts as a high-frequency amplifier, and the reader will no doubt have noticed the method of switching which has been adopted. When the switch is placed on the "long-wave" side the anode resistance is joined in series with the coil L2 and condenser C2, and the

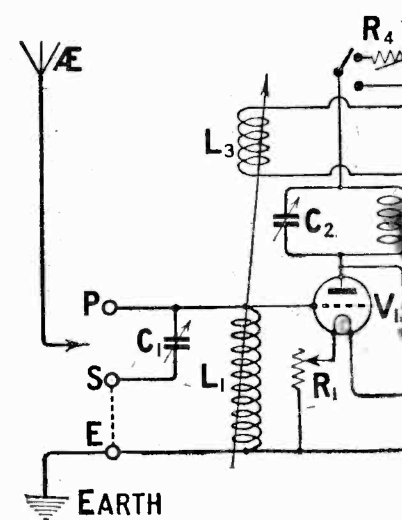
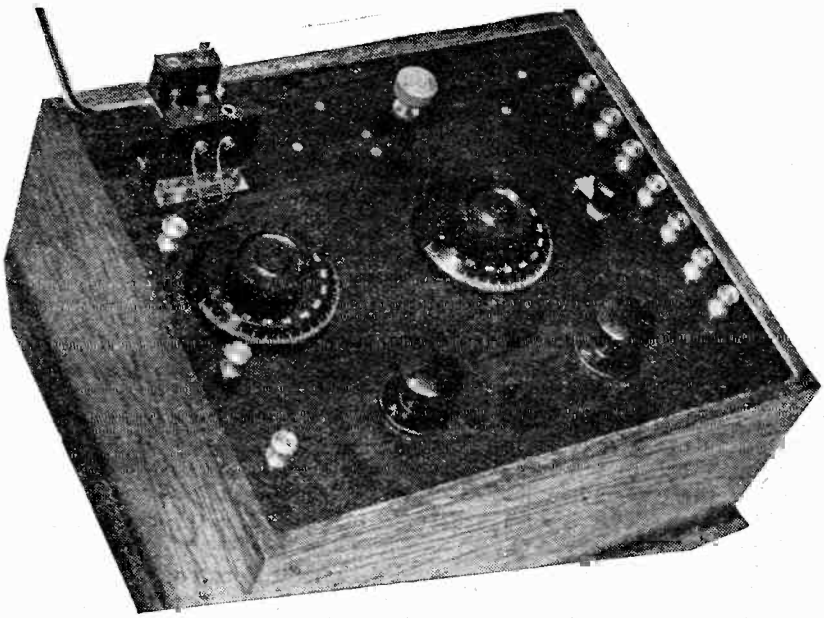


Fig. 1.—The c

e Receiver
l Design

. BARBER.

nables either short or long wave
vith a minimum of trouble.

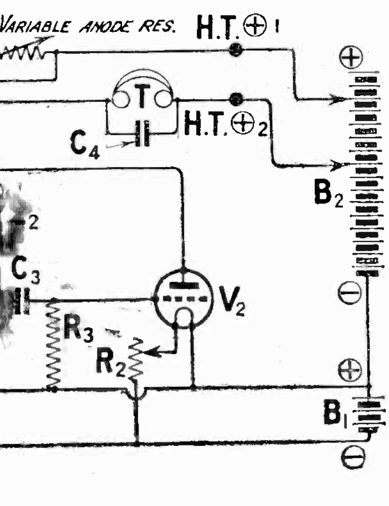


A view showing the controls.

positive of the high-tension battery. The anode oscillatory circuit is thus left in circuit when receiving the longer waves, and it is found that no undesirable effects resulted, or at least none were observed upon lengthy trial. No appreciable increase in signal strength was noticed, by aural observation, when the anode oscillatory circuit was shorted.

L.F. Stages

No note magnifiers have been included in the set illustrated, the object being to illustrate the principle, and it is clear that any note magnifiers required may be added afterwards, or included on the same panel. The set was designed with the object of use with the amplifier described by the present writer in the December 10 issue of this journal, and the reader is referred to that article for the complete description. For the benefit of those who may desire to operate a loud-speaker, a circuit diagram (Fig. 4) is given which shows how two low-frequency amplifiers may be added on the same panel, utilising one stage of transformer and one stage of low-frequency resistance coupling.



ircuit adopted.

Necessary Parts

The component parts necessary for the construction of this receiver are listed below, and for readers' information the names of manufacturers are given. It is clear, however, that any reliable make of component may be substituted for that named, provided that due consideration is given to its dimensions, as some alteration may be necessary if a component larger than the one specified is used. Values, where given, should be strictly adhered to, as any alteration here may result in the set not giving satisfactory results.

One ebonite panel, 12 in. by 10 in. by 3/16 in. (Radion mahoganite).

One cabinet of suitable size, at least 6 in. deep (Camco cabinet).

Two variable condensers (square law), one of .0005 μF and one of .0003 μF maximum capacity (Jackson Bros.).

One two-way coil holder (Magnum).

Two valve sockets (Magnum, anti-capacity type).

Two filament resistances (Burndept, Ltd.).

One variable anode resistance (Bretwood). No disadvantage will, in general, be found in using a fixed anode resistance, in which case a Dubilier 80,000-ohm resistance will be suitable.

One coil plug.

One switch arm and two studs (Bowyer-Lowe Co.).

Ten terminals (Burne-Jones).

One fixed condenser of .0002 or .0003 μF capacity, and one two-megohm grid leak.

If the grid condenser is provided with clips, one other clip will be required, but if not, it will be necessary to provide one pair of clips.

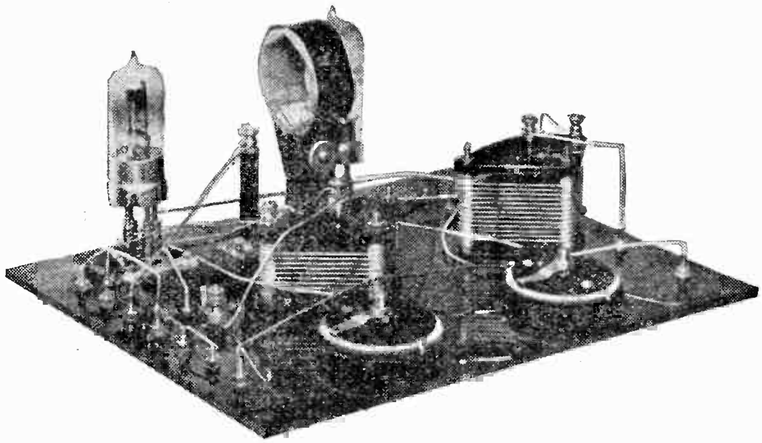
One .001 μF fixed condenser (Dubilier).

Filament resistances of the dual purpose type are incorporated in this receiver, but it is clear that should the constructor intend using only bright emitter valves, resistances of, say, seven ohms will suffice, while if dull emitters are exclusively to be used rheostats of, say, 25-35 ohms should be obtained. It is only in cases where a six-volt accumulator is used and a sudden change from bright to dull emitter valves is made that a dual purpose rheostat is required.

Layout and Wiring

The layout of the panel is given in Fig. 2, and should present no difficulty. The position of the valve sockets and anode coil plug should be carefully noted, and if the constructor already possesses a valve of large diameter he should ascertain whether or no there will be sufficient clearance. If not, the second valve socket may be moved slightly away from the coil mount. The clearance shown in the drawing was sufficient for the valves and coils in use. The anode coil mount is so arranged that the coil, when inserted, will be at right angles to the plane of the aerial coil, and centrally disposed in relation to it.

Many readers, when making up a set from a Radio Press design, prefer some arrangement other than that given by the author; there can be no objection to this, provided that the constructor has some experience, that the general principle of the layout be followed, and that the essential shortness of certain wires be preserved. Grid leads must receive special attention, and anode leads are next to receive consideration, while the relative spacing is also of considerable importance. Fila-



Showing the valves and anode coil.

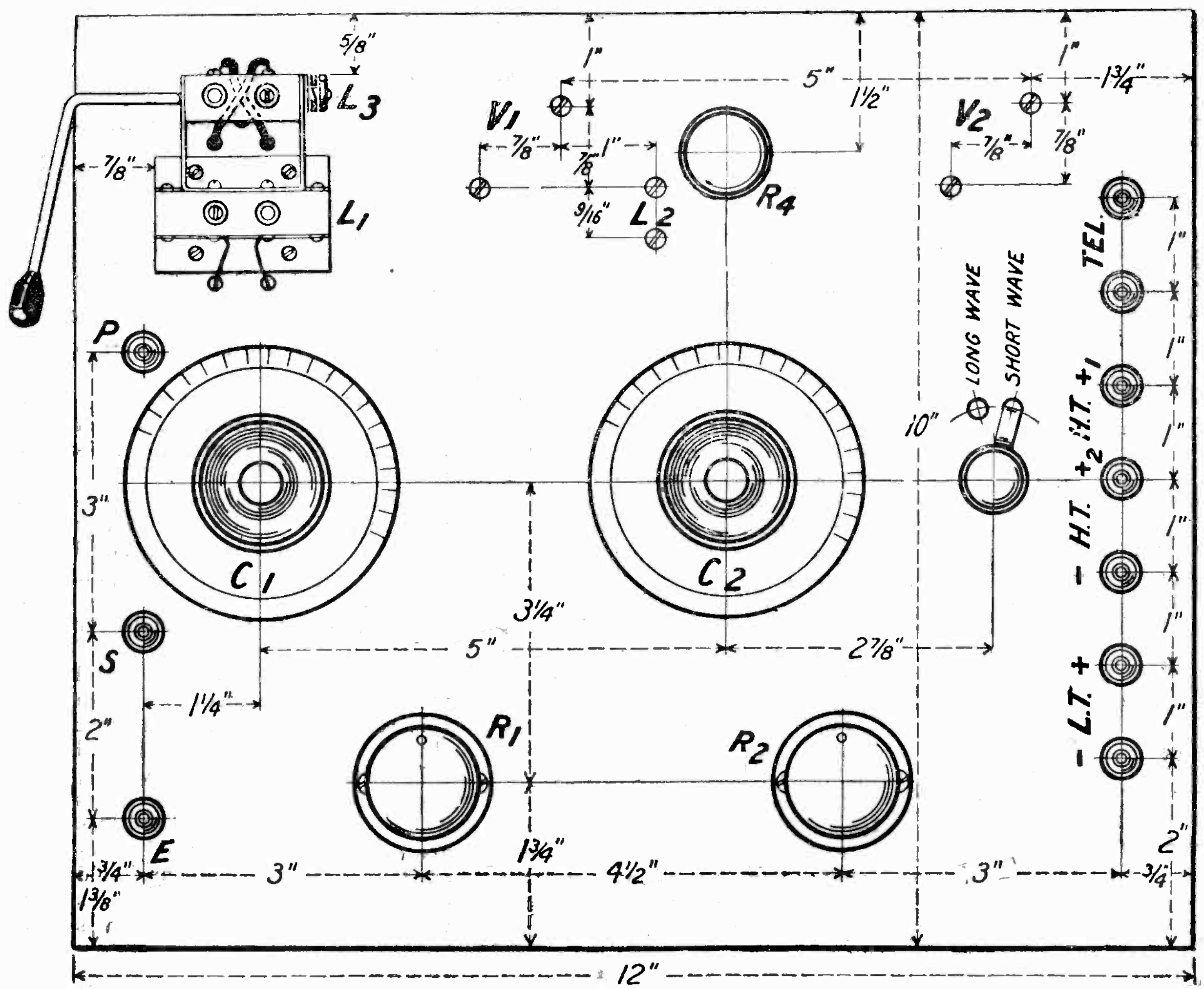


Fig. 2.—A half-size drawing of the panel, giving all necessary dimensions. Blue print No. 90a.

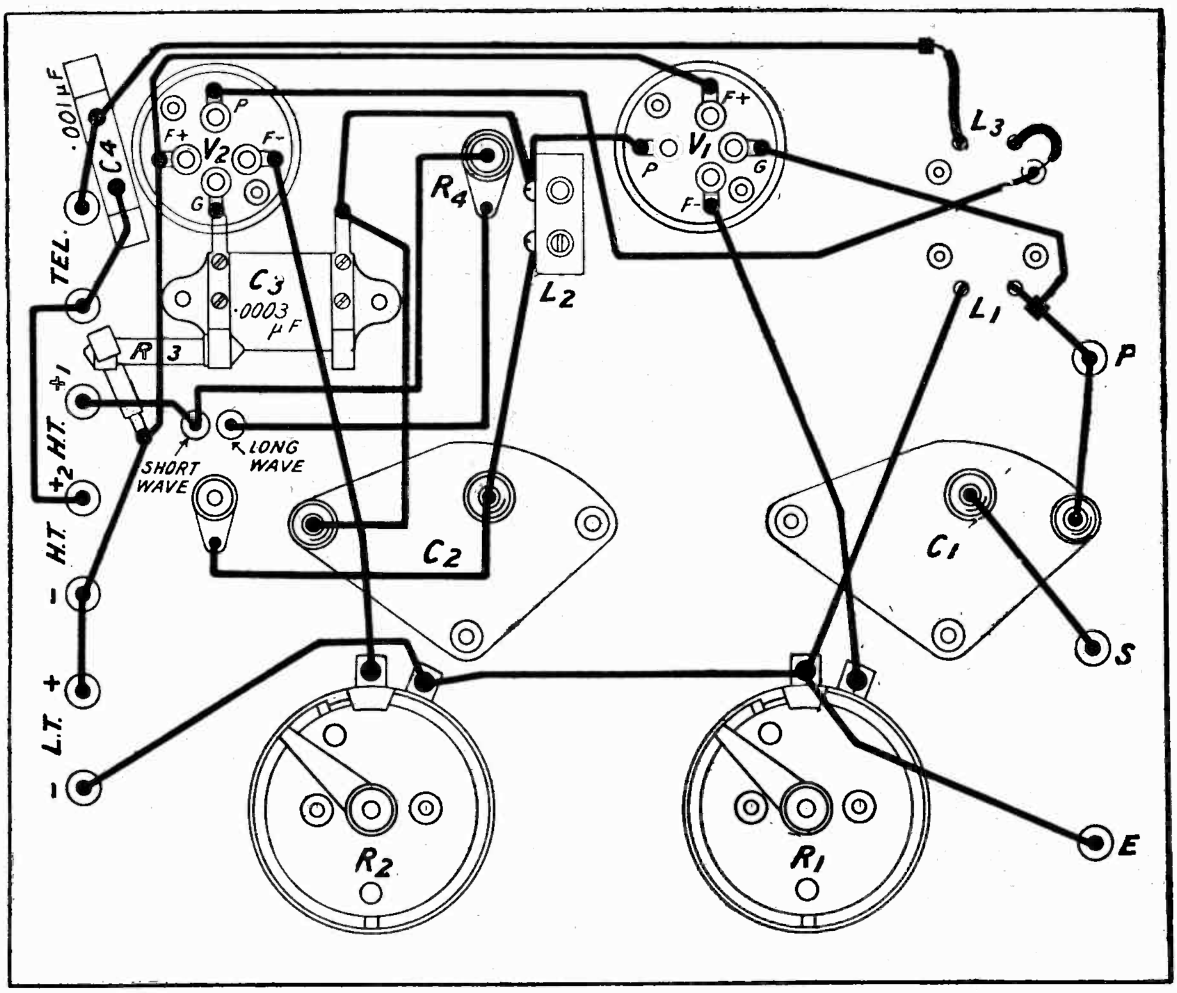


Fig. 3.—The wiring diagram, showing the necessary connections. Blueprint No. 90 b.

ment wiring is, in general, carried out first, these leads lying close to the panel out of the way of other leads.

Wiring

Wiring in this receiver has been carried out with No. 16 S.W.G. bare tinned copper wire, of circular cross-section. Square section wire may be used, if desired, or alternatively thinner round wire insulated with sleeving may be used. All joints should be soldered if the best results are to be obtained, as many cases of noisiness may be traced to leads fastened under nuts becoming loose or slightly oxidised.

Coils

The wiring diagram will make the connections clear, while the planes of the wires may be seen in the various back-of-panel photographs. When all connections have been made a test of the receiver under actual reception conditions may be carried out. Insert the valves and anode coil, which may be a No. 50 or 75 coil, the latter being a very useful coil in this position, and secure the panel in the cabinet. If a tray type of box, such as that illustrated, is used, there will be no need to screw the panel down, as it drops in on fillets and rests quite safely while tests are being made. It may afterwards be screwed down if desired. Using parallel tuning, a No. 35 coil will be required, on a standard P.M.G. 100-ft. aerial, for the lower of the short-wave stations, say, up to 400 metres, above which a No. 50 coil will be required. The size of the reaction coil will largely depend upon the resistance of the aerial, the coil being larger for a high-resistance aerial than for one of low resistance. For an average aerial a coil one size larger than the aerial coil may be employed.

Terminal Connections

The switch must be on the right-hand (short-wave) stud. Connections to batteries and so on are made, as indicated in Fig. 2. The top two terminals in the right-hand row are those to which the telephones are connected; the next pair are for positive high tension supply to each valve, and may be joined together for a preliminary test. The next terminal, reading downwards, is that to which the negative lead from the high-tension battery is joined, while the bottom pair are respectively joined to the positive and negative terminals of the accumulator.

Tuning

The filament resistances are then turned slowly from the "off" position, and tuning is carried out on both variable condensers simultaneously, keeping the reaction coil well away from that in the aerial circuit. On hearing signals from, say, the local station, adjust the aerial condenser for the loudest signal, then find the best setting for the anode tuning condenser. Now bring the reaction coil slowly nearer to the aerial coil, retuning slightly on the aerial condenser, and note if there is an increase in signal strength up to a point, after which signals become distorted. If this is so, loosen the coupling between the aerial and reaction coils at once, as interference may be caused to other listeners owing to the set being in a condition of oscillation. If, however, no such effects are noticed when the two coils are close together, reverse the connections to the moving (reaction) coil by changing over the flexible leads to the moving socket.

Receiving Chelmsford

For the reception of the high-power experimental station at Chelmsford the switch is moved over to the left-hand (long-wave) stud, a No. 150 coil is inserted into the aerial socket, while the reaction coil, under average conditions, may be a No. 200.

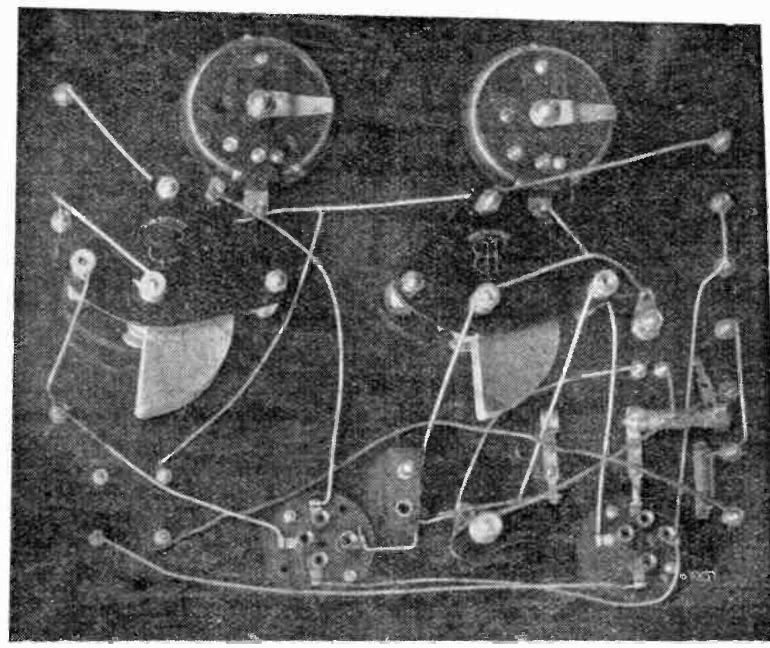
When the change-over from short to long waves is effected it will be necessary to increase the high-tension voltage applied to the first valve. This is effected by plugging the flexible lead from the terminal H.T.+1 into a socket of the battery corresponding to a higher voltage, whilst the anode resistance is adjusted to give the best results.

Results

The set, as described, has been in use on a 100-ft. aerial in S.E. London, about six miles from 2LO, and a short account of the results obtained is here given. 2LO, of course, is uncomfortably loud on telephones with both valves alight, and when listening to that station on 'phones the first valve may be turned out, the resulting signals being quite strong enough. When the amplifier, previously mentioned, is joined up, excellent loud-speaker signals are obtained.

Whilst writing this article, I am listening to Madrid on 'phones, with the reaction coil swung away to 90 deg., signals being perfectly clear and distinct, while every word of the announcer can be followed. With slight application of reaction, Hamburg can be heard, interfering with Madrid, there being only three metres difference in the wavelengths of these stations. When the amplifier is added, Madrid gives very clear signals on the loud-speaker with 90 deg. reaction coupling.

(Further results will be given in our next issue.)



A plan photograph of the wiring.

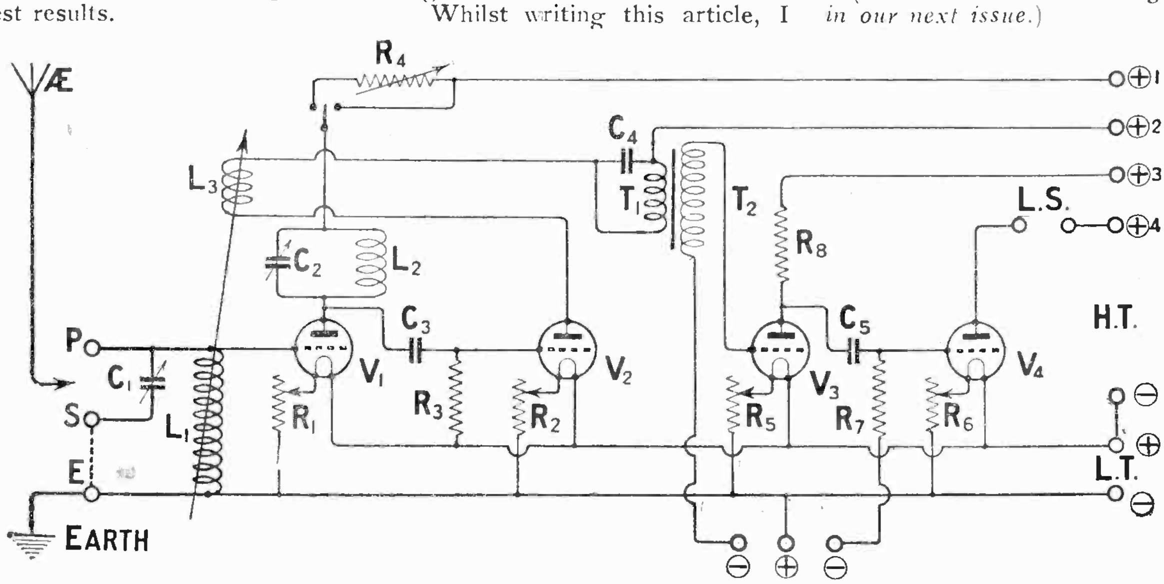


Fig. 4.—Showing the connections necessary when a two-valve amplifier is added, the last stage of L.F. being resistance coupled.

A Home-Made Coil

RECEPTION on short waves has become very popular of late, and a great many different kinds of low-loss inductance coils have been designed to enable these wavelengths to be received with efficiency. The great point about a coil for short wavelengths is that it should

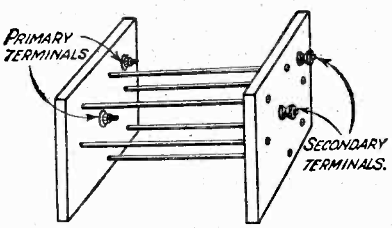


Fig. 1.—Details of the coil former.

have the smallest possible self-capacity and that resistance should be kept at a minimum by the use of stout wire. The coils to be described will be found quite easy to make up and efficient in use. In addition to this they have one good feature not shared by a number of other designs—they are exceedingly robust. Fig. 1 shows the finished former, which consists, as will be seen, of two ebonite end pieces, between which is a "skeleton" of hexagon section formed by six rods. These rods may be made of hard, well-seasoned wood, which has been thoroughly well shellacked, but if it is decided to use bare wire for the turns, they should be of $\frac{1}{4}$-in. round ebonite. In Fig. 2

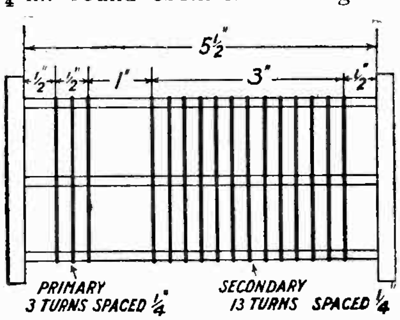


Fig. 2.—Illustrating the method of winding the coil.

is seen the method of winding the primary and secondary coils, both of which are placed upon the same former. The primary consists of three turns of No. 18 s.w.g. wire with a spacing of $\frac{1}{4}$ in. between turns. The secondary, which begins 1 in. away from the primary, has 13 turns of the same wire, also with $\frac{1}{4}$ in. spacing between turns.

The End Pieces

The layout of the end pieces is shown in Fig. 3. Each is made from a piece of $\frac{1}{4}$-in. ebonite, 4 in. square. Upon one of these is drawn with a scriber a circle 3 in. in diameter, whose circumference is divided into six equal parts by lines drawn from the centre at an angle of 60 deg., as shown in the diagram. In case no protractor is available, a condenser scale may be used for obtaining the angle, or a watch dial may be pressed into service, 60 deg. being equal to 10 one-minute divisions. Another method which gives quite good results is to use

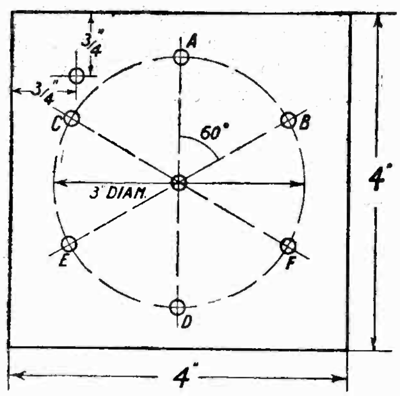


Fig. 3.—Layout of the end pieces.

a pair of dividers, setting their points at a distance apart equal to the radius of the circle. A punch mark is now made at A, one point of the dividers being placed in it. Marks are next made with the other point at B and C. The same process is then carried out from a punch mark made at D. It will be found that the distance between C, E and B, F is slightly greater than it ought to be, but this will make no difference to the efficiency of the coil. It is only necessary to lay out one of the end pieces. When this has been done, the two should be clamped tightly together and the drill run through both. All the holes on the circumference of the circle should be made 4 B.A. clearance and countersunk on what is to be the outside surface. Make two further 4 B.A. clearance holes, one at the centre of the circle and the other $\frac{3}{4}$ in. below the top and $\frac{3}{4}$ in. from one of the side edges. These are for the terminals.

Now cut out six lengths of $\frac{1}{4}$-in. or 5/16 in. round ebonite rod, making a 4 B.A. tapped hole in each end of all of them. The

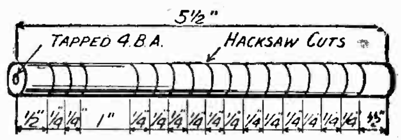


Fig. 4.—How the rods are grooved.

former can now be put together by running countersunk screws through the end pieces into the rods. When this has been done, mark out each rod, as shown in Fig. 4, and make light cuts with a hacksaw to hold the windings in place. Wind the primary in the following way:—Through the top rod of the former at the third notch, drill a hole with a No. 55 Morse drill. Pass the end of the wire through this, taking it straight down for $1\frac{1}{2}$ in.

Winding the Coil

Then bend the wire and lead it to the shank of the central terminal, making a soldered joint. Fig. 5 makes this part of the process quite plain. Now wind the turns on backwards until all three are in place, cutting the wire and soldering to the shank of the other terminal. The turns should lie in the hacksaw cuts and they should be put on tightly, though

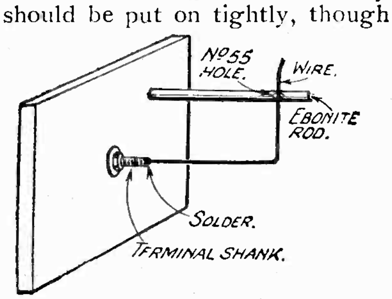


Fig. 5.—Secure the wire in the manner shown.

not so tightly as to bend the ebonite rods. The central terminal is thus attached to the "out" end of the primary and the other to the "in" end. In winding the secondary the process is similar. The anchoring hole is drilled at the notch nearest the primary windings, the end of the wire being taken through the middle of the coil to the central terminal. Thirteen turns are then put on as before, the end being soldered to the central terminal. In the secondary, the central terminal is "in" and that near the corner of the end-piece the "out."

The reaction coil is made in the same way and contains, like the secondary, thirteen turns. Here, the length required for the ebonite rods is 4 in., since there is only one winding. In connecting the coils to the set, very short pieces of stout wire should be used for the primary and secondary. The reaction coil connection should be a short length of double flex of good quality.

The coils will be found delightful to use. The combined primary and secondary stands on the table and is not moved. The reaction coil is placed fairly close to the secondary end of it. It can be moved about in any direction with the greatest ease, so that the adjustment of the coupling to the amount required is quite a simple matter. To avoid the effects of hand capacity the coil should be moved by means of a stick or a piece of ebonite rod. If desired, a handle 8 or 10 in. in length may be screwed to one of the end pieces. A suitable variable condenser to use with these coils is one of 0.00025 μF in parallel with the secondary.

R. W. H.

VALVE NOTES

(Concluded from page 431.)

As will be seen from the figure, the low-frequency currents produced after rectification are fed, not into the grid circuit of the first valve, as in Fig. 1, but into the grid circuit of the second valve. The amplified low-frequency currents which now appear in the anode circuit of the second valve are fed into the grid circuit of the first, which amplifies them, the loud-speaker L.S. being included in the anode circuit of the first valve instead of the anode circuit of the second.

It will be seen from Fig. 3 that the first grid receives the original high-frequency E.M.F.s and low-frequency E.M.F.s after a single stage of amplification.

The grid circuit of the second valve receives the low-frequency E.M.F.s without amplification and E.M.F.s due to a single stage of high-frequency amplification.

Keeping to the original figures, the maximum grid sweep, in the case of the first valve, will be 14 volts, while the grid sweep, in the case of the second valve, will be 10 volts.

This does not even things up altogether, but the valves are worked more equally.

The figures I have quoted are not based on any relative measurements, but are merely given for the sake of explaining how, by inverse duplexing, it is possible to balance the work done by the valves.

THE ROMANCE OF WIRELESS

SIR,—Reference your Editorial in the *Wireless Weekly*, No. 10, Vol. 5.

Apropos the paragraph commencing "No novelist has yet seized upon the true romance of wireless. . . ." Apparently the writer of the Editorial is not conversant with the novel, "Looking Backward," by Edward Bellamy.

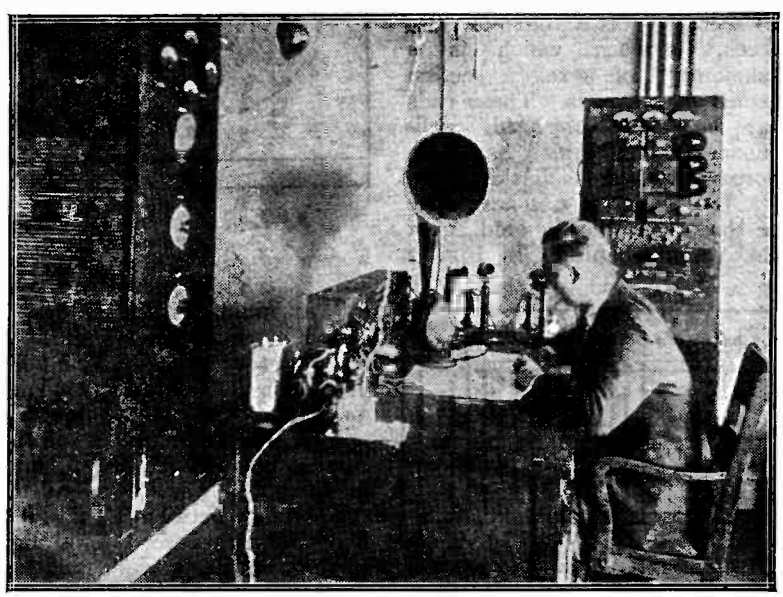
If he will turn to Chapter xi of that book he will find a remarkable forecast of broadcasting of to-day, or at least of what we are hoping broadcasting will attain. True, the results as described in the novel are obtained through the medium of the extension of the ordinary telephone system, but the prophecy of "music on tap" is, nevertheless, startling, and even more accurate than flights of fancy by better known authors, such as Jules Verne and H. G. Wells.

Wishing your paper and kindred publications every success.—Yours faithfully,

P. COCKROFT.

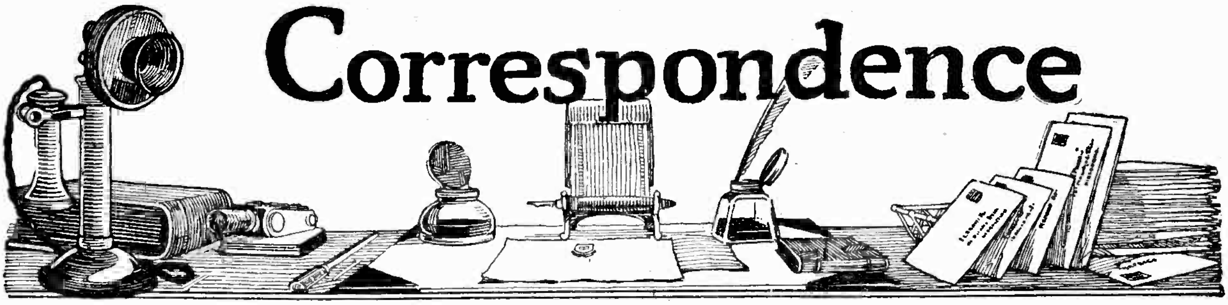
Leeds.

CANADIAN STATION HEARD IN IRELAND



CNRA, the new station of the Canadian National Railways at Moncton, New Brunswick, by means of which it is hoped to relay British Broadcasting programmes to the chain of ten broadcasting stations supplying entertainment to the expresses of the Canadian National Railways, has been heard in Ireland, by Mr. McMurray, of Bangor, Co. Down. Our photograph shows the operating room of radio station CKCH, owned and operated by the Canadian National Railways. This station, located at Ottawa, Canada, is the most powerful radio broadcasting station in the Dominion.

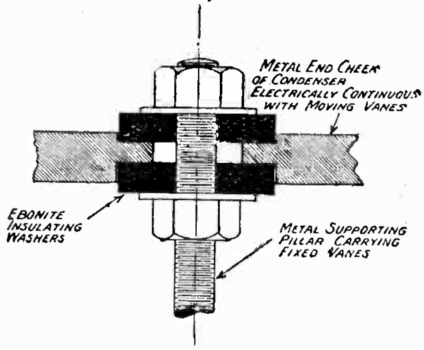
Correspondence



LOSSES IN CONDENSERS

SIR,—I have read with interest the articles that appear on pages 165, 179 and 209 of your issues of November 19 and 26 regarding losses in variable condensers, and I note that you attribute these losses to (*a*) metal end-plates instead of ebonite, (*b*) "very small" ebonite bushes.

With regard to (*a*), I feel sure that you intend your remarks to apply only to metal end-plates provided with insulated bushes to carry the rotor spindle, as there can be no possible objection to metal-end plates which are electrically continuous with the rotor, as otherwise such designs would not be used and specified by the National Physical Laboratory and by the Bureau of Standards (see Circular No. 74). The latter form of construction was adopted by my Company after a prolonged series of measurements of losses actually obtained in the



This diagram shows the method of clamping the fixed plates of Burndept condensers.

various types, the great advantage being that rotor frame, dust cover, end-plates, and shaft are all electrically continuous and form a metal box which can be so connected in the circuit that it is virtually at earth potential, thus obviating all the usual hand-capacity effects.

With regard to (*b*), the fixed plates are supported inside this box by means of the *smallest possible quantity* of solid dielectric. In other words, best quality ebonite washers are used, and they are made as *small as is compatible with mechanical strength*, for the simple reason that losses, *i.e.*, bad power factor, are not usually due to poor *insulation* (see later remarks), but to *dielectric absorption*, which is proportional to the *mass* of the dielectric and to the potential gradient through it, and therefore, it is desirable to *keep the bushes small*. In order that the potential gradient may be low, bushes should be so shaped and placed that capacity through them is small; this result is obtained by my Company in a manner which is made clear by the attached sketch, in which a stem (fixed plate support) is clamped to a metal end-plate by two grade "A" ebonite washers, the whole assembly being so shaped that comparatively few lines of dielectric strain pass through the ebonite, the concentration of such lines being from stem to end-plate, between the ebonite washers, where the dielectric is air.

Use on Short Waves

The effect of this construction ensures ruggedly constructed variable condensers in which losses are so low that circuits in which they are used will oscillate with ease at wavelengths of 40 metres and less, always provided that losses in other parts of the circuit are kept equally low. The following measurements taken on December 23 in my laboratory may be of some interest :—

Condenser A :—A Burndept Standard Air Condenser, with metal end-plates and steel dust covers. Nominal capacity, .001 mfds. Catalogue No. 417.

Condenser B :—A precisely similar condenser but made up with grade "A" ebonite end-plates.

Frequency of measurement = 1,000 cycles.

	Condenser A (Metal).	Condenser B (Ebonite).
Minimum capacity :—		
(I) Dust covers off	Mfds. 23.8	Mfds. 12.4
(II) Dust covers on	34.2	—
Maximum capacity ...	1017.8	992.6
Equivalent series resistance :—		
(*a*) Scale set at 100 mfds. ...	Ohms 12.0	Ohms 35.0
(*b*) Scale set at 500 mfds. ...	12.0	40.0
Power Factor:	Per cent.	Per cent.
(*a*) Scale set at 100 mfds. ...	0.074	0.220
(*b*) Scale set at 500 mfds. ...	0.015	0.050

Returning to my remarks that losses are not due to poor *insulation*, I would point out that at the high frequencies used in radio telegraphy it is a fact that low insulation resistance in a receiving condenser does not matter (of course I am speaking in terms of megohms). If we assume "low insulation" to be, say, 2 megohms, and the condenser to be set at a value of, say, .0003 mfds. on a wavelength of 300 metres, the reactance of the condenser will be 530 ohms, and really there does not seem to be much harm in shunting 530 ohms with 2 megohms, does there?

In conclusion may I be permitted to congratulate you upon the attitude you so often take up with regard to wireless apparatus, viz., that the *scientific* correctness of the design must not be subordinated to convenience in *mechanical* constructions.—Yours faithfully,

C. F. PHILLIPS,
M.I.R.E., A.M.I.E.E.
Chief Engineer and Director,
Burndept, Ltd.

*Roughly equals percentage of applied power lost in condenser.

"THE FIRST MILLION"

SIR,—Allow me to reply briefly to your comments on my letter published in December 17 issue of your valued journal.

(1) You controvert my statement that sets are constructed solely for the purpose of obtaining excellence of broadcast reception. What, I would ask, *are* they constructed for, if not for this specific object? Merely for the satisfaction to be derived from producing a scientific instrument, intended to be used not as a scientific instrument, but for contemplation or display as an *objet d'art*?

(2) You refer to your efforts to educate the public in the proper use of reaction. I gladly acknowledge the justice of this claim, but I maintain that the nuisance complained of persists *and grows*, despite all your efforts. Therefore, I still think it right that those about to take up wireless should be warned that good reception is by no means solely or mainly dependent on good set-construction, but is obtainable only on very rare occasions owing to the malpractices of set mis-users.

(3) Finally, I agree that my suggestion that reaction should not be permitted is a drastic remedy. But serious evils require drastic treatment, and at present I am unaware of any other effective suggestion for putting an end to the interference caused by those who do not know how to use their sets or (*and this is the real cause of the evil*) do not care what trouble or annoyance they cause their wireless brethren.—Yours faithfully,

P. C. MAYWOOD.

Teddington.

TRANSATLANTIC V.

SIR,—This is yet another appreciation of the wonderful "Transatlantic V" set described by Mr. Percy W. Harris in your June issue of *Modern Wireless*.

Although I have only recently completed it, I can honestly say that I have had every Continental station on the loud-speaker that I have tried for, Madrid being one of the best. The only modification I have provided is for reversed reaction by means of two "Clix." I thought this would be useful on very low wavelengths, but I have not needed it yet. The rest of the set is an exact copy, even to the components.

I have rigged up a simple device for cutting out the first H.F. valve when required. It consists of a four-pin adapter for the first valve socket, the grid and plate legs being shunted by a .25 μF condenser. I have found no advantage in using a second device of this sort for the second H.F. valve socket when using the detector valve only, just as good results being obtained by turning out the filament of this valve. Better results are obtained on the detector valve alone by using the plug-in fitting in the first valve socket than by simply turning out the two H.F. valves. Wishing you still more success,—Yours faithfully,

H. L. WILLEY, M.A., M.B.

Sheffield.

ALL CONCERT DE LUXE

SIR,—I herewith beg to report results obtained with the "All-Concert de Luxe" receiver (R. P. Envelope No. 4, by Percy W. Harris).

I bought the envelope immediately it was published, and completed the set on July 19, and have had nothing but praise for it ever since.

The stations which I have received so far include all B.B.C. (not including relays) stations, Eiffel Tower, Radiola, L'Ecole Superieure, Petit Parisien, Vox Haus, Hamburg, Breslau, Leipzig, Koenigsburg, Munich, and not forgetting Frankfurt.

In Stirling I can get any one of these stations while the British stations are operating, and Breslau is the only one on which I can say there is any interference from another broadcasting station, Glasgow being well in the background, but still audible.

There is no interference whatever between Radiola and 5XX.

The only attempt I have made with this set to get America was between midnight and 1 a.m. recently, and although I got a very strong carrier wave and a man speaking from 12.15 a.m. until 12.25, and from about 12.30 until 12.50 I was unable to make out one single word.

According to all the rules of the game my aerial is one of those on which I should expect to catch nothing but atmospherics. It is 100 ft. long, including 15 ft. lead-in, not more than 18 ft. high, and about twenty-two telephone wires cross its mid-point about 12 in. above; it has a lovely sag, and the solitary insulator at the free end is as black as the ace of spades, as it has never been cleaned since I put the aerial up a year past in March.

On an inside aerial in the town of Motherwell I recently had Glasgow, Edinburgh, Newcastle, Bournemouth, Frankfurt-on-Main, and Hamburg, and if anyone had told me about getting the last two stations on an inside aerial I would have told them how to get China and Chili as well.

Although I had some difficulty in tuning out Glasgow on the outside aerial I heard every item from Frankfurt from 9 o'clock until they closed down with their Hymn of Praise at 11 p.m. I also had Hamburg and all the other B.B.C. stations, including 5XX, on this aerial, which would be about 70 ft. long and 5 ft. of a lead-in and about 18 ft. high.

The earth consisted of about 12 ft. of the same wire, 3-20 enamelled copper, screwed down to the base of the water tap.

I built the "All Concert Receiver" when it came out in *Modern Wireless*, September, 1923; but whether it was due to lack of experience or to some other cause unknown, the results were not to be compared with this set.

I have been pottering about with all sorts of circuits ever since on the "hook up" principle, and whenever I wanted anything special I always fell back on the ST45.

But even at its best there was always something amiss. [The ST45 circuit is the one used in the All-Concert set.—ED.]

I have carried out the instructions in the envelope almost to the letter, the only alterations being the substitution of a Lissen variable grid-leak for the fixed one, and instead of having one H.T.+ I have three, one for each valve. This was so that I could comply with makers' instructions for the low-consumption valves.

The first night I tried out this set I picked up a station calling Java, and then the kind gentleman at the other end of the rainbow repeated all the numerals right up to ten without a mistake—at least, I never detected one—and then after selling more oranges he closed down, and I have never heard him from that day to this.

I haven't the foggiest idea where it was, but I had a No. 300 coil in the aerial and a 400-coil in the anode.

I have had one or two other stations as well, but I have been unable to identify them, so they are not included in the list.

I have waited a long time for a decent design for a three-valve set, but I am happy now; and to be candid with you, I wouldn't change it for any commercial set that I have seen.

I have it mounted in a mahogany box which is French polished, and the transfer lettering shows up beautifully on the ebonite; the general appearance has been admired by everyone who has seen it.

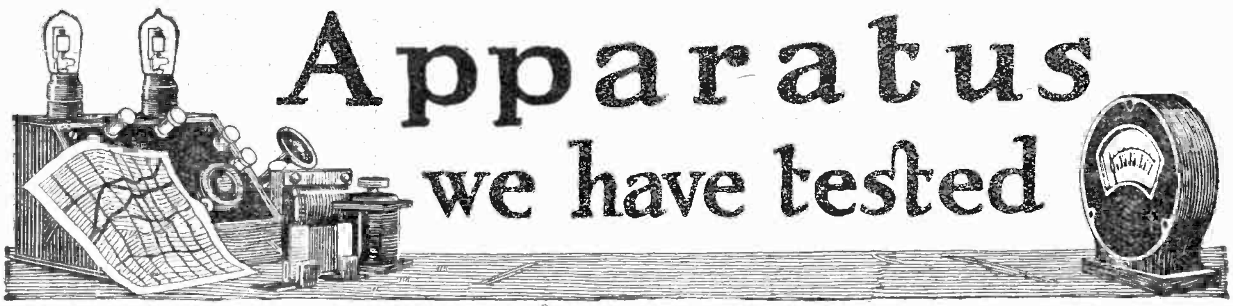
I should mention here that I do not use the variable gridleak when tuning, but merely alter the resistance until I obtain the best result on the local station, or when I change the valves.

I can strongly advise anyone who is desirous of building a three-valve set to get busy with this one, and they will be amply repaid for their work. Wishing you every success,

—Yours faithfully,

R. A. HUGHES.

Stirling.



Conducted by A. D. COWPER, M.Sc., Staff Editor.

Magnum Plug-in H.F. Transformer

Messrs. Burne, Jones & Co. have submitted for test two specimens of their plug-in high-frequency inter-valve transformers, covering the ordinary short-wave broadcast range from 300 to 600 metres wavelength, with a parallel variable condenser of .0003 μF capacity. These are neat instruments, highly finished, and wholly enclosed; of cylindrical form, $1\frac{3}{4}$ in. high by $1\frac{3}{4}$ in. diameter, and on the ordinary four-pin base. The connections are clearly indicated by engraved symbols on the base.

On test, both gave very closely the wavelength range indicated, and the degree of signal-strength selectivity and amplification associated with this type of fine-wire plug-in transformer. If used as a neutrodyned tuned-anode coupling device, the wavelength range will be, of course, slightly different to that given here.

A Three-Coil-Holder with Fine Adjustment

Lissen, Ltd., have sent for test a form of three-coil holder in which fine adjustment is obtained (by a tangent-screw micrometer device) of both of the outer coils, the inner coil being fixed as usual. This is mounted on an ebonite base $4\frac{1}{2}$ in. by $2\frac{1}{4}$ in., with holes for fixing on panel or cabinet; a row of six small terminal screws (which nip the end of the connecting wires in metal-bushed holes in the edge of the ebonite in a manner which will make for neat wiring) is arranged down one side. The coil-mounting plugs are circular in shape, and the outer ones rotate on a common horizontal axis. This rotational movement is controlled by tangent worm-screws working in a substantial thread cut in the periphery of the ebonite plugs themselves, and operated by small knobs at the ends of 3-in. spindles. The hand-capacity effects are thereby reduced to a minimum, and very fine adjustment of coupling is possible over a range of 90 degrees of arc by this slow micrometer movement. Short lengths of flex make the electrical connections to the terminals.

On test, the device was found to work smoothly and without shake or appreciable back-lash, and to give narrow regulation of coupling. The largest sizes of coils could be controlled without any difficulty or instability, so that the coil-holder is particularly suited for long-wave work or with the large oscillator coils used in certain "super" circuits. The insulation resistance was found to be excellent, and the finish and workmanship all that could be desired.

Loading Devices for the High-Power Station

Messrs. British Thomson-Houston Co., Ltd., have submitted two loading devices for existing receivers to enable these to be used for the reception of the new high-powered long-wave station without serious structural alterations. These two accessories are designed, apparently primarily for B.T.H. receivers, to effect loading in a simple way.

The one device is a large loading-coil in the form of a narrow disc or slab, 3½ in. diameter and only ⅜ in. thick over the cheeks of the former. Connections are made by two slotted metal feet spaced at 1¼ in. apart. On trial, in series with an ordinary No. 35 coil to represent existing inductance in *e.g.*, a parallel-condenser-tuned crystal set, this received 5XX with a parallel tuning-capacity of .00025 μF, corresponding to a small or high single-wire aerial.

The other device is in the form of a cylindrical box 2¼ in. diameter by 1 in. deep, with a lid which has a knurled rim and can rotate through a small angle, operating thereby a simple selector-switch in the interior. This switches, at will, into parallel connection with the tuning inductance of the set, across which the device is placed by means of two short flexible connectors with ring terminals, an enclosed mica fixed condenser whose capacity was measured as approximately .0034 μF. This relatively very large tuning capacity sufficed, on trial, to tune an ordinary No. 60 plug-in coil—corresponding, *e.g.*, to the inductance of a tuning variometer in the original crystal adjusted at a medium setting—to the wavelength of 5XX. Actually, in a test made with a valve-receiver, a No. 60 coil would oscillate with this condenser and a No. 200 reaction-coil.

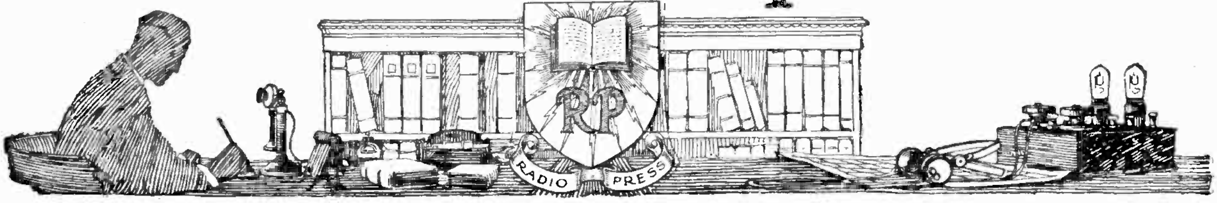
The general finish and workmanship of these units was of the highest order; the appearance, in their brown-moulded composition cases, was distinctly pleasing.

Ediswan Potentiometer

From Messrs. Edison Swan Electric Co., Ltd., we have received a sample of their type, WL. 561 potentiometer. This is a circular instrument, reminiscent of an ordinary filament-resistance, but fitted with the necessary three terminals. It is adapted for panel-mounting by two small screws, and is equipped with a knob bearing an indicator. The terminals are readily accessible, being arranged each on an extension-arm, and are of reasonable size. The resistance wire is wound in the form of a spiral on a flat fibre strip which is then bent round in the form of a circle, and enclosed drum-fashion between two ebonite end pieces. The variable tapping-point required is made by a contact-shoe at the end of a radial arm controlled by the knob outside.

On test, the resistance came out at about 240 ohms, sufficient for ordinary purposes in radio technique, and the device operated smoothly and silently. It can certainly be recommended for use where such an instrument is indicated.

Information Department



SUPPLIED BY RADIO PRESS SERVICE DEPT., LTD.

B. S. J. (NUNEATON) wishes to take up the subject of short wave reception, and asks for any general advice upon making a start.

It is best to build a completely separate receiver for this purpose, and we think that for a beginning you should study the article in the October 8 issue by Mr. Percy W. Harris, entitled "100 Metres and Below." You may find it necessary to make some alterations in your aerial system for the greatest efficiency on really short waves, and the first thing to try is a counterpoise earth, which very often overcomes a number of the difficulties which are met with in the case of a direct earth. Good results can be obtained with a counterpoise consisting of a single insulated wire hung perhaps 5 to 6 ft. off the ground, or a little more if conditions demand it, directly beneath the aerial, and preferably of slightly greater length than the aerial, say 120 ft. Difficulty is sometimes experienced if the natural wavelength of the aerial falls on one of the waves upon which it is desired to work, since it is often found that ordinary single-valve reaction sets will refuse to oscillate upon this wavelength. Some form of aperiodic aerial tuning reduces the difficulty, although it does not as a rule overcome it; and the only real remedy seems to be some alteration in the constants of the aerial, such as a reduction by, say, 10 ft. of its length. This, of course, assumes that the aerial is of considerable size to begin with, and in the case of a small aerial an attempt should be made to enlarge it, in case of a difficulty of this nature. We do not think you will obtain satisfactory results merely by trying to substitute suitable short-wave transformers in your Transatlantic Five Receiver.

U. A. B. (E.C.4) has a Family 4-valve Receiver (Radio Press Envelope No. 2), and experiences a certain amount of difficulty in freeing his results from distortion, and enquires as to the use of power valves and grid bias.

It is not as a rule necessary to use more than one power valve in this set, and this valve should be inserted in the fourth socket, counting from the left. It will be necessary to employ grid bias for this valve alone, and this is best done by breaking the connection between the secondary of the transformer which passes the signals on to this last valve, and the filament circuit. Upon examination it will be found that one end of the secondary of this transformer is connected to the grid of the fourth valve, and the other end of the secondary is connected to the filament circuit. Break this latter connection, and take the wire from the transformer secondary to a new terminal upon the panel. Connect the negative of the grid bias battery to this new terminal, and connect its positive to the low-tension negative terminal.

Additional anode volts must also be applied, and this is best arranged as follows: Connect, say, a 72-volt high-tension battery to the ordinary high-tension terminals and connect an additional 36-volt unit in series between the loud-speaker and the terminal marked LS plus. Connect the negative of the battery to this terminal, and connect its positive to the free tag of the loud-speaker. The other tag of the loud-speaker remains connected to the other loud-speaker terminal.

K. S. J. (EXETER) has a Transatlantic Five receiver which is behaving in a manner which he finds extremely puzzling. It gives perfectly satisfactory results upon the high-frequency side only, but when used to work a loud-speaker it will, at times, quite without warning, suddenly begin to distort very badly and signals almost immediately die down to something like a quarter of their previous volume. Our correspondent has noticed that a strong atmospheric will often provoke the trouble, as also will a particularly loud passage in an orchestral item which is being received. He finds that the only cure for this condition, when once it has set in, is to switch off the set for a few moments.

This trouble is one which is quite commonly met with in low-frequency amplifiers of the resistance-capacity type, the usual trouble being a grid leak of too high a value. The grid leak is usually of some abnormally high value, and the substitution of the correct one of 2 megohms will no doubt cure the trouble. In some exceptional cases, however, a valve of rather unusual type requires a still lower value grid leak to overcome this choking, and one of, say, ½ megohm should be tried. Incidentally, grid leaks of quite low value are somewhat advantageous in this position, and a ¼ megohm is often recommended.

M. S. B. (PORTRUSH) possesses a receiver employing two high-frequency valves coupled by means of tuned transformers. He obtains very good results from a number of the B.B.C. stations, but is much troubled by interference from shipping. He is considering trying constant aerial tuning in the receiver and wishes us to express an opinion as to what the probable effects would be in the case of this set.

The principal effect which would be noticed in the case of an instrument of this sort on adding constant aerial tuning would probably be a considerable increase in the tendency to oscillate, and it would therefore be found that it would be necessary to turn the potentiometer considerably further towards the positive end in order to stop self-oscillation. Such additional positive bias is certainly not an aid to selectivity, and, therefore, we are inclined to think that in this instance constant aerial tuning might not be an advantage, unless some other method of controlling reaction were adopted. Probably a better expedient would be to use a loose-coupled primary and secondary circuit, with a little negative magnetic reaction upon the secondary coil, to check the tendency to oscillate.

Radio Press Information Dept.
2/6 QUERY COUPON 2/6
WIRELESS WEEKLY. Vol. 5. No. 12. January 7, 1925.
This coupon must be accompanied by a postal order of 2/6 for each question, and a stamped addressed envelope.

Two Popular Envelopes and A Book

BY

PERCY W. HARRIS

Editor of "The Wireless Constructor."

Mr. Harris' reputation as a constructional writer and designer is second to none.

With an almost uncanny knowledge of the needs of the "home constructor," he is not only able to design sets which rank as the best of their kind, but he is able to describe them with a skill which enables even the beginner to follow his designs and obtain equally good results. Tens of thousands of sets have been made according to his designs, and every one has enhanced the reputation of the author and also that of Radio Press Ltd., who have the exclusive services of Mr. Harris.

Mr. Harris has two envelopes to his credit, Nos. 2 and 4 of the Radio Press Envelope series, each containing pages of photographs on art paper, sheets of instructions, wiring and panel blue prints, lists of components, and, in fact, all the features which have made Radio Press Envelopes the last word in guides to the constructor. He has also written a standard constructional work, "Twelve Tested Wireless Sets," which has had an enormous sale and which will strongly appeal to readers of "Modern Wireless" as all kinds of sets, from a crystal to a "Transatlantic," are fully described.

Read this letter from the South-West of Africa.

SIR,—I suppose you will be surprised at hearing from someone in the outskirts of the Empire, but I am only writing you a few words of appreciation of the Family four-valve set described in Radio Press Envelope No. 2. This compact little set is by far the best operating set I have yet handled. Having had nearly 15 years' wireless experimenting, I have naturally handled many sets.

As to results obtained, these exceeded anything like expectations. Cape Town (750 miles) comes in at good strength on H.F. and detector. With note magnifier added, signals are too loud for 'phones. The power of Cape Town is the same as 2LO, so these results are far better than could be hoped for. JB (Johannesburg), with ½kw. in the aerial, comes in quite loud on two valves, his distance being 740 miles. Shipping comes in with a roar. 5XX comes in with fair 'phone strength on three valves. Three a.m. one morning I managed to pick up KDKA on three valves at good 'phone strength. All high-power Morse stations come in well, and I can get them any time of day or night on two valves.

Hoping you will find this interesting, and congratulating you most heartily on your design of a thoroughly reliable and efficient set.

Yours truly, PERCY F. SYMONS.

Windhoek, S.W. Africa.

And this one :

SIR,—About three weeks ago I purchased the envelope containing particulars regarding the "All Concert Receiver," and wish to give you my results.

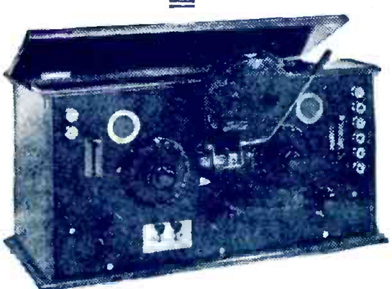
Without any wavetrap I am able to tune in 2BD at excellent loud-speaker strength, and with very slight interference from 5NO.

OTHER RESULTS: Radio-Paris, loud-speaker. 5XX, good; 5NO, excellent; 2BD, excellent; 5SC, good: these are all the B.B.C. stations which I have bothered with so far. Le Petit Parisien, loud in 'phones. Vox Haus? (woman announcer), fair loud-speaker. Hamburg, good loud-speaker. Breslau, fair loud-speaker.

I have had many more foreign stations than these, but have not heard their call signs.

HENRY R. MYERS.

Durham.



Envelope No. 4.

Twelve Tested Wireless Sets .. 2/6d. 2/8d. post free.
By Percy W. Harris.

Radio Press Envelope No. 2 .. 2/6d. 2/9d. " "
By Percy W. Harris.
(4-Valve Family Receiver)

Radio Press Envelope No. 4 .. 2/6d. 2/9d. " "
By Percy W. Harris.
(3-Valve All Concert de Luxe.)

All obtainable from wireless dealers and booksellers, or direct from the publishers, Radio Press Ltd., Bush House, Strand, London, W.C.2

Envelope No. 2.

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