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WHAT TO DO: If you can release any of these types of instrument please communicate at once with Mr. R. P. Browne, B.Sc., Secretary, The Radio Manufacturers' Association, 59 Russell Square, London, W.C.1, giving the details enumerated below. Only instruments in working order should be offered. Do not send the actual meter until advised.

PLEASE GIVE THESE DETAILS: (1) Type of instrument. (2) Approximate age and condition. (3) Whether it is a gift or for sale. (4) If the latter, the price desired. (5) Name and full address.

HE GIVES TWICE WHO GIVES QUICKLY

This Page appears by courtesy of the Automatic Coil Winder & Electrical Equipment Co. Ltd., (Makers of "Avo" Instruments), to reinforce Lord Hankey’s recent appeal, which is urgent and essential to the war effort.
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DECEMBER, 1941.

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Covering Every Wireless Interest

DECEMBER 1941

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**SHORT-WAVE COILS, 8-PIN.**

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**SHIELDING.**

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents.

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Amateurs and Professionals

Should Post-war "Experimental" Transmitters Know Morse?

Judging by our correspondence, those whose interest lies in amateur transmission are more prone than any other section of Wireless World readers to making plans for the post-war era, and the time when they can resume their hobby. Of the many problems that have been discussed in our columns, none has aroused more interest than the question "Should Amateurs Know Morse?". Before attempting to find the right answer, it seems necessary to clear away a misconception that has tended to obscure the real issue.

What we and our readers describe as "amateur" transmission would officially be known as "experimental" transmission. Theoretically at least there is no basic difference, as regards the G.P.O. machinery for licensing, between (a) an experimental station set up by a great wireless company for the investigation of some vital problem by a highly trained team of engineers, and (b) the station of an amateur whose sole interest (whatever he may say on his application form) lies in achieving long-distance communication. Real experimental work and the "hobby" side of transmission must be divorced from each other before we can think clearly on any of its problems, including the present one.

Everyone expects the number of amateur transmitters to increase greatly after the war, and one of the strongest arguments adduced by those who think they should know morse is that, in a given frequency band, there is room for more CW than 'phone stations. That the amateur who knows morse can, with a given power, communicate over much longer ranges and make more contacts will also not be disputed.

Another telling argument is that morse helps to overcome the language difficulty, thus enabling amateur radio to play its part in fostering international friendship. The pronunciation difficulty disappears, and it is a fact that operators of different nationalities do manage to exchange ideas with little trouble, thanks in part to the use of an international jargon of abbreviations and codes, some official and some highly unofficial, that has gradually come into being. It is also urged that, in the case of emergencies and the breakdown of other forms of communication, messages can be handled better by telegraphy than telephony; that is certainly true if the operating is good.

Officialdom holds that amateurs should know morse in order to understand signals from government and commercial telegraph stations with which they may be interfering. In spite of one correspondent having brought forward specific instances of such uses of morse, we are not convinced that this argument is sound; it seems to date back to the days of spark transmitters and broadly tuned receivers. It would be more useful to insist that the amateur transmitter could be reached through the land-line telephone by a G.P.O. control centre.

Those who object to the morse qualification do so mainly on the grounds that it may prevent well-qualified scientific workers from obtaining a licence, though others adopt the somewhat negative attitude that telegraphy, as opposed to telephony, is a crude and technically uninteresting method of communication.

Nothing in Dispute

When the controversy started we remained neutral. Now, after reading carefully all the arguments on both sides, one comes to the conclusion that there is really nothing at issue between the apparently opposed schools of thought. The answer, then, to the problem that has been intriguing our correspondents seems to be clear. Amateurs—using that word in its true sense—should know morse, or they will miss something of what amateur radio has to offer them. Professional research workers, or others qualified to carry out serious investigations, need not. It has been argued that without knowledge of morse they cannot observe the common courtesies of non-interference within the experimental bands. But that is surely a difficulty that could be overcome by suitable channel allocations.

The same applies, more or less, to a hypothetical third class of transmitters—true amateurs who wish to confine themselves to telephony. There seems to be little reason why they should not be allowed, subject to rather drastic safeguarding regulations, to work in strictly limited channels.
Broadcasting Over the Mains

"Wired Wireless" Distribution Over Electric Supply Networks

By P. P. Eckersley, M.I.E.E.

In this article the former Chief Engineer of the B.B.C. explains the technical means of putting into effect a project in which he has long been interested.

ONE must assume that the object of a broadcasting service is to interest—which is also amuse—the listener. But there is no such person as the listener; the public is composed of all sorts of listeners with varying tastes and prejudices, so, in order to amuse “all of the people all of the time,” broadcasting must cater for widely different tastes. It can only do this by simultaneously offering the listening public a large number of programmes to choose between. The listener should be able to listen “à la carte”; at present the poor chap has to “take the dinner.”

It is not possible to give a multi-programme service by radio because of the limitation of channels. True, one can “hear” lots of stations, but they all send the same type of programme: There is no continuous service of jazz, talk, symphony, light music, plays or whatever there could be if there were enough channels.

If wires rather than wireless waves were used to link the listener to the programme source, theoretically, any number of channels are available for the diffusion of any number of programmes. Obviously, carrier transmission would be used; transmitters would send their output into the network. Receivers, physically connected to the network, would be tuned to this programme or that. It is a radio system which does not radiate! Therefore, the carrier frequency separation can be ideal for high-fidelity reproduction, the signals strong enough to overcome any noise, and the receiver robust and simple.

Existing Wire Networks, or —?

A national service of wire broadcasting demands the existence of a conducting network interconnecting every house in the kingdom. This network could be constructed anew to form the basis of a “general communication” system, or the existing telephone and “electric mains” networks could be employed by superimposing carrier currents.

Sooner or later—later, if we go on being stupid—a new network will be constructed. It is within the bounds of possibility that this could be designed to diffuse a large number of sound and vision programmes as well as being used for the private telephone.

The attenuation of mains current with distance is an inherent factor in the possibility that this could be done. It is not possible to give a multi-channel service by radio because of the limitation of channels. True, one can “hear” lots of stations, but they all send the same type of programme: There is no continuous service of jazz, talk, symphony, light music, plays or whatever there could be if there were enough channels.

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connected. The shape of the network is determined purely by the run of the streets. Branch feeders, not shown, run from the street cables into the houses lining the streets.

Fig. 3 shows the schematic connections of a sub-station. The power distribution system is shown in full lines, the added connections, necessary for injecting the carrier currents into the street cables, in dotted lines. Only one outgoing cable and the secondary windings of only one power transformer is shown, it being understood there may be many street cables and several transformers. The primary of each transformer is energised from the higher voltage brought by the ring main. The potential points Ph1, Ph2, Ph3 (Fig. 3) produce voltages 120 deg. out of phase with one another, and from 200 to 240 volts above the "star" or "neutral" point N. This is at zero potential, and earthed at the sub-station, but, deliberately, nowhere else on the network.

Any number from two to fifteen street cables may run out from a sub-station. Each cable contains four copper conductors. These are laid in insulation. The insulation is wrapped in a lead sheathing S and this in turn has armouring outside it. The lead sheath plays an important part in the carrier current injection scheme and is, therefore, shown in the diagram. Armouring is not shown.

The three phases Ph1, Ph2 and Ph3 are connected to these cable conductors and the fourth conductor is joined to the earthed star or neutral point. The lead sheaths of all the cables are bonded together and are also bonded to the branch cables which connect the house wiring to the street cable conductors.

Fig. 4 indicates how the houses get a supply. Branch feeders, having a lead sheath but only two conductors, are joined between any one-phase wire and neutral. But to distribute the load evenly between phases, different houses are joined to different phase wires. In effect, a third of the houses are fed from one phase and neutral, a third of the houses from another phase and neutral, and the remaining houses from the remaining phase and neutral. Thus the neutral goes into every house and any one phase into a third of the houses. Each house thus has a single-phase supply.

It will be appreciated that, so to speak, a network of copper and a network of lead bonded together joins groups of houses, anything from 300 to 1,000 in common practice, to a given sub-station. The basic idea underlying our method of carrier current superimposition is to treat all the copper conductors in the street cables as one conductor and all the lead sheathing of the cables as the other conductor. This forms a two-conductor transmission line. Thus, so far as the carrier current system is concerned, we have got to bunch all the copper conductors together at the sub-station. An outright physical connection of these conductors would short-circuit the mains. But if condensers of large reactance to the power current (of frequency 50 c/s) but small reactance to the carrier currents (the lowest frequency of which is above 20,000 c/s) are joined from each phase and the neutral conductor to a common point, then this point taps all the copper conductors in parallel. One terminal of this bunch point is used to form one conductor of a transmission line for the carrier currents, the other terminal being the cable sheath.

This is illustrated by the dotted lines in Fig. 3. Through the four condensers, C, all the copper are joined in parallel to one terminal of the carrier current generator H. The other terminal of this generator is joined to the cable lead sheath.

Isolating the Neutral Wire

It is the object of the scheme to raise all the copper conductors to the same carrier potential. It would not be possible to raise the carrier potential of the neutral conductor to the same potential as the phase conductors unless the neutral earth connection were interrupted by a choke L. This is designed to have a high impedance to the carrier currents, but virtually zero impedance to the power currents. Thus, so far as the power system is concerned, the neutral remains earthed, but in respect to the carrier currents the neutral is insulated from earth and can be raised to the same potential as the phase conductors.

Once this is done, then, clearly at any point on the network all copper conductors have the same carrier potential. Since the domestic load (lights, cookers, refrigerators and so forth) is connected between any one of the phase conductors and the neutral, obviously there is no difference of carrier current potential across the load. So the load may vary between an infinite and virtually zero impedance without disturbing the level of...
Broadcasting Over the Mains—

the carrier currents thus superimposed.

Apart from the advantage that, with this method of carrier current injection, there is no necessity to fit an automatic gain control circuit in the house receivers, the scheme has the further merit of minimising "noises" developed across and by the lead.

Because, as is seen from the dotted lines in Fig. 4, showing the connections for energising a house receiver in one house by the carrier currents, one terminal for the input to these receivers is found at the junction of two condensers C connected between phase and neutral. Any disturbances created on the mains containing components in phase opposition do a conversion at the junction of the condensers. The majority of disturbances are phase opposed and so are not heard as interference noise.

"Selectors"—not Receivers

We like to call the house receiver "a selector" so as to underline the fact that it has few of the vices of a "wireless." It is energised as to its high potential point as described. Its earthy terminal must be joined, in effect, to the lead sheath of the incoming cable. The input impedance of the selector is purposely made very high. Thus if the path between the earthy terminal of the selector and the lead sheath is of high resistance, but lower than the selector input impedance, signals will not be diminished by this high resistance. Thus the earthy terminal of the selector may be connected to the third earthed pin of a three-pin power socket. If this is not provided, then the steel conduit in which the house wiring is run can be used.

In the rare cases where cab-tube tyre two-conductor wiring is used an earth has to be found as for a wireless set.

It is insisted that, so far as the transmission system is concerned, the return is not an earth return, albeit the return conductor is earthed. The transmission line proper—the bunched copper and the insulation—is a conductive cable, and the currents (which may be of the order of one or two amperes because the system is of very low impedance) flow only on the outer surface of the copper and the inner surface of the lead. These currents do not flow, in sensible quantities, in the high-impedance house wiring, nor into the high-impedance selectors; they exist to establish a potential on the low-impedance carrier network.

This rather long, but necessarily long, description, shows how, given a carrier current generator in a substation, all the houses fed from that sub-station can be given a programme supply. A thousand houses, at maximum, are fed from one sub-station; the average is more like five hundred. Thus, in order to cover an area, means must be devised to get a carrier current supply to each sub-station.

It would be wasteful to install separate transmitters in each sub-station. Thus our idea is to use repeaters in each sub-station which take a low-level supply from all the transmitters, located at some chosen point in the area, and amplify this to a value suitable for injection into the network. In fact, we require a scheme exactly similar to the power supply scheme illustrated in Fig. 7. That is to say, we want a pair of wires which follow the route of the ring mains, or at any rate which touches all the sub-stations, and which can carry the output of all the transmitters, each sending out separate programmes. This pair of wires must be tapped on to at the sub-station by the repeater input terminals.

Thus one method to achieve this would be to install all our transmitters at G in Fig. 7, energise the ring main with the carrier currents output from the transmitters, and tap the ring main on to the repeaters at each sub-station. But this presents difficulties. Kilovolts with thousands of kilowatts behind them terrify me, for one thing. Then the ring main has protective gear in its circuit which would impede the carrier currents. Condensers for by-passing the sub-station transformers would cost a lot of money and might break down. Power engineers hate one touching their sacred HT mains!

Using Inter-station 'Phone Lines

It is common practice to run ordinary telephone pairs in the same ducts which carry the ring mains. These are used by the engineers for talking from sub-station to sub-station and/or for operating protective gear. Since our currents are of super-audio frequency, we can use these pairs, even if they are being used to carry audio currents, to carry the high-frequency output from one set of transmitters—unique to the system—and distributing this combined output to the sub-station where it is picked up by the repeaters.

Thus, in sum, the basic conception is to use transmitters—just as there are programmes to be supplied—at some point in the area and to take their combined output on a telephone pair to all the sub-stations in the area. In each sub-station, repeaters, giving equal amplifications to all the frequencies in the complex representing the several modulations of the several transmitters, each having a different carrier frequency, amplify the combined disturbance and feed it into the street cables at a suitable level and according to the scheme previously described.

The reader will, I am sure, appreciate a certain reluctance on my part to give a much more detailed description of a scheme which, owing to the blocking of vested interests, has never had a chance of being put into practice. One must still hope that some happy day we shall be allowed to see if it all works our commercially as well as it has, in demonstration, technically.

Meanwhile the following more quantitative information may be of interest.

Some Data

The power required per programme, per typical street cable, is of the order of 1 watt. The impedance per typical street cable varies, if not terminated, between 0.5 to 1.5 ohms, and is usually inductive. Thus the current per programme is of the order of 1 ampere per cable. A cable, a watt, an ampere, an ohm is a good rough guide!

We use carrier frequencies, for a six-programme system, of 26, 39, 52, 65, 78 and 91 kc/s. These are, in fact, derived from the harmonics of a master oscillator having a frequency of 13 kc/s. If the carrier frequencies were not thus "cogged"—if, in other words, each transmitter had a separate drive—the peak voltage of the combined equal output of all transmitters would be six times the peak voltage of one. This would require a repeater dealing with 36 times the power of one programme. By cogging the frequencies the peak voltage of the combined disturbance may be adjusted so that the repeater power is only a little more than six times the power required for one programme.

The lowest "house voltage" on a typical network energised by powers of the order given above is about 300 millivolts. This gives the required signal-to-noise ratio.

We have demonstrated a selector giving noiseless reproduction when plugged into the same socket as was being used to operate a flashing neon sign. We laugh at vacuum cleaners, refrigerators, light and power switches, and so forth.

The transmitters are designed on the asymmetric sideband principle. This has been discussed in published papers. Suffice it to say that we get a "level" audio output up to 8,000
c/s from the very simple and cheap selector, with a carrier separation of 13 kc/s. The extra harmonic distortion introduced by the asymmetric principle is of the order of 2 per cent, at 1,500 c/s; less at zero or other frequencies.

Our object has been to make the selector (house receiver) cheap to manufacture, easy to operate and pleasant to listen to. The superheterodyne principle is used and there are two stages, one a frequency changer, the other a combined second detector and output valve. The maximum "undistorted" power output is 2 watts; quite enough (too much?) for an average room.

There are two filters; one preceding, the other following; the frequency-changer valve. The first filter deals with the signal-frequency currents and has settings to give it the same band width of response over the six bands of frequencies representing the six programmes. The filter following the mixer and dealing with the intermediate-frequency currents has, as in common practice, a constant performance.

The user has no fine tuning to do. A rotating switch is provided which clicks into any one of six positions. Only when the click mechanism registers can the programme be heard. Thus, no mistakes can be made; the filters are designed to give their correct responses at the given setting. This exact design is made feasible because the carriers are, compared with radio practice, of much lower frequency. The minimum ratio of maximum side band to carrier frequency is (say) 1,000 to 1,005,000 = 1.005 in average radio practice. This makes filter design for the carrier current scheme ever so much simpler.

The quotations we have had for manufacturing the selector in quantities shows that the cost is far less than for a radio receiver of comparable performance. But what can a radio receiver give, in variety of choice of programmes with clear reproduction—considering the carrier separations and relative levels—compared with a wire broadcasting system such as I have attempted to describe?

### Wireless Engineering

In his inaugural address as president of the Institution of Electrical Engineers on October 23rd, Sir Noel Ashbridge, B.Sc.(Eng.), who is Controller of Engineering of the B.B.C., stated that he felt the added responsibility of being the first representative of a new public undertaking to hold the office. Sir Noel, who is in his fifty-second year, has been with the B.B.C. since 1926. Immediately prior to that time he was at the Marconi Company’s experimental station at Writtle, Chelmsford. He was knighted in 1935.

As is customary for the president, he dealt with the subject on which he has specialised for many years, and in doing so treated the subject as a general engineering one. He gave a very comprehensive review of the whole field of broadcasting in this country, "avoiding the more detailed and highly specialised questions." The international wavelength situation and its effect on this country was very thoroughly covered. Short reviews of the television and overseas services were also given. It was interesting to hear Sir Noel state that the expenditure on the London television service was, in effect, 30 times greater than would have been covered by a licence fee of ten shillings from viewers.

He made some interesting observations concerning engineering training in his concluding remarks. "It has sometimes occurred to me," he said, "that the methods used in the medical profession to train students might be applied to engineering. Here, I believe, lectures and clinical work proceed side by side after the first two years or so. One might almost visualise the equivalent of clinical work, which is, I think, the right term applying to explanations of practical problems—so to speak—on site. This, of course, is not a new theme... but a complete separation between theoretical and practical training is still common." Visualising that large numbers of war-trained students who have been through short courses and prematurely pushed into industry, "to meet exceptional demands which cannot possibly continue for long after the war," will have to be absorbed into peacetime activities as nearly allied to their wartime employment as possible, he suggested that some scheme of parallel factory and college work will be necessary if such men are to be capable of equipping themselves for higher posts while still supporting themselves. He pointed out that if nothing is done there will be a large number of unemployed and part-trained men attached to the industry, who will constitute a problem for years to come.

So far as frequency modulation is concerned, Sir Noel suggests that the advantage of frequency modulation may be exploited in connection with television services, since in most countries there are no commitments with regard to television systems. "No thoughts on the work which should be undertaken in relation to broadcasting after the war would be complete without including the outstanding question of television," stated Sir Noel. "There will be the obvious necessity of a rapid restoration of the service, but it cannot be assumed that this should be immediately restarted without regard to the lapse of time which has taken place. It cannot even be assumed that the same fundamental standards of definition should be adopted. Not many budding industries in the nature of a public service have had the advantage (some people might say it was a disadvantage) of making a new beginning after two or three years of regular working, and it is hoped that the fullest advantage will be taken of this almost unique position."

### Choosing Replacement Valves

**An Official List**

Many valve types are scarce, and so, to assist in the choice of suitable alternatives, the British Radio Valve Manufacturers’ Association has prepared a list of equivalent and "preferred" types. This list, which has now been issued by The Wireless World in booklet form, costs 1s. through newspapers or booksellers. Direct from our publishers, by post, the cost is 1s. 1d.
Aerial Coupling
Which is the Best Circuit for All-round Efficiency?

By S. W. AMOS, B.Sc. (Hons.)

Attention to the design of the aerial coupling is worth while in all types of receiver, but is especially important in small, economical sets if an adequate performance is to be obtained. The article discusses the merits and shortcomings of well-known types of aerial coupling.

A GOOD aerial coupling should give the best possible amplification and selectivity at all settings of the tuning condenser, should not unduly restrict the waverange of the circuit, and should be such that the readings of the tuning condenser are substantially the same no matter what the constants of the aerial system.

Any aerial-earth system contains inductance, capacity and resistance, and accordingly Fig. 1 (a) has the theoretical equivalent shown in Fig. 1 (b), where \( V \) represents a generator of alternating potential. This forms a series tuned circuit with a resonant frequency, the value of which is dependent upon the shape and size of the aerial system, and hence the amount of inductance and capacity present. Typical values for \( L \), \( C \) and \( R \) for an average outdoor horizontal aerial are 20 \( \mu \)H, 200 \( \mu \)F and 50 ohms respectively, giving a resonant frequency of 2,516 kc/s (110 metres).

Fig. 1. The characteristics of any aerial-earth system (a) may be simulated by a series resonant circuit (b) in which the value of \( L \), \( C \) and \( R \) are appropriately chosen.

These values of \( L \), \( C \) and \( R \) will be used in some of the subsequent calculations.

In the early days of radio a type of aerial coupling frequently used is that illustrated in Fig. 2 (a), from which it can be seen that this is the simplest possible method of connecting an aerial to a tuned circuit. The theoretical equivalent of the circuit is given in Fig. 2 (b), from which it is clear that the aerial capacity \( C \) is effectively in parallel with the circuit \( L_1 C_1 \). If \( C_1 \) has the usual maximum value of 500 \( \mu \)F and if \( C \) is 200 \( \mu \)F, then the greatest possible variation of capacity in the tuned circuit is from 200 \( \mu \)F to 700 \( \mu \)F, i.e., an increase of 3.5 times. The ratio of maximum to minimum wavelength receivable depends on the square root of this, and is hence 1.87, a value which might have some application in long wave circuits, and it would permit reception over a range of 1,070-2,000 metres, but which would be very inconvenient for general use on medium and short waves, where we want a value of 2.75 at least. It is clear, too, that the dial readings of condenser \( C_1 \) will depend on the constants, chiefly the value of \( C \), of the aerial-earth system.

The selectivity of this system is very poor indeed. This, of course, was of no consequence in the early days of broadcasting. This simple aerial coupling thus has many disadvantages, but it should not, therefore, be assumed that the method is obsolete and completely useless, for it has an application in simple receivers used purely for high-quality reception of local stations. Here the good amplification is useful, and the lack of selectivity is an advantage, as it permits good reproduction of the sidebands and, if the receiver is insensitive and close to the transmitter, there is no possibility of interference from stations of neighbouring frequencies.

The first step towards improving the selectivity of the arrangement in Fig. 2 was made when a fixed or variable condenser \( C_0 \) was introduced into the aerial lead as shown in Fig. 3. Theoretically this simply reduces the effective value of the aerial capacity \( C \), and the practical consequences of this are an improvement in selectivity and an extension in waverange. Moreover if \( C_0 \) is very small compared with \( C \) the dial readings will be independent of the constants of the aerial. Many such condensers were, and still are, marketed in impressive boxes, and all sorts of fantastic claims—and charges—were made for them.

Fig. 3. The introduction of a small series condenser \( C_0 \) in the aerial lead will improve waverange and selectivity at the expense generally of amplification.

Suppose we wish to calculate approximately the value of \( C_0 \) which will permit reception of the medium waveband 200-550 metres. The capacity variation needed is 7.56:1 (i.e., 2.75²:1). Neglecting stray capacities, we can see that this variation is possible when \( C_0 = \frac{500}{2.75^2 - 1} = 80 \mu \)F approximately. Since strays may account for some 30 \( \mu \)F, a smaller value, say 50 \( \mu \)F, should be used in practice. Two 0.0001 \( \mu \)F condensers in series will give this value.

The variation in amplification at various frequencies given by such a circuit as this is shown in Fig. 4, in which curve (a) applies to the circuit of Fig. 2, and curve (b) applies to that of Fig. 3, the series aerial condenser being taken as of 50 \( \mu \)F capacity. The effect of the condenser is to move the peak considerably towards the high frequency end of the spectrum, so much so, in fact, that it does not fall within the range of medium waves at all. As a consequence, the amplification over the medium-band range is reduced.

The effects of aerial capacity are particularly marked in the case of short-wave circuits. Consider such a circuit which includes a coil of 8 \( \mu \)H inductance, and a parallel tuning condenser of 100 \( \mu \)F maximum capacity. Allowing 4 \( \mu \)F for valve capacities and 7 \( \mu \)F for the minimum capacity of the tuning condenser, by application.
of the formula $\lambda = \frac{1885}{\sqrt{LC}}$, the wave-range can be shown to be 17.7 to 54.4 metres, which includes most of the interesting short-wave transmissions. If a normal outdoor aerial is connected directly to such a circuit according to the circuit of Fig. 2, the tuning capacity is just "swamped," and recourse to $\lambda = \frac{1885}{\sqrt{LC}}$ again shows that the tuning range obtained is 78 to 92 metres, which does not include any of the desired band! If we do not wish to disturb the calculated wave-range unduly the circuit of Fig. 3 can be used, and, if we decide to include the 15-metre band, Co must not exceed 2 or 3 $\mu$F. Capacities as small as this can be made by running two pieces of wire about 20 S.W.G. in Systollex sleeving parallel for an inch or so. This calculation shows very convincingly the need of an aerial with a very low capacity for use on the short waves. A short vertical rod answers this requirement well. The series condenser method of aerial coupling is recommended.

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Another method of increasing the selectivity of the circuit of Fig. 2 is by connecting the aerial to a tapping point on the coil, as shown at Fig. 5 (a), the theoretical equivalent of which is given at Fig. 5 (b). This has the practical consequences, as before, of effectively reducing the capacity due to the aerial, which is thrown across the coil, and so improving the wave-range coverage and the selectivity. It is a very simple matter to calculate roughly the capacity "reflected" into the tuned circuit $L_1C_1$. If the

$$L_1$$ has 90 turns, and the aerial is attached to a point $z_0$ turns from the earthy end, and if the aerial capacity is 200 $\mu$F, then the capacity effectively in parallel with the tuning system is given by the usual formula $L = \frac{1885}{\sqrt{LC}}$.

The selectivity of the circuit is shown graphically in Fig. 4, where the selectivity of the circuit $L + Lo$ is expressed in $\mu$H, and $C$ is expressed in $\mu$F. The selectivity of the circuit $L + Lo$ is shown in Fig. 4, both to circuits with "reflected" capacities of 50 $\mu$F, and hence with the same wave-range. The superiority of the tapped coil with regard to amplification is clearly shown by a comparison of the two curves.

Although low tapping points give the best performance as regards amplification, selectivity and wave-range is obtained with the aerial attached at the approximate middle point of the coil.

For such a connection the "reflected" capacity is one-quarter of the aerial capacity, i.e., is about 50 $\mu$F for an aerial in which $C = 200 \mu$F. Curve (d) of Fig. 6, and curve (b) of Fig. 4, both apply to circuits with "reflected" capacities of 50 $\mu$F, and hence with the same wave-range. The superiority of the tapped coil with regard to amplification is clearly shown by a comparison of the two curves.
Aerial Coupling—

Poor amplification, some extensive waveranges can be secured with the aid of them. Suppose, for example, a medium-wave coil of 157 µF is tapped so that one-tenth its total number of turns are included in the aerial circuit. The “reflected” capacity is 260 or 2 µF. With careful attention paid to choice of a tuning condenser with a low minimum capacity the total strays can be reduced to about 30 µF, giving a capacity variation of 17:1, and hence a wavelength variation of about 4:1. If the maximum wavelength received is, as usual, 150 metres, then the lowest obtainable is 140 metres.

The difficulty with all the methods of aerial coupling described up to now has been that the factors selectivity, amplification and waverange are interdependent. Increase of amplification is usually achieved at the expense of selectivity and waverange and vice versa. The transformer method, the theory of which is in many ways very similar to that of the tapped coil, offers better possibilities of giving a superior performance in these three respects, as the degree of coupling between primary and secondary windings can be varied (it was fixed, of course, in the tapped coil).

The effect on selectivity and amplification of varying the degree of coupling is illustrated by the curves of Fig. 8, which is reproduced from an article by Reed. It is clear from this that the optimum coupling for amplification does not give best results as far as selectivity is concerned, but it also shows that there is one particular degree of coupling—actually one-half the value for optimum amplification—which gives 80 per cent. of the maximum possible selectivity and the same percentage of the maximum possible gain. This degree of coupling is clearly a very good compromise, and RF transformers are best designed with reference to it. It is somewhat unfortunate that there appears to be no simple rule for calculating degrees of coupling between coils, which means that this particular method of aerial coupling, though theoretically very good, is not and will certainly not be made from the waste paper which we contribute. But it must not be forgotten that wireless instruments, whether produced for the Services or for domestic use, are of a very delicate nature, and will need a good deal of packing material, and we certainly can visualise our waste paper being put to good use for the protection of Service wireless gear.

New R.C.A. Record Changer

M ANY of the 1942 series of R.C.A. Victorla radio gramophones recently announced in America are to be fitted with a new automatic record changer which plays both sides of each record without turning it over.

The essential feature of the new design is a tandem tone arm with two pick-up heads, one of which is used to play the underside of the record. A special light movement with a permanent sapphire needle has been designed, which will follow the groove faithfully with less pressure than is required to lift the record or cause it to slip on the diminutive turntable, which, with underside playing, must be smaller than the title label. Up to fifteen records are stacked on three automatic release supports arranged round the outside of the record. The bottom record is dropped on to the turntable and played in the usual way by the top pick-up. At the end of the record the arm swings out, the turntable is stopped and restarted in the opposite direction, and the bottom pick-up is gently raised into contact with the run-in groove of the underside of the record.

Finally, the dual tone arm swings clear of the record, which is then gently deposited through a slot into a felt-lined compartment at the side.
"Total War"

A Lightweight Portable for Emergencies

By W. H. CAZALY

Here is a type of "stand-by" receiver that almost everyone needs nowadays. The design is sufficiently flexible to allow a wide choice of components; even the "junk-box" may be counted upon to provide many of them.

The design of unorthodox receivers with miscellaneous circuits and components has acquired a new and serious significance in these times, and it is worth while to review the possibilities inherent in the "junk-box." Many cases of servicing and new construction will increasingly rely on it. No apology is made, therefore, for presenting this effort at adapting the use of odd components to suit wartime conditions.

The circuit employed in this case is given in Fig. 1. Needless to say, once one starts this sort of thing, the variations of arrangements that leap to the mind are endless; to discuss them even in part in an article such as this is out of the question. This circuit was finally chosen, after a deal of experimenting and calculation, because it seemed to conform to the purpose in mind—that of producing a compact, sturdy, self-contained receiver, with the minimum of special components, that would keep the owner in touch with official sources of broadcast information on both the SW and the medium wave-bands, in the event of extraordinary situations arising. Reliable headphone reception is provided on two SW bands covering from well below 15 metres to over 80 metres, and also from 200 to 500 metres; loud speaker output is obtained if required on the MW band and on some of the SW stations; HT consumption at from 50 to 70 volts is of the order of 2.5 to 4 mA, and LT power may be derived either from cycle lamp batteries or, with slight circuit alterations, from a small accumulator.

The practical model made up by the author is shown in an accompanying photograph. Of course, innumerable modifications in layout are possible, provided fundamental principles are borne in mind. It was built that way because, in that form, despite its obviously "home-made" appearance, is fitted comfortably into a biscuit tin measuring 3½ x 3½ x 7½ in., the lid being used as a "chassis" or base upon which all the components are mounted, while another tin of the same size attached, as shown, held the HT and LT batteries. The aerial and earth consist of lengths of flex carried when not in use on wire hooks

Fig. 1. Complete circuit diagram. The frequency bands covered are, approximately, 600-1,500 kc/s, 4-12 Mc/s and 12-21 Mc/s. (Much depends on stray capacities.) Values of components are:
- C1, C3, 0.0001 μF;
- C2, C4, C7, 0.0005 μF;
- C5, 0.01 μF;
- C6, 0.005 μF;
- C8, 4 μF;
- C9, 0.25 μF.
- Ri, 1 MΩ;
- R2, 10,000 Ω;
- R3, 10,000 Ω;
- R4, 1 MΩ;
- R5, 100,000 Ω;
- R6, 280 Ω;
- R7, 1 MΩ;
- R8, 0.1 Ω.

Filament characteristics of the valve types shown:
- V1, 2 V, 0.1 A;
- V2, 1.4 V, 0.05 A;
- V3, 1.4 V, 0.1 A.
"Total War" Receiver—
soldered on the side of the case, each
being provided with a crocodile clip.
To put the set into operation, it is
only necessary to unwind the aerial,
fling it out and clip it up to some high
support, clip the earth to the nearest
convenient earthed point (even a
metal skewer stuck into moist ground
will do), connect the headphones
(which may conveniently be a light
pair with tape headbands), and switch
on. The whole forms a box shape that
is easily packed or carried with other
belongings when on the move.

There is, of course, more in these
simple designs than meets the eye.
The most important factor of all is
the control of reaction; unless this is
extremely good, reception on the SW
bands with this type of receiver is very
unsatisfactory. First of all, it is neces-
sary to obtain oscillation with the
low anode voltage available. Some
thought and care in construction must
be expended over the portions of the
circuit involved. The "classical"
magnetic feed-back system is excellent
for MW bands, but uncertain at higher
frequencies. The Colpitts is excellent
for high frequencies, but the use of
series tuning condensers curtails the
coverage on MW. The Hartley is ex-
cellent on both, but needs to be modi-
ified to get rid of certain disadvantages
that are present in its basic form—see
Fig. 2 (a). Here, it will be seen, the
tuning condenser is "live" on both
sides to both HT positive and to RF.
These disadvantages are removed by
adopting cathode coupling, which, as
shown in Fig. 1, is embodied in the
receiver. The action of this circuit is
perhaps best understood by deriving
it in steps from the basic Hartley (see
Fig. 2). The tuning condenser may
have one side put at earth potential as
regards DC from HT without affect-
ing the principle of operation by in-
cluding a "blocking" condenser C2 in
Fig. 2(b). This still leaves both
sides of it "live" to RF, however,
and this is avoided by a slight re-
arrangement of the components, as
shown in Fig. 2(c), in which the rotor
(moving vanes and spindle) is tied
down to chassis. This has a further
advantage in putting the reaction con-
trol resistance effectively at chassis
potential as regards RF, which avoids
"hand-capacity" effects, although it
is still necessary to insulate this com-
ponent from chassis from a DC and
AF viewpoint—but this is easily done
with fibre bushes. The arrangement
now becomes substantially that of
Fig. 1. It will be observed that con-
trol of reaction consists essentially of
controlling the capacitative path for
HF from the anode of the detector
valve to the chassis; for this reason R2
in Fig. 1 must have very low self-
capacity. It might further be argued
that R2 need not be in the path of the
DC anode current, since variable com-
position resistors in such positions are
notoriously noisy; some such arrange-
ment as that in Fig. 2(d) might be
adopted. The objection to this idea
is that it is difficult to substitute a
choke in place of a resistor in this
particular instance, because chokes
usually have resonances at RF that
are apt to be exceedingly troublesome
in the control of reaction, especially
when, as in this case, they are required
to be effective from 15 metres to 500
metres. A suitable choke was found
to have a wide field and to be exces-
sively bulky. A resistance, therefore,
becomes necessary in place of the
RFC in Fig. 2 (d), but if it is fixed at,
say, 10,000 ohms, which is satisfactory
over all the frequencies involved, it
very considerably reduces the anode
voltage and the AF developed across
the transformer primary, and so may
make reaction hard to obtain at the
higher frequencies, and certainly re-
duce the overall gain at AF. As a
matter of fact, a certain amount of
AF gain is lost even with the arrange-
ment finally adopted, shown in Fig. 1,
since R2 always has a certain amount
of resistance; but the loss is compara-
tively small, and the simplicity and
saving of space and excellence of con-
trol are adequate compensations. As
was said earlier, once one starts dis-
cussing variations of these circuits,
endless avenues of possibility open up;
if readers think something else would
be better, they have only to try it.

For the same reason—to avoid the
use of specially designed and awkward
chokes—half of the tuning coil con-
sists of a double winding that also

![Fig. 2](Image)

**Fig. 2.** From the basic Hartley of diagram (a) the three other circuits can be derived. Corresponding components bear similar reference lettering. Comparing these circuits with Fig. 1, C1 here corresponds to C2, C2 to C4 and R to R2.
Wireless World

DECEMBER, 1941

The choice of a detector valve is fairly wide, since it is only necessary that its characteristics should be such that the changes in conditions brought about by reaction control should have the minimum effect on its behaviour and that its Ra should be low. To avoid bulk, the older type of screen-grid or pentode non-vari-mu HF valve is not used. The newer smaller valves with vari-mu characters are put and some what critical electrode potentials do not appear to hold themselves well to really smooth reaction control without high anode potentials; backlash is very annoying. There are, however, many triodes that behave excellently, especially when control is obtained, not by greatly varying the anode voltage and so the mu and Ra, but by varying, as is done in this case, the amount of RF feed-back alone. On the higher frequencies, however, the triode must have a comparatively low Ra, even if it has a correspondingly low mu. One of the "first LF" type—Ra about 8,000 to 12,000—is suitable.

Concerning the choice of components generally, the following remarks may be of assistance.

The coils, of which the constructional data are given in Fig. 4, should be carefully made and be of a form closely to the dimensions given. The tuning condenser actually used in default of anything better is an aluminium one; it was washed in strong soap and water and dried thoroughly, to clean it and improve the surface of the vanes—aluminium is attacked by alkali. A brass condenser would probably give better results. The coils are mounted directly on the 4-pole 3-way Yaxley type switch—which happened to be handy in the junk-box—by stiff wire leads. The use of plug-in coils is apt to give rise to hand-capacity effects besides being cumbersome. Of course, if a switch of this kind is unobtainable, it may be necessary to cut out one of the SW or the MW bands and use a simpler switch. The valves are "de-capped"—i.e., the bases are removed, and connections are made directly to the leads from the electrodes coming through the glass pinch—in the case of the AF valves for saving of space, and in the detector for efficiency; the composition bases of detector valves give rise to surprisingly high losses at high frequencies that may make all the difference to reaction. The AF transforms the thickness of the resistance wire available, may be calculated from data given in wire tables. Of course, all the valves may, if desired, be of the two-volt type, if corresponding and obvious changes in filament wiring are made.

Perhaps the author may be permitted to mention that the desire for and notion of this receiver was provoked by his experiences in France during the retreat to Dunkirk, when English broadcasts of news bulletins picked up on the "domestic" receivers taken out by his unit for purely entertainment purposes sometimes proved, during those anxious days, almost the only effective means of finding out what was happening, what parts of the country were likely still to be open, and of planning movements in the event of losing touch with HQ. He does not wish to risk being "caught blind" in the future.
Progress in Telearchics

Controlling Model Aircraft by Wireless

This plane, winner of the National Contest held at Detroit, has an 8-ft. wing span and weighs 8 lb. including 2 lb. of radio gear and 2 oz. of petrol. Rudder and elevator controls operated by the solenoid - escape-ment system are employed. The drop-door shown gives access to the wireless apparatus.

TELEARCHICS, or the distant-control of mechanism, has been a subject which has always interested not only the wireless enthusiast, but also the ordinary man in the street, and in no direction is this interest more strongly shown than in the radio-control of model aircraft. Turning to The Wireless World of nearly 30 years ago, we find that in September, 1913, an account was given of the great interest taken by the general public in the radio-controlled model aircraft which were being demonstrated at the Earls Court Exhibition, a demonstration in which a number of model battleships were successfully bombed, the bomb-releasing mechanism being also controlled by wireless.

After that we don’t hear much of radio telearchics for thirteen years, until in 1926 this journal gave constructional details of wireless apparatus used to control the movements of a model boat. No great interest was shown, however, probably because at that time there were so many and varied other applications of wireless which claimed the attention of both technicians and the general public. It has been left to the U.S.A. to develop the science of modern radio telearchics, and, judging by a report published in the American amateur radio journal, QST (from which the illustrations in this article are taken), of the aerobatics performed by several radio-controlled model aircraft at the eleventh meeting of the National Model Airplane championship meeting at Chicago in July, simply amazing progress has been made.

Among the feats performed by the eight radio-controlled planes which took the air were taking-off, spot landing, figure-of-eight flying, cross-country flights to given objective, spins, power-dives and, most astonishing of all, a perfectly executed demonstration of looping-the-loop, in which the plane took off under radio control, climbed to 1,500 feet, power-dived to within a few feet of the ground and then climbed steeply and turned over on its back in a graceful loop at a height of about 300 feet.

Model Aircraft Up-to-date

The main thing that will interest the wireless man will be the means whereby the radio control is carried out. First, however, a word must be said about model aircraft as they are understood the term in America. We must get rid of any preconceived ideas of small boys launching elastic-powered motor. The control was simple, said one tooth to “escape” each time the magnet is energised. The rotary motion of the wheel is converted to the reciprocating motion needed by the rudder by a radio-control event appeared on the programme. This must be reckoned as the official birthday of radio-controlled aircraft flying, for although there had been much talk, and a great deal of unsubstantiated, but possibly true, claims made previously, there appears to be nothing “official” before the summer of 1937.

Radio control was first applied in 1937 to model sailplanes, that is to say, gliders. The control was simple, and applied to the rudder only. Although complex arrangements of selector switches such as are used in automatic telephone exchanges were suggested—and have since been adopted—they were too complicated and required too much battery weight to be a success in those early days, and so we find a very simple arrangement being used consisting of an escapement wheel driven by an elastic-powered motor.

The escapement wheel is very similar to that of a clock, except that there are only four teeth. A simple solenoid is used to allow one tooth at a time the magnet is energised. The rotary motion of the wheel is converted to the reciprocating motion needed by the rudder by means of a very simple “link” connection. Its modus operandi can be clearly seen in Fig. 1. Since there are four teeth to the wheel, the rudder will go through a complete cycle of movements for every four operations of the relay, centre, full left, centre,
full right. By using a larger number of teeth it seems fairly clear that intermediate rudder positions could be obtained.

Now the obvious disadvantage of this method is that movements of the rudder must be in sequence, and to repeat any movement it is necessary to go through the whole sequence of movements. Thus, if the rudder has been turned to the left, and then returned to centre by a further impulse from the relay, it is not possible to turn it left again until it has been turned to the right and again returned to centre. The disadvantage is not so great as it seems, however, as the whole sequence of rudder movements can be run through in a fraction of a second, so that the plane gives no more than a "flicker" in its attempt to obey the unwanted movement which the rudder momentarily urges upon it when passing through the sequence. This argument applies also when an additional control unit is used to operate the horizontal rudder, or elevator as it is usually called.

The Modus Operandi

This simple elastic-powered escapement-control system must not be confused with an earlier system used by experimenters in which the solenoid, instead of being used to release the escapement, was linked to the rudder in an attempt to operate it direct. Such arrangements were never very successful, as they needed quite considerable power.

Before dealing with more complicated systems of control we must now turn to the method whereby wireless is used to energise the escapement-releasing relay. It will be opportune to discuss it in full here, since the purely wireless part of the business is more or less the same, no matter whether the actual method adopted to control the rudder, etc., is simple or complicated. What is needed is a receiver which, on the receipt of pulses from a comparatively low-powered transmitter situated within about a mile or so from its base, as it is not, of course, possible to control their movements effectively unless they are well in sight. For this reason, also, the power of the transmitter used for control is quite small, as low as five watts in some cases, although the average power used seems to be round about the 20-watt mark, one or two rather complicated arrangements using up to 60 watts.

There is little need to say much about the transmitters, which are conventional five-metre outfits designed to give several spot frequencies round about the five-metre mark. The actual number of channels used depends on the number of controls on the aircraft, and also the method of control used. Thus, in the escapement system already described, if the rudder only is controlled, then only one channel will be required, another channel being necessary for the elevator, and another for motor speed control, and so on. Other more complicated arrangements may require two channels for each control. Each channel normally means a complete receiver, or, in other words, a valve and its associated components. An alternative method is to adopt a pulsing system like that of the automatic telephone in order to control the various channels, and this system is actually used by many designers.

The Joystick Principle

One of the most interesting parts of the apparatus is the actual ground control unit, apart from the transmitter. At first simple keying was adopted, a dash being sent out to operate the escapement or controlling relay. It was soon found, however, that the operator forgot in which position he had last left the rudder; and, desiring to turn sharp left to avoid a tree, he would fail to remember if one pulse would do the job, or if two preliminary sequential pulses were first necessary in order to bring the rudder to the right and back to centre once more. The result was that crashes were frequent.

Many ingenious solutions to the problem have been found, but probably one of the best is based on the joystick principle. Control is effected by means of a specially constructed switch which is so arranged that it not only resembles a joystick, but the position of the switch handle gives a direct indication of the position of the rudder in the plane which it is controlling. When the switch is to the left, the rudder is to the left, and so on.

Another development which contributed materially to this weight reduction was the production of a sensitive and reliable relay weighing only two ounces, or about one-quarter of the weight of relays previously used. The sensitivity of these relays is extremely high, and some of them will work on a power of less than one milliwatt.

The circuit which seems to be universally employed is that of the super-regenerator, but this is not very surprising when it is remembered that the wavelength used for control lies in the five-metre band. At first an 80-metre wavelength was employed, which, curiously enough, was approximately that used in the case of The Wireless World radio-controlled model boat in 1926. It was quickly found, however, that for various reasons a five-metre wavelength was more suitable. One reason was that the problem of receiver design was simplified.

The comparatively short range of the direct ray on the five-metre band is an advantage rather than otherwise, as it limits the risk of a transmitter interfering with other services. There is no object in having a greater range than radio-controlled model aircraft are not normally flown more than two miles or so from their base, as it is not, of course, possible to control their movements effectively unless they are well in sight. For this reason, also, the power of the transmitter used for control is quite small, as low as five watts in some cases, although the average power used seems to be round about the 20-watt mark, one or two rather complicated arrangements using up to 60 watts.

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Progress in Telearehes—

When the switch is at the midway position, the rudder is likewise positioned, but the operator, who may want to move the rudder to the left, cannot tell whether he need only push the switch to the left or whether the rudder first requires to be taken over to the right and then centred again. Therefore, a ratchet is attached to the joystick so that it can only be moved in sequential order. In some cases, telephone switches of the central-zero type have been adopted for this purpose.

Usually, the control panel is not built into the transmitter, but is mounted on a light camera tripod and attached by a long length of twisted wire to the main unit. This is done so that the operator can take or make advantageous position for observing the movements of the plane, such as on a mound or even up a tree. Transmitters are usually designed to take all their power from a car battery, and are mounted near the parked car, a simple type of telescopic aerial being employed.

More Elaborate Systems

On the plane, battery weight must, of course, be considered, but, fortunately, in recent years the development of the so-called personal receiver in America has made battery manufacturers weight-conscious, and it is possible to buy 45-volt HT batteries weighing only 5 oz. Since the standing plate current is under 2 milliams, no trouble arises on account of ampere-hour capacity. For filament lighting flashlight batteries are normally employed. These provide filament current for several hours continuously. In cases where electric motors are used for controlling the plane, flashlight cells are also used to provide the 4½ volts necessary.

It is not surprising that right from the beginning attempts have been made to supersede the escapement system, with its need for sequential operation, by other systems in which instantaneous reversal of rudder or other controlled member can be obtained without going through the complete cycle of movements. For this purpose great use has been made of the small reversible electric motors produced for push-button receivers. Many arrangements employing these motors have been developed, some simple and some elaborate. In general, with these systems the relays may be considered as switches which turn the motors on or off, and these switches are “open” when receivers are “idling” (no pulses being received), and the motor turns either when a signal comes along, or when, for some reason, the receiver suddenly goes dead and the plate current drops to zero. Systems which employ these motors are gradually displacing older arrangements.

The Interference Problem

By far the most elaborate of these motor arrangements is that used by the first-prize winner at the 1941 national meet, and it is worth explaining in some detail. The whole plane only weighed five pounds, and, in view of this fact, it is astonishing what an elaborate system of control was used. The plane had two standard manufactured receivers, one working the rudder with continuously variable movements, and the other controlling the engine revolutions. The rudder was normally held over at full left, presumably by spring loading. A variable-speed DC motor operating it through a fluid-drive clutch tended to pull it over through the centre position to full right. The amount by which the rudder was pulled over depended on the grip exerted by the fluid-drive clutch, which, of course, was itself dependent on the motor speed.

The job of the ground control unit was, therefore, to control the motor speed. This was done by providing at the ground control point a similar motor having its speed controlled by a series rheostat, the handle of which constituted the joystick. This ground motor controls the keying of the transmitter in such a way that the corresponding motor in the plane runs at the same speed, the rudder being deflected in the manner already described.

The engine of this plane had two timers, one set for full speed and one for slow. Normally the full speed timer was connected, but the controlling signal caused it to be displaced by the slow speed one. The second-prize winner at the show was the plane which looped the loop, as already described. In this aircraft there were rudder and elevator control, motor speed control and motor-off control, the latter being effected by breaking the ignition circuit for a sufficient time to allow the motor to “die.” Only one receiver was used, but there was a very elaborate dialling and pulsing arrangement, on the principle of the automatic telephone, and the ground-control unit represented a miniature automatic telephone exchange with all its pulsing relays and selector switches. The radio equipment on the plane weighed 3½ lb., about one-third that of the remainder of the plane, including the engine.

Another competitor used a battery of door-bell pushes on his control unit, with rows of synchronised dial lights to indicate the position of each control on the plane.

The mystery ship of the meeting, which was not actually tried out in the air, was entered by Purdue University. It had a 14-valve receiver and employed some system of audio-frequency selection, incorporating tuned reeds.

One interesting problem is that of interference to the planes from amateur transmitters, which may happen to be working on a frequency which one of the aircraft controlled is using. On one occasion a plane which was 1,200 ft. up refused to obey the ground control, and careered round the country in a large circle indicating half-rudder position. When finally brought to earth all controls were found to be in order, and it was concluded that the rudder control had been “held” by a neighbouring amateur transmitter.

In view of the enormous strides made between the initial meeting in 1937 at which radio control first made its appearance and the latest meeting held only four years later, very big developments are expected next year. More especially is this so as more and more amateur transmitters and model aircraft enthusiasts are collaborating in experimental work, and manufacturers are turning their attention to the production of specialised components for this entirely new field.

For obvious reasons, we are not likely to see any developments in this country until after the war, but a field day of this nature might prove a useful and pleasant change to the customary amateur DF field days held over here. There will certainly be scope for the exercise of all the ingenuity and skill in radio matters of which the amateur transmitter in this country is capable.

The Wireless World Diary

As supplies of The Wireless World Diary and Reference Book for 1942 are limited, to avoid disappointment readers are advised to obtain their copy immediately from a bookshop, stationer or bookstall. The reference section includes all the usual features as well as one or two additions, one of which gives the times, as compared with GMT, of the major cities of the world. The price, including purchase tax, is 2s. 9d.
Developments in Broadcasting

I.E.E. Wireless Section Chairman’s Address

THE assistant chief engineer of the B.B.C., Mr. Harold Bishop, C.D.E., B.Sc. (Eng.), who is the new chairman of the Wireless Section of the Institution of Electrical Engineers, gave a very comprehensive review of the technical developments in broadcasting and the trend of progress up to the outbreak of war in his inaugural address on November 5th. He dealt with the more detailed and highly specialised questions which Sir Noel Ashbridge avoided. Mr. Bishop joined the Marconi Company in 1922 and in the following year joined the staff of the British Broadcasting Company at 2LO.

In his review of the construction of studios and their characteristics he dealt with the programme input equipment. The period of two years before the war saw the growth of a new conception in the handling of programme material. The principle of the new scheme outlined by Mr. Bishop is that the control of dynamic range and balance of a studio programme is carried out during both rehearsal and transmission from within the studio's control cubicle, a small room adjacent to the studio. The studio and cubicle are provided with all the necessary technical equipment to enable producers to rehearse their programmes both artistically and technically.

"The years immediately preceding the war saw the rapid development of high-power transmitters having so-called high-efficiency or power-saving modulation systems," said Mr. Bishop. "Of these, the well-known Class B modulation systems, in which the modulator output is coupled to the anodes of the main high-frequency amplifier, claimed the most attention, and many transmitters employing this circuit are now in service. The economy in power cost as compared with the cost of operating the older type of high power anode-modulated transmitter using modulators operating in the Class A condition, or the equally well-known HF power amplifier type of transmitter is substantial. For example, for 100 kW radiated, a Class B transmitter requires 300 kW input whereas the older type requires 460 kW. Assuming a transmission time of 5,000 hours a year and electric power at 0.75d. a unit, the annual saving amounts to about £2,500. If this is multiplied by the number of transmitters in service, the importance of this technical development is seen to be very real."

Mr. Bishop pointed out that it had been suggested that the days of amplitude modulation on medium waves are numbered by the development by Armstrong in the United States of a practical system of frequency modulation using ultra-short waves of the order of 7 metres or less. "It is, of course, too soon to say," he added.

Frequency Stability

Dealing with the use of quartz crystals for the frequency control of modern transmitters, he said that in the oscillator circuits developed by the B.B.C. the supply voltage frequency co-efficient had been reduced to a negligible value. It can now be said that the cause of frequency instability —of the order of ± 1 part in 10⁵—lies in the quartz plate and mounting.

A large number of Post Office crystals are now in use in B.B.C. transmitters and their average long-time frequency stability over a period of a few months is of the order of ± 1 part in 10⁶, while the short-time frequency stability over a period of a few days is ± 3 parts in 10⁹, provided that the crystals are installed in high grade constant temperature ovens.

International comparisons carried out in 1939 by simultaneous measurements of stable broadcasting stations by the R.C.A., New York, the U.I.R. station at Brussels, and the B.B.C. measuring station cited by Mr. Bishop, showed agreement between these centres of better than 1 part in 10⁶ on the short-wave signals measured, the comparisons being limited in accuracy by short-wave fading phenomena.

Mr. Bishop suggested that, in the straitened conditions of post-war finance, the public will have little money to spare for anything which is not a necessary necessity. He pointed out that whereas the pre-war receiving set gave value for money, the post-war product will have to be still more attractive if it is to achieve the success that public interest can give it. Reliability in use and improvements in servicing will be expected by the listening public, and to achieve both objects a greater measure of component standardisation seems essential. "In particular," said Mr. Bishop, "the component for which a measure of standardisation is outstandingly necessary is the valve. There should be no drastic limitation in the number of types to reduce cost and achieve simplification. The type of valve determines to a large extent the type of circuit, and in so far as the number of valve types would be limited there would be a measure of circuit standardisation, but further standardisation of circuits would seem to be unnecessary and undesirable."
RESEARCH for alternative materials for use in receivers, necessitated by the demands of national defence in the United States, has resulted in the production of many newly developed substances by R.C.A. Laboratories.

Aluminium was one of the first items essential to receivers affected by the priorities control. In order to save the 74 tons of aluminium used for the cans screening IF coils, of which four million were used in R.C.A.-Victor sets last year, the cans have been replaced by cardboard tubes, coated with a moisture-resisting substance and a sheet of copper foil.

Plastics are under consideration to replace the metal housing that protects loudspeaker cones. They can also be used in a number of other parts in both radio and gramophone equipment. But even plastics are likely to need curtailment, because defence needs have created a shortage in the supply of formaldehyde, required to manufacture the synthetic resin used as a base in some plastics.

It was therefore decided to find an alternative for plastics. The answer was a felted substance made from shredded wood, cardboard and paper scraps, and sulphite pulp. Moulded and treated with a moisture-resisting impregnant, it proved to be as tough as either wood or plastics. Moreover, by the use of thermofusion, metals can be bonded to it.

Experiments are also being conducted with Lignin, a by-product of paper mills, as a substitute for plastics.

A replacement has also been found for the phenol-formaldehyde resins used to impregnate paper tubes upon which coils are wound.

The practically non-existent supply of aluminium for ordinary commercial purposes posed a knotty problem for the manufacturers of electrical transcriptions (special recordings), used for broadcasting. The properties of aluminium which make it more desirable than anything else are perfect surface flatness and rigidity. It has been found that certain types of ceramic materials, including glass, can be used satisfactorily.

Another development of even farther-reaching effect has been made by the chemists in R.C.A. Laboratories. The supply of shellac, an important ingredient in a gramophone-record compound, which comes chiefly from India, is fast dwindling. By improving the chemical properties of durability, plasticity under heat, hardness at ordinary temperatures and resistance to mechanical wear, the research workers have developed a new process which greatly conserves the ingredient's use to possibly three to four times normal expectation.

RECORDINGS: Preference for "Hill and Dale" in U.S.

It is interesting to note that according to a recent survey conducted among broadcasting stations in America there is a growing use of vertical, or "hill and dale," recording for electrical transcriptions. The percentage of stations in favour of it is approximately 43, as against 35 for lateral recording, the remainder having no preference. The actual percentage of vertical recordings being employed is, however, roughly only 22, whilst 57 are lateral-cut recordings. Electrical transcriptions usually take the form of 78-rpm, disc, the playing speed of which is 33⅓ r.p.m. The remaining 21 per cent. of the recordings used for broadcasting are ordinary commercial gramophone records.

The statistics from which these figures are gleaned were issued by the Recording and Reproducing Standards Committee of the U.S. National Association of Broadcasters, as a result of a questionnaire sent to 197 stations in an endeavour to formulate standards that will tend to bring about uniform quality of reproduction of transcriptions with a minimum number of reproducing equipment adjustments.

The questionnaire reveals that nearly 31 per cent. of all broadcasting time is devoted to recordings.

FM AND THE AURORA BOREALIS

A GOLDEN opportunity for frequency-modulated broadcasting to prove its claim of freedom from interference was provided during the recent display of the aurora borealis, which played havoc with amplitude-modulated transmissions in the Northern Hemisphere. Reports published in the American Press declare that except for sporadic freak long-range reception at distances as great as thousands of miles, FM transmissions were virtually unaffected by the black-out which prevailed.

WRUL AND WRUW

The World Wide Broadcasting Foundation, which operates the two 50-kW international short-wave stations WRUL and WRUW situated at Scituate, Mass., has been granted permission to erect a third station on the same site. It will operate at 6.04, 15.13, 15.35 and 17.75 Mc/s with a power of 200 kW. It will be recalled that the United States Reconstruction Finance Corporation recently granted the sum of...
$40,000 to the Foundation, which is a non-profit-making concern operating the stations "for enlightenment." It was suggested at the time that this indicated concrete Government interest in a counter-propaganda campaign.

THE PRESS AND BROADCASTING

Newspaper Ownership of Stations Criticised

The U.S. Federal Communications Commission is investigating the question of newspaper ownership of broadcasting stations. It would appear from the opening statement by the chairman that the question of joint control over newspapers and broadcasting stations, which has been a topic of interest for some time, has been brought to a head by the application for FM licences by newspapers. 'The F.C.C. chairman pointed out that the applications for FM stations by newspapers 'raise the question of the extent to which, and the circumstances in which, grants to newspapers will serve the public interest.' It is interesting in this connection to note the statement issued by The Detroit News, owners of the stations WWJ and W45D (FM). "As the founders of the first commercial broadcasting station WWJ, which we have operated daily since 1920, we ask for nothing more than a dispassionate examination of our record of service for twenty-one years, including our pioneer efforts towards the development of broadcasting in ultra-high frequency, and more recently in the frequency modulation fields. . . . The original intent of The Detroit News in entering the radio field was to further reliable methods of communication as a natural step in the advancement of journalism, and increase our service to the public. To this end we operated our station for five years without accepting any revenue of any kind from any source. . . . It would seem to us fundamentally unjust to judge any application for a new licence or the continuance of an old one on any other basis than the good character, fitness and responsibility of the individual applicant."

Despite the fact that the chairman stated that the F.C.C. had an open mind on the question of newspaper ownership, Broadcasting declares that 'His interrogation of witnesses indicated he was seeking to build a case against the propriety of joint newspaper ownership and operation of broadcast stations.'

Of the 882 stations in the States, 208 were linked "by ties of ownership with newspapers or with persons associated with newspapers."

COLUMBIA TRANSMITTERS

New Short- and Medium-wave Stations

With the transfer of Columbia's international short-wave station WCBX from its original site at Wayne, New Jersey, to Brentwood, Long Island, a marked improvement in its reception has been noted in this country. The transmitter is temporarily using only one aerial directed towards Europe and three directed towards Latin America. It will be remembered that it was planned to erect a new 50-kw transmitter, which will have the call letters WCRC, on the same site. This transmitter, which has been granted the frequencies 6.12, 6.17 and 21.57 Mc/s, will probably be testing by the time these notes are in print.

Near the site of the short-wave stations is Little Pea Island, in Long Island Sound, which was little more than a patch of rugged rocks until the CBS engineers built a man-made "island," 150 feet square, on it to accommodate the new CBS medium-wave key station WABC. The 50-kW station, using a 410-foot mast radiator with a hinged capacity top, made its debut in October.

This novel station site was chosen after exhaustive tests, as it provided a direct sea path for the station's signals to its service area. The island has been renamed Columbia.

MAGNETIC STORMS

Experience has shown the engineers of R.C.A. Communications that magnetic storms have more effect on transmissions travelling east to west and west to east. During the display of the aurora borealis, therefore, they transmitted messages to London via Buenos Aires, where they were automatically relayed. Success was also achieved in reaching Europe by resorting to the use of long waves, generated by Anderson alternators at the R.C.A. station at Rocky Point, Long Island. These alternators, of 1918 vintage, are the only ones in service in the U.S.A., and are held in reserve for such emergencies.

AMERICAN "NATIONAL" NETWORK

Plans to use the 880-odd broadcasting stations in the United States for the purpose of radiating announcements and communiques in the event of a national emergency have been outlined by the U.S. Defence Communications Board. The scheme is to link all stations as one great network, and at the same time to link neighbouring stations to a regional defence centre.

It is stated that nearly 500 stations are already connected to the nucleus of the network, and that only 12 of the remainder are situated at some considerable distance from existing programme lines.

FROM ALL QUARTERS

Mr. Baird and Cable and Wireless

Arrangements have been made by which Cable and Wireless will obtain the collaboration of Mr. J. L. Baird, who has accepted an appointment as Consulting Technical Adviser to the company as from November 1st.

I.E.E. Premiums

In announcing the awarding of the various I.E.E. premiums for papers read before the Wireless Section, Mr. T. E. Goldup, who in Mr. W. J. Picken's absence took the chair, stated that the Institution premium of £10 had been given to C. F. Booth for his paper on the application and use of quartz crystals in telecommunications. This is the fifth time in ten years that the Institution premium has been awarded for papers read before the Wireless Section. The Ambrose Fleming premium of £10 was awarded to N. M. Rust, O. E. Keall, J. F. Ramsay and K. R. Studdley for their paper reviewing broadcast receivers. A premium of £10 was awarded to C. A. Mason and J. Moir for their
The World of Wireless—

paper, "Acoustics of Cinema Auditory," and another of £5 was awarded to R. H. Barfield for his paper on the performance and limitations of the compensated loop direction finder.

P.S.G.B.
The Officers of the Radio Society of Great Britain have all been nominated to serve again during the coming year.

G.E.C. Short-wave Station

The international short-wave station of the General Electric Company, KGEI, on Treasure Island, San Francisco, has been granted permission to increase its power from 20 to 50 kW. Its location is changed to Belmont, California.

British People's Set?

It was proposed at the annual meeting of the Scottish Radio Retailers' Association that representation should be made to serve again during the coming year. The times (BST) of these and the short-wave signal on Treasure Island, San Francisco, has been granted permission to increase its power from 20 to 50 kW. Its location is changed to Belmont, California.

Marconi's Tomb

It was recently announced from Rome that the body of Marconi had been placed in a mausoleum on the site where he conducted his early wireless experiments.

"Talking Books" Tax Free

Gramophones specially designed for the reproduction of "talking books" for the blind have been granted exemption from Purchase Tax.

B.B.C.  News Bulletins

Among the 65 news bulletins in 25 different languages broadcast in the B.B.C.'s European and Near East service there are now only two in English. The times (BST) of these and the short-wavelengths on which they are radiated are marked with an asterisk in the following list of B.B.C. transmissions of news in English:

1900: 25.53, 19.82, 16.84, 16.77.
1930: 25.53, 19.82, 16.84, 16.77.
1945: 25.53, 19.82, 16.84, 16.77.
1700: 31.75, 25.53, 19.64, 16.64.
2300: 49.39, 41.96, 41.49.

I.E.E. Wireless Section

At an informal meeting of the I.E.E. Wireless Section on Saturday, November 15th, at 4 p.m., Mr. P. R. Courcy will open the discussion on ageing tests of valves, thus enabling them to hear the characteristic sounds of internal-combustion engines, showing effects of incorrect valve adjustments, etc., to assist in the training of men for engine rooms in the ships of the U.S.A. These recordings are brought back to the classrooms on shore and reproduced, at a suitable volume-level, for the student engineers, thus enabling them to hear actual sounds of engines running smoothly and fairly. The instructors can then point out the significant noises for which to listen.

Educational FM

The use of frequency modulation for educational broadcasting is extending rapidly in the United States. The seventh non-commercial educational FM station is to be erected by the Chicago Board of Education.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

<table>
<thead>
<tr>
<th>Country : Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>America</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WNBH (Boud Brook)</td>
<td>15.130</td>
<td>18.83</td>
<td>2.13, 3.0, 4.05, 6.05</td>
</tr>
<tr>
<td>WRAJ (Boud Brook)</td>
<td>17.720</td>
<td>18.87</td>
<td>2.13, 3.0, 4.05, 6.05</td>
</tr>
<tr>
<td>WGER (Schenectady)</td>
<td>9.530</td>
<td>31.48</td>
<td>0.05, 10.53, 9.54</td>
</tr>
<tr>
<td>WGEA (Schenectady)</td>
<td>15.320</td>
<td>19.57</td>
<td>7.49, 9.53, 9.54</td>
</tr>
<tr>
<td>WBOS (Hull)</td>
<td>11.870</td>
<td>25.27</td>
<td>5.0, 9.0, 12.0 mid</td>
</tr>
<tr>
<td>WCB (Philadelphia)</td>
<td>11.800</td>
<td>25.10</td>
<td>12.30 a.m. (Mon.)</td>
</tr>
<tr>
<td>WCBX (Wayne)</td>
<td>11.830</td>
<td>25.38</td>
<td>7.30, 8.15, 8.45, 11.30</td>
</tr>
<tr>
<td>WCBX</td>
<td>15.370</td>
<td>19.65</td>
<td>2.0, 5.05</td>
</tr>
<tr>
<td>WRLU</td>
<td>11.720</td>
<td>25.28</td>
<td>11.30</td>
</tr>
<tr>
<td>WRLU</td>
<td>11.700</td>
<td>25.45</td>
<td>8.0, 9.30, 3.0</td>
</tr>
<tr>
<td>WRUL</td>
<td>18.350</td>
<td>10.54</td>
<td>4.0, 9.30, 3.0</td>
</tr>
<tr>
<td>WRUL</td>
<td>17.250</td>
<td>10.69</td>
<td>4.0, 9.30, 3.0</td>
</tr>
<tr>
<td>WLWQ (Cincinnati)</td>
<td>15.250</td>
<td>19.07</td>
<td>5.0, 5.0, 8.0, 8.0</td>
</tr>
</tbody>
</table>

| **Australia**     |      |        |                       |
| VLBT (Lydhurst)   | 11.840 | 25.34 | 5.20 |

| **Egypt**         |      |        |                       |
| SUX (Cairo)       | 7.865 | 38.14 | 6.50, 10.10 |

| **French Equatorial Africa** |      |        |                       |
| FZI (Brazzaville) | 11.970 | 25.60 | 8.45 |

| **India**         |      |        |                       |
| VUD3 (Delhi)      | 9.560 | 31.28 | 1.30, 4.00 |
| VUD4              | 11.830 | 25.36 | 9.0 a.m., 1.30, 4.00, 6.13 |
| VUD5              | 15.290 | 19.69 | 9.0 a.m. |

| **Japan**         |      |        |                       |
| JZI (Tokio)       | 9.635 | 31.46 | 8.0 |
| JZL               | 11.990 | 25.42 | 10.30 |
| JZL4              | 15.160 | 19.86 | 8.0 |

| **Manchukuo**     |      |        |                       |
| MTCL (Hailung)    | 11.775 | 35.48 | 8.0 a.m., 10.5 |

| **Sweden**        |      |        |                       |
| SBO (Motola)      | 6.065 | 49.46 | 10.30 |

| **Thailand**      |      |        |                       |
| HSP5 (Bangkok)    | 11.715 | 25.61 | 12.46 |
| HSP5N              | 19.030 | 15.77 | 12.46 |

| **Turkey**        |      |        |                       |
| TAP (Ankara)      | 9.465 | 31.70 | 7.15 |
| TAQ                | 15.195 | 19.74 | 12.15 |

| **U.S.S.R. (Moscow)** |      |        |                       |
| 31-metre band      | ---  | ---   | 7.0, 8.0, 9.0, 10.15 |

| **Vatican City**   |      |        |                       |
| HVJ                | 6.190 | 48.47 | 8.15 |

| **MEDIUM-WAVE TRANSMISSIONS** |      |        |                       |
| Ireland            | 565   | 531    | 1.40, 6.45, 6.50, 10.0 |

It should be noted that the times are BST—**one hour ahead of GMT**—and are p.m., unless otherwise stated. The times of the transmission of news in English in the B.B.C. Short-wave Service are given at the top of this page.

* Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.
Acoustic Aerials
A New Technique for Predicting the Polar Characteristics of Complex Arrays

The use of models of complex directional aerial systems for checking the predicted performance has generally been based on ultra-high frequency technique, the frequency of excitation being increased so that the wavelength bears the correct relationship to the length of the radiating elements in the model. While good results have been obtained with this method, there are considerable difficulties in taking measurements without disturbing the field, and also in making allowance for the change of conductivity of the earth's surface with frequency. Since most of the problems of multiple aerial design are based on wave interference, it seems probable that a study of acoustic interference patterns might provide a satisfactory solution, and investigations recently described in America confirm this view. Not only can the scale of the acoustic model be reduced below that of high-frequency models, but with suitable microphones the disturbance of the field pattern is much less. Mathematical treatment produces similar equations for acoustic and electromagnetic radiation, the only correction when interpreting the results being a term resulting from the fact that radio waves are polarised, whereas sound waves in air are not.

The design of the acoustic equivalent of the aerial is based on the assumption that the radiation emanating from a series of elemental doublets distributed along the aerial. Accordingly, the acoustic equivalent consists of a pipe with a series of fine holes drilled at short intervals, through which sound is emitted in strength and phase depending upon the standing wave in the pipe behind. In order that the pressure distribution shall simulate the current in the radio version, there should be an antinode at the end of the pipe, i.e., the pipe should be open. This would, of course, give rise to considerable unwanted sound radiation, and in practice the end of the pipe is closed to form a node, and the first hole (representing the tip of the aerial) is drilled a quarter wavelength down.

Experimental Details

In the experiments carried out by the authors, a frequency of 600 c/s was used with a wavelength of 22.6in. at 20 deg. C. A half-wave aerial would then consist of a series of holes rising 11.3in. above ground level and topped by 5.65in. of closed pipe to produce the anti-node at the highest hole.

A Western Electric 555W loud speaker unit was used as a source of sound energy in the practical work, and, after a series of experiments on relative pipe diameters, hole sizes and spacing, it was found that a diameter pipe drilled at intervals of 1in. with holes 0.05in. in diameter gave the closest approximation to the current distributions found in radio aerials. That is to say, the energy lost by radiation from each hole resulted in the same progressive departure from sinusoidal distribution.

Field experiments were made first of all with an acoustic model of the simple vertical half-wave aerial, the characteristics of which are well known.

The model was arranged to project through a tiled surface laid on the ground. The hard tile acts as a good reflector, and if it is of reasonably large diameter compared with the wavelength, reflection from the change of conditions at the boundary is negligible. A diameter of 35ft. was used in these tests.

The microphone is suspended from a light derrick of small-diameter tube, designed to cause the least possible interference with the sound field. It is capable of rotation through 360 degrees for polar curves, and the arm may be raised or lowered to any required altitude angle. Both these operations are effected by lines actuated from the control point at a distance of about 50ft. from the aerial model.

In the early stages trouble was experienced from standing waves reflected from buildings and other objects in the vicinity, and it was found necessary to use a directional microphone of the "machine-gun" type pointing directly at the sound source to minimise these effects. Trouble from extraneous noise was eliminated by using a selective circuit between microphone and amplifier tuned to 600 c/s. This also avoided complications which might have arisen from the presence of harmonics in the sound source.

Close agreement with calculation was found in all cases, and experimental curves of field patterns result-
Acoustic Aerials—

ing from special current distributions could be closely duplicated acoustically by drilling holes of different sizes along the pipe.

It is pointed out that deviations from sinusoidal current distribution in the aerial have marked effects on the high-angle distribution of the field which are difficult to calculate and measure, and it is in this direction that the results given by the acoustic model are invaluable.

For some purposes an acoustic model consisting of two point sources, one at ground level and the other at the top of the aerial, may be used. This method is not accurate for high-angle measurements, but is useful at lower angles at short distances, and where only the vertical component of the field is required.

Mutual impedance measurements of two aerials can also be made by the acoustic method. The principle involves the measurement of the distribution of pressure and phase due to one aerial along an imaginary line corresponding to the position occupied by the second. This is done by using a two-point source for the first aerial and employing the line of the second with a probe microphone, both the pressure and phase being measured electrically by oscillographic comparison of the input and output circuits.

Comparison of field strength of WLW directional aerial obtained (dotted) by calculation, (full line) from acoustic model and (single points) by radio field strength measurements.

with the length, but the magnitude of the pressure varies until it reverses when the pressure passes through zero at certain critical lengths. To overcome this difficulty the transmission line must be properly terminated by a method similar to variation of tapping points on an electrical line. Since it is not feasible to move the tapping point along a pipe containing a standing wave, the same result is obtained by using two plungers to move the standing wave system past the stationary tapping point.

This method was used successfully in an acoustic model of the directional aerial system at station WLW, from which useful information about the high-angle radiation was obtained. As a matter of interest, the ground level polar curve is reproduced, showing the close agreement with theoretical and radio field strength curves.

The acoustic method of aerial design is not only of value in studying actual cases, but may be used to produce special polar curves for which methods of obtaining the required current distribution are not yet known. What these current distributions should be can be easily stated after measuring the pressure in the pipe by the stethoscope method. These can then be handed to the radio engineer as a guide to the line of development.

Identifying the Luftwaffe

SEVERAL new types of aircraft being used by the Luftwaffe are depicted on the revised edition of the Flight identification chart of German aircraft. The chart, which comprises 135 silhouettes of the leading types of German aircraft supplemented by 44 line drawings and measures 13 X 10 in., can be ordered from the Flight Publishing Co., Ltd., Dorset House, Stamford Street, London, S.E.1, price 12s. 3d., plus 6d. postage on single copies, 7d. up to three copies, or 8d. up to six copies.

BOOK RECEIVED

Blueprint Reading Simplified. By A. C. Parkinson.—This book points out the great advantages to all engineering workers of being able to read machine drawings quickly and accurately, and takes the reader through what is virtually a concise course in engineering drawing. Wireless men know how great a handicap it is not to be able to read and understand a theoretical diagram, which may be described as the shorthand form of the cumbersome pictorial or practical wiring plan. To the mechanical engineer the machine drawing is analogous to the theoretical circuit diagram, and lack of ability to understand it at a glance forces him to rely on a pictorial representation. Pp. 91; 79 figures. Sir Isaac Pitman and Sons, Ltd., 39, Parker Street, Kingsway, London, W.C.2. Price 6s.
Salving Accumulators

Regeneration of Sulphated Cells

By A. HICKLING, M.Sc., Ph.D.

It is a common and annoying experience that lead accumulators which are only intermittently in use for laboratory or experimental work gradually lose their capacity and their ability to hold a charge. This is due in nearly all cases to the sulphating of the negative plates which takes place if the cells are allowed to stand idle for lengthy periods. It does not seem to be generally realised, however, that there exists an extremely simple method by means of which even very badly sulphated accumulators can be restored to practically their original capacities. This method, which was originated by Bennett and Cole many years ago, consists merely in replacing the sulphuric acid electrolyte by a solution of sodium sulphate, giving a long charge in the ordinary manner, and then washing out with distilled water and filling with fresh acid. The results of this treatment are remarkably good, as is shown by the following test carried out by the present author.

Eight 2-volt accumulators of a very well-known make were selected for testing out the method. They had given good service over a period of about six years, but owing to irregular charging they had eventually become badly sulphated and were almost useless. The cells, which were of the multi-plate celluloid-cased type, had originally a capacity of some 30 ampere-hours (Ah).

The accumulators were first charged in the ordinary way at 2 amps. for 25 hours. They were then put on continuous discharge at 0.5 amp., and their useful life was considered ended when the voltage (on discharge) fell to 1.80 volts. The capacities, measured in this way, were:

<table>
<thead>
<tr>
<th>Accumulator No.</th>
<th>Capacity (Ah)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 4, 5, 6, 7, 8</td>
<td>4.5, 4.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5</td>
</tr>
</tbody>
</table>

It is seen that in most cases the capacities were only about a sixth of the original values. The cells were then emptied, washed out twice with distilled water, filled with a 20 per cent. solution of sulphuric acid of specific gravity 1.25, and their capacities measured exactly as the same way as before. The new values were:

<table>
<thead>
<tr>
<th>Accumulator No.</th>
<th>Capacity (Ah)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 4, 5, 6, 7, 8</td>
<td>28, 26, 28, 27, 29, 29, 29</td>
</tr>
</tbody>
</table>

It is seen from these results that a most remarkable improvement in the capacity of the accumulators had been brought about, the new values not being very different from the original rating. To test whether this improvement would be maintained on subsequent ordinary use, the discharged cells were now recharged at 2 amps. for 25 hours and the capacities again measured. The results given below show that the improvement is substantially maintained.

<table>
<thead>
<tr>
<th>Accumulator No.</th>
<th>Capacity (Ah)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 4, 5, 6, 7, 8</td>
<td>29, 29, 29, 29, 29, 29, 29</td>
</tr>
</tbody>
</table>

The treatment does not seem to affect the cells disadvantageously in any way, and there was no undue shedding of active material.

The mechanism of the regeneration appears to be roughly as follows: When a lead accumulator is allowed to stand for long periods in the discharged state, the fine particles of lead sulphate on the cathode tend to dissolve in the electrolyte and reprecipitate as larger and more insoluble crystals on the electrode. In this form the lead sulphate presents a relatively much smaller surface area, and is not readily reduced back to lead by cathodic hydrogen when the cell is recharged. The capacity of the accumulator is then very much lowered, and we have the phenomena associated with sulphating. On charging with a sodium sulphate electrolyte, however, the liquid in the vicinity of the cathode becomes alkaline owing to the discharge of hydrogen ions, and the lead sulphate, being then subsequently deposited on the electrode in a finely divided form and the cell is restored to its original condition.

The merits of the regeneration treatment seem to be such that it should be widely known among electrical experimenters, as it is extremely simple (as opposed to various methods of chemical regeneration proposed from time to time), and it serves to restore to useful life many accumulators which would otherwise be discarded—probably a serious matter in these days of shortages.

The unusually attractive appearance of R'S AMPLIFIERS® Sound Equipment creates the immediate impression that here is something that is out-of-the-rut...that has 'breeding.' And its appearance does not belie its performance, for R'S Equipment reaches a standard that few seek to attain. Whatever your interest—commercial or industrial—you will find that an investigation of the R'S range is time well spent. Of course, we'll gladly co-operate with you on any special needs.

**AMPLIFIERS**
- **Porta Thirty.**—20 watts output. Two speakers (this equipment can accommodate up to fifteen speakers), AC 200-250 volts. Complete with "mike," C.P. stand and cables. The scene of perfection in portable amplification.

**CHASSIS**
Five types of chassis are available. 30 watt, 30 watt, 15 watt, 12 watt and a 12-watt Battery Unit.

**ACCESSORIES**
Crystal Microphones and Stands. Speaker Units (Exponential Horns), 11 watts and 13 watts capacity.
LETTERS to the EDITOR

The Editor Does Not Necessarily Endorse the Opinions of His Correspondents

Should Amateurs Know Morse?

The letter signed "No-Remorse" in the November issue needs answering. No doubt "a very large proportion of our best radio engineers do not even pretend to know morse." Similarly, a very large proportion of our best radio amateurs do not pretend to be radio engineers.

As for the statement that "quite a lot of amateurs scarpce through a morse test and then either buy a ready-made transmitter or a kit of parts..." isn't it time to publish some facts about this point? It would be interesting to get the R.S.G.B. to conduct a census, but as that may not be possible I have made a private "census" of local amateurs. Out of twenty-three local amateurs with radiating licences, only one was using a commercially built transmitter. There were no kits transmitters in use. The remainder, of powers up to ½ kW, were home constructed. As for the receivers, there were eight American-built communication sets. The remainder were home-built straight sets. Nine of these stations used CW only; only two worked exclusively on telephony. These results show that, in this area at least, the amateur with no knowledge of morse would be unable to contact 40 per cent. of the locals at all, and would be unable to contact the majority for 50 per cent. of the time. Of course, these figures may not hold over the whole country, but it seems probable that these results would be confirmed by a country-wide survey.

If "No-Remorse" has no knowledge whatsoever of morse, and therefore cannot have first-hand knowledge of pre-war amateur CW operating, he is not qualified to criticise the necessity for morse, however learned his 20 years' radio technical experience may have made him.

With regard to the proposal to divide amateur bands into separate phone or CW bands, there are one or two objections. It would inevitably lead to the need for a multiplicity of crystals, which many amateurs, especially the younger ones, are not in a position to afford. One of the chief joys of amateur work is constructing really good gear out of junk picked up for next to nothing. A new crystal may mean several weeks' pocket money for these young enthusiasts.

"SIGNALMAN."

Supplementary AVC

Your readers may be interested in a circuit, which I have devised and had in use for the past year or so, for minimising the effects of selective fading.

It is, in effect, a limiter whose threshold working point is determined by the normal AVC voltage. Thus, under normal reception conditions it does not operate, but operates when the carrier voltage drops. It then produces an "artificial" AVC voltage, which depends mainly on the higher pitched part of the sideband frequencies, i.e., the part that is most prominent during selective fades. Also AVC is "slowed down" due to the 1-nfd. condenser, which all goes to help the action during high-speed fading.

This device has the effect of stopping all extra loud bursts of sound and seems to reduce harmonic distortion, probably because it prevents overloading of the RF and IF stages.

London, S.W.19. R. G. YOUNG.

Post-war Wireless

Some of your more politically minded readers may object to your reference to "immutable economic laws," for since economics is a function of man-made society, its laws which were made by man can be altered by other men. But what I believe you have in mind is that the wealth and labour devoted to radio will not exceed the proportion due to its potential services to mankind at the present state of organisation of a mechanised society.

Neither Mr. Rosen's article nor your Editorial gives serious consideration to the possible uses of radio. For example, is there not likely to be a great use of "blind-landing" equipment and other forms of specialised D.F. for civil aviation after the war, to say nothing of the radio altimeter? Then consider the American "Highway Radio" for giving instructions to motorists; this points to a further sphere of application of radio to assist transport. An entirely different sphere is the electric calculating machine; everyone knows that the Totalisator is worked electrically, but there are also machines for solving differential equations which cannot be solved by calculation, and there are numerous other applications of electrical technique to the assistance of other forms of science. Many of these are, of course, small-scale uses which would not absorb much manufacturing capacity; but I mention them to reinforce my main argument, which is that one cannot take it for granted that entertainment will retain first place in radio production after the war, but that we have yet to investigate what use could be made of radio technique in a world in which the economic law governing production was the benefit of the product to the community.

D. A. BELL.

Training of Wireless Engineers

The trouble about which Mr. Webb complains in the November Wireless World is tackled at its root in Mr. Edward E. Rosen's article, appearing in the same issue. The present war has given support to the view (which seems to be implicit in Mr. Rosen's article) that here, as in America, radio engineering should be acknowledged as a distinct and separate profession. Every support should be given to Mr. Rosen's suggestion that British universities should establish degrees in which radio and allied engineering may be taken as a main subject. A National Certificate in Radio Engineering, also sponsored by Mr. Rosen, has been advocated by this Institution in correspondence with the Board of Education since 1935. The proposal was turned down by the Board on the grounds that the requirements of the embryo radio engineer were met by the curriculum of the National Certificate in Electrical Engineering.

The Professional Purposes Committee of this Institution recommends...
not only that a National Certificate in radio be established, but that, like all other National Certificates, it should provide for specialisation. This affords a safeguard against the danger of certain branches of radio engineering (e.g., television) coming to be erroneously regarded as separate arts or vocations as well as applications of radio engineering.

It is sincerely hoped that this Institution’s renewed request, made through Lord Hankey, for the establishment of a National Certificate in Radio Engineering will be granted without undue delay.

G. D. CLIFFORD,
General Secretary,
The British Institution of Radio Engineers.
London, S.W.1.

Broadcast News Presentation

I WAS keenly interested in the Editorial in your June issue entitled “Presentation of Broadcast News,” particularly your observation that the make-up and style of broadcast bulletins has undergone little fundamental change since 1930, or, for that matter, since 1922, and that broadcasting is still too much like the newspapers and the newspapers are too much like broadcasting. In support of this contention you point out that the morning newspapers often contain long items in the same words as the radio bulletins of the previous night. Another interesting observation in your article was that what might be termed “geography lessons” in news bulletins annoy well-informed listeners. You argue that there should be a well-defined line between real news on the one hand and commentary, exposition or speculation on the other, and that proper might be broadcast in “telegraphese” to ensure the utmost economy in words.

I cannot pretend to have any firsthand knowledge of the contents of news bulletins in the Home Service of the B.B.C., but I have listened carefully to the Empire bulletins, and, in common fairness to the men who write them, I must say that many of them bear evidence of careful sub-editing. They are not written in “telegraphese” and they do contain, at times, information which might be regarded as “geography lessons,” but so far from annoying even well-informed listeners, this information seems to please them. In my experience, not many people are so well informed to-day that they can call to mind at a moment’s notice the information required to give them a clear understanding of any and every item broadcast. I agree that the inclusion of information can be overdone, but I think there is a happy medium in which sufficient explanatory matter is added to give the uninformed listener a clear picture of the happening, without at the same time annoying the informed listener.

In my opinion, the difference between newspaper and radio treatment of news lies not so much in the choice of material as in the way in which it is presented. I believe that radio should tell its story in broad, bold outlines. All unnecessary detail should be excluded, and so should every word which does not play a vital part in the story. It is not easy to do this and at the same time preserve euphony of language and continuity of thought. Radio news writing must be euphonious, otherwise even the best announcer cannot read it smoothly.

A successful radio news writer must first of all be a clear thinker. Once he has absorbed the facts of a story he should be able to pick out the points that really matter and express them in clear, simple language. A really good man can tell a big story in 150 words. I have frequently seen fairly big stories told in 100 words. Obviously, much detail had to be omitted, but listeners got a good picture of the things that really mattered. In my experience, that is all they ask for and that is what I think they should get. Australian listeners, at any rate, would soon protest if they thought we were keeping back part of a story because it was difficult to tell over the air; they would also resent any withholding of details in the interests of the newspapers.

Finally, I think every radio news writer will agree that good “copy” isn’t turned out by accident. At the risk of being redundant, I repeat that clear thinking must precede clear writing. The man who cannot think clearly will never make a good radio news writer. Lest it be thought that I am reflecting on journalistic standards, I hasten to add that he will never make a good newspaper man either.

M. F. DIXON,
Federal News Editor,
Australian Broadcasting Commission.
Sydney.

The “Fluxite Quins” at work

“That’s a fine place to drop it, by gum! ”

“’Wont hurt—it’s FLUXITED chum.”

“Won’t hurt? why ‘twas put”—

Gassed OI—“ on my foot.
My toe’ll need FLUXITE—it’s numb!”

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ALL MECHANICS WILL HAVE
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A Mild Brain Teaser

RECENTLY I had to take an exam, the first I’d sat for for many, many years. One of the questions looked a gift at first sight, but a little thought showed that it wasn’t such money for jam as it seemed. Here it is in case you care to have a go at it. A potentiometer whose windings have a resistance of 60,000 ohms is connected across a 240-volt source of DC. The slider is connected to the anode of a pentode and is adjusted to make the anode voltage the negative end. What is the resistance of the windings between the slider and the negative end? “Easy,” you cry. “Two-forty volts through 60,000 ohms means a steady current of 4 milliamps. So between the slider and the positive end the current is 6 plus 4, equals 10 milliamps; resistance 6,000 ohms, Answer: 60,000 minus 6,000, equals 54,000 ohms.”

But what about the fixed resistance represented by the valve, which is in parallel with the windings between the slider and the negative end? The true answer is obtainable only by simultaneous equations and a quadratic. Have a shot! Our old friend Kirchoff’s second law is the key.

Common Sense

• Anyhow, it’s what I call a silly question. Your practical man, if he wanted to know the answer accurately, would never have bothered about quadratics. He’d have stuck a milliammeter between the negative end of the potentiometer windings and the earth line. Knowing the current through the part of the windings between the slider and the earth line, the simplest of calculations would have given him the answer.

Personally, had I been marking the paper, I’d have given about 3 out of 10 to those who indulged in intricate calculations and got the right answer, and full marks to those who got the rough answer of 45,000 ohms and added that they’d use the milliammeter method to obtain absolute accuracy. Exams are apt to expect far too academic an attitude in answering questions, whereas amidst the brass tacks of actual working it’s the essentially practical approach to a problem that is of the first importance.

Random Radiations

By “DIALLIST”

Those Voltages

IN the course of the present war I’ve been stationed in a variety of places and had a queer assortment-of quarters, ranging from wooden huts (they have been my chief abiding places) to requisitioned houses, generally slightly bent by bombs or land mines, and even, during one blissful month, to a luxury hotel. Wherever I go I take with me a small wireless set and a reading lamp, hoping that even the wooden huts and the semi-wrecked houses may have electric supplies of a kind. Generally they have, though during the winter of 1939 it was a case of oil lamps and a battery set—when I could get HTBs. But the voltages have been a bit of a nightmare. The set can cope with anything from 200-240 DC and has a rather bigger range on AC so long as the frequency is 50 cycles. Only twice has it been stymied—once by 100-volt DC and once by 25-cycle AC. But I’ve had to collect a fine varied assortment of bulbs for the reading lamp! Let’s hope that one of the benefits of post-war reconstruction will be the standardisation of voltages and frequencies in the supply mains of this funny old country of ours.

W.B. Senior Output Transformer

DESIGNED to match the majority of loudspeakers to any type of high-resistance output, this new output transformer is suitable for heavy duty and will pass currents up to 50 or 60 mA (twice these values in push-pull). Ten ratios ranging from 10:1 to 75:1 are available, and four of these may be used with push-pull circuits. The makers are Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts.

The Fan Problem

YOU may remember that I wrote a month or two ago of difficulties experienced with some of the cheaper American-made electric fans. The big snag is that the windings of the induction motor haven’t sufficient reactance to 50-cycle AC to reduce the current to an amount that they can safely carry. Hence they are apt to burn out, especially if the spindle is not running freely through lack of lubrication. And when you tackle the job of rewinding you find that you can’t make bigger coils because there’s no room in the casing. An idea worth trying out struck me, and it proved to give the answer. A microfarad condenser has a reactance of about 3,000 ohms at 50 cycles. That was obviously too much, so one of two microfarads was tried in series with the windings. This gave a fair speed. Three microfarads gave a speed rather on the high side. Though the windings didn’t heat up, the bearings did after a longish run. The solution eventually found was to use two small 500-volt test condensers of 1 and 2 microfarads respectively and to fit a switch so that either 2 or 3 microfarads could be used.

Caution Needed

The fan can then be run for, say, an hour, with 3 microfarads in series; then, if its motor case becomes hot the switch is turned over to the 2-mfd. setting and it is run like that till it cools down. I don’t know the inductance value of the motor windings, but the speed when 3 microfarads are used with my fan leads me to believe that not so very much more capacity would produce something getting on towards resonance. And that would, of course, mean firework, for in such an acceptor circuit capacitive and inductive reactance then cancel out, and there’s nothing but the ohmic resistance left to oppose AC. If, therefore, you have rewound a small fan or want to curb the exuberance of one that hasn’t yet burnt out, be careful in your experiments with series capacities.

Servicing Difficulties

THE other day I was talking to a first-rate serviceman, one who really does know the job and can always be relied upon for good work. He was remarkably cheerful, considering the difficulties of the times. Having a wide circle of customers, he employed three or four assistants to oppose AC. If, therefore, you have rewound a small fan or want to curb the exuberance of one that hasn’t yet burnt out, be careful in your experiments with series capacities.
WIRELESS

A substitute at a more reasonable figure is much to be desired. There is a substitute, the 25L6, which is not too hard to find or too highly priced. I don't know these valves, but I believe that 50L6 has a 0.15 amp. heater and the 25L6 a 0.3 amp. heater. The solution is to load up the filaments of the other valves (including the rectifier, probably a Z4) to 0.3 amp. I'm told that the line cord resistance does get unduly hot—if it does it can be wound with heavier wire. Anyhow, some of the "doctored"idgets have been working well for 7 or 8 months, so the eating seems to prove that pudding satisfactory.

Abstracts and References

Each year a subject index to the Abstracts and References section of The Wireless Engineer has been published as part of the December issue. This, however, will be discontinued this year, and instead it will be published, together with an index to authors, separately early in 1942. A charge of 25.6d., plus 3d. postage, will be made for the index, and, as supplies will be limited, it will be necessary to order copies from the publishers, at Doreset House, Stamford Street, London, S.F.1, before the end of the year.

The November issue of The Wireless Engineer, which was on sale on the first of the month, contains more than 250 abstracts from, and references to, recently published articles on wireless and allied subjects in the technical journals of the world. Issues are obtainable to order through newsagents or direct from the publishers at 25.6d., including postage.

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A Selection of the More Interesting Radio Developments

RADIO GUIDEWAYS

A NAVIGATIONAL course for a ship or aeroplane can be formed by transmitting two radio beams so that they overlap slightly. The overlapping part then produces a "lane" or guideway, which is identified by the navigator by the merging together of two complementary Morse signals, such as A and N, or T and E, into a continuous note, when the two signals are transmitted separately one on each of the beams.

The width of the "lane" so formed depends on a number of factors, such as the rate at which signals fall off, and the spread of each of the beams. The ideal course would be a line, but this is not possible in practice.

The object of the invention is to produce a narrower lane than that normally produced, so that a vessel following it will produce a narrower lane than that normally produced. Usually the filament has the disadvantage that as the filament is heated to a very high temperature in order to produce the desired emission, it is necessary to heat the cathode to a very high temperature in order to produce the desired emission. Usually the filament current is kept at a constant value by means of rheostat control, but this has the disadvantage that as the filament "varies" its resistance increases so that a constant-current drive means an increasing power-input and an unnecessary shortening of the last period of the filament's life. Incidentally, this method of control also gives a greater emission than is necessary in the final period of operation. If, on the other hand, the filament is worked on constant voltage, the emission will fall below that required for satisfactory results.

According to the invention, a rheostat control is used to maintain the emission at a constant level from beginning to end of the filament's life. For this purpose a small auxiliary filament of identical make-up is run in parallel with the main filament, preferably mounted in a separate miniature control tube. An ammeter inserted in the anode circuit indicates the effective emission, and a rheostat in the common supply circuit to both filaments is varied so as to keep the ammeter reading at a constant value.


FILAMENT CONTROL

When using a high-powered cathode-ray tube, say, for projecting television pictures on to a large screen, it is necessary to heat the cathode to a very high temperature in order to produce the desired emission. Usually the filament current is kept at a constant value by means of rheostat control, but this has the disadvantage that as the filament "evaporates" its resistance increases so that a constant-current drive means an increasing power-input and an unnecessary shortening of the last period of the signal indication is reduced to the narrow sector in which both oscillating beams are kept stationary.

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SUPPRESSING INTERFERENCE

One method of reducing the effect of impulsive interference, such as that caused by the ignition systems of motor cars, is to limit the maximum output of the set both for signals and interference alike, thus preventing the former from being swamped by the latter. In addition, it is possible to insert a shunt circuit across the input so as to by-pass any disturbances of steep wave-front without appreciably affecting the acceptance of the required signal.

According to the invention, an independently limiting bias replaces the more usual automatic one, and is made to include an audio-frequency component which renders a diode (included in the shunt circuit) non-conducting except suppression circuit for interference.

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ELIMINATING UNDESIRED SIGNALS

The circuit shown herewith comprises an inductance L, a condenser C, and a resistance R, the latter being earthed through an impedance Z, which may be either an inductance, a capacity or a resistance. If signals are injected into such a circuit by any form of coupling (not shown), then any desired frequency can be excited from the output taken from the point X by varying that tapping point in such a manner that the potential developed (by the undesired frequency) across the resistance R is equal and opposite to the potential it develops across the impedance Z. The potentials must, of course, be matched in phase as well as being equal in amplitude, and this is ensured by first tuning the main L, C circuit to resonance and then making a fine readjustment of either the inductance or capacity on either side of the resonant point.

The principle can be used to cut out an interfering signal, particularly where the inductance L is a frame aerial and the voltage developed across Z is, at least in part, that due to the well-known vertical effect.


RADIO-ALTIMETERS

It is well known that the height or clearance of a craft above a reflecting surface, such as the sea or ground, can be measured, by transmitting radio energy of varying wavelength, and heterodyning the wave reduced after reflection with the wave then being radiated. The resulting beat-frequency will depend upon the time taken by the reflected wave to complete the double journey, and so gives a measure of the craft's altitude.

In practice, however, it is found that the desired beat frequency is largely masked by harmonic frequencies, which appear to be due to irregularities in the contour of the terrain or to variations in its conductivity; these auxiliary frequencies also vary, to some extent, with the height at which the observations are taken and the speed at which the craft is moving.

The invention is concerned with a method whereby the demodulation pro-
ducts of the reflected and outgoing waves are analysed, and attenuation circuits, combined with negative reaction and automatic gain control, are utilised to get rid of the undesired harmonic frequencies, or at least to reduce their effects so that the fundamental beat frequency dominates the indicator and so gives a clear-cut indication of the altitude required under given conditions of operation.

Electrical Research Products, Inc.
Convention date (U.S.A.) November 16th, 1938. No. 533538.

CATHODE RAY INDICATORS

When measuring, say, the output of a short-wave oscillator, it is usual to apply to the two pairs of deflecting plates of a cathode ray tube, two voltages which are displaced 90 deg. in phase. The simplest method of securing the desired phase-shift is to connect a resistance in series with a condenser across the supply to one pair of plates, the values of the resistance and capacity being determined by the formula \( R = \frac{1}{\omega C} \). But for very high frequencies this method breaks down owing to the very low input impedance that will then exist across the plates.

Method of obtaining phase-shift.

The figure shows how the difficulty can be overcome. The plates A, A1 are connected across a circuit LA and the plates B, B1 across a circuit LB, both circuits being tuned to the common output frequency L, and being screened from each other at S. At this frequency they will accordingly behave as pure resistances.

For very high resistances the interplate capacity (shown in dotted lines) may be sufficient to introduce the required phase-difference of 90 deg. Otherwise, they are coupled together from tapping points T, T1 through a condenser C, the tappings being such that the effective resistance in series with C satisfies the formula already given.


The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

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Recollections of Long Ago

I WONDER if any of you noticed in your papers recently the report of a case in New York in which a lady secured a divorce from her husband on the grounds of mental cruelty because he had put a television set in the bathroom and it made her feel all hot and bothered to see the announcer's face smiling at her from the foot of the bath when she was sitting in it.

Reading about it carried my mind back to the dim and distant past when we had television in this country, a bygone memory about which I often talk to my grandchildren and tell them that, with luck, they may live to see the day when it returns. In those far-off days I followed my previous practice in the realm of sound broadcasting and equipped each room of the house, including the bathroom, with an extension cathode-ray tube, carrying all feed wires including high- and low-tension supply in a special low-capacity multi-core cable of high insulation.

I well recollect the first time I put this system into operation. We happened to have staying with us on a visit a young niece of Mrs. Free Grid's, a comely damsel of some eighteen summers—I mean the girl, of course, and not Mrs. Free Grid.

She happened to be in the bath when she was sitting in it. A piercing shriek for assistance, coupled with disjointed exclamations about there being a strange man in the bathroom. Not knowing exactly what had happened, Mrs. Free Grid and I raced upstairs together and, flinging her aside, I put my weight against the locked door and broke my way in, ready to do battle with the intruder.

For the moment I stood gaping foolishly until Mrs. Free Grid angrily pulled me out, for there was nothing to be seen but the girl, standing in the bath wrapped in a towel, and gazing horror-stricken at the smiling and debonair features of the Alexandra Palace announcer on the screen. It was perhaps unfortunate that at that moment the announcer was talking about the glorious view before him, but as it turned out afterwards, there was an extra broadcast on and he was giving his impressions of the scenery.

It took quite a lot of arguing on my part to convince the girl and Mrs. Free Grid that television was not a duplex affair and that, although they could see the announcer, he could not see them. In fact, Mrs. Free Grid was never quite convinced, as she fitted a dainty pair of "black-out" curtains in front of the screen which the occupant of the bath could draw or not as circumstances dictated. I noticed, however, that she did not forget to cut a tiny peep-hole in the curtain so that she could see the programme without herself being seen when in the bath.

Electrosurgery

I WAS particularly interested in the article published in The Wireless World on radio surgery, as it all seems so absurdly simple. Not that I have any particular desire to try my 'pince-nez' hand as a surgeon, as I still have bitter memories of what happened years ago, soon after I was first married, when Mrs. Free Grid was suffering from a boil on the back of the neck. In a foolish moment of youthful enthusiasm I volunteered to operate on it for her. Whether my hand was unduly shaky, or whether my hacksaw had one or two jagged teeth, I cannot say, but the ensuing yell she set up brought a strongly worded protest about taking the bread out of his mouth from a dentist living next door.

No, the point of the article which interested me was the one in which it was stated that radio surgery was being increasingly used for the "face renewal" operations practised in modern beauty parlours. It so happened that I had been reading the article just before blundering unexpectedly into one of Mrs. Free Grid's

“at homes” one afternoon. One glance at the guests which Mrs. Free Grid had invited to make free with my bread and margarine immediately convinced me what tremendous scope there was for this sort of thing, and I immediately saw in it a means whereby I could not only rebuild my depleted fortunes, but could at the same time help my country as a super-tax payer.

Unfortunately, my country did not show itself as willing to help me as I was to help it, for I was unable to obtain the necessary permit to buy the valves which were, of course, in the transmitting case. Fortunately, one does not have to depend upon valves entirely, and The Wireless World had published a circuit diagram of an alternative spark generator, and it was a simple matter to construct an induction coil. At length I had everything completed, and at Mrs. Free Grid's next reception I called for volunteers to take their seat in the operating chair. Nor did I lack patients, for it is a curious fact that while men have a childlike faith in doctors, women are equally trusting where beauty specialists are concerned, and, moreover, by a curious kink in the feminine mental make-up, whereas the most passé of women never believes that she is beyond repair, yet on the other hand the most young and beautiful of them always imagines that nature can be improved upon.

My first patient was also my last, and I had to spend an anxious half-hour in applying artificial respiration with a stirrup pump. The whole snare was, as I found out afterwards, that I had been working on too low a frequency, this being due to my miscalculating the LC constants of the circuit, owing to my foolishly following "Diallist's" advice in the September issue of this journal and attempting to juggle with his new-fangled "all-in" logarithm tables instead of sticking to the old and trusted long-hand mathematics to which I had been accustomed all my life.

The Wireless World, December, 1941
Many of us can remember the array of candles waiting in the hall, and the eerie, flickering shadows as we climbed the stairs. For those were days when candle power was—well, just candle power, and nothing more. To-day it is a symbol of brilliant, unlimited light, in a world transformed by electricity.

PHILIPS were pioneers in the development of the electric lamp, and pioneers, too, in other fields where electrical equipment has added to our comfort and well-being; given us new processes in industry... new standards in entertainment... and a glimpse of that new design for living which is to come.

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