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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.

CONTENTS

EDITORIAL COMMENT

Wireless for Private Communication

Is the Post Office Monopoly Too Rigid ?

UNDER the Wireless Telegraph Act the Post Office is granted a monopoly in this country for the control of wireless communications. It is for this reason that all wireless stations are subject to a licence from the P.M.G., including transmitters and receivers for reception of broadcasting.

The Post Office also grants licences to commercial companies for the establishment of wireless services from point to point whilst the Wireless Telegraph Act specifically states that, subject to suitable regulations, the Postmaster-General shall not withhold licences for experimental purposes. When wireless licences are granted to amateurs and others for experimental purposes it is expressly stated in the licence that the stations must not be used for the transmission of ordinary messages but that all communications must be relative to the experiments. It is for this reason that amateurs in this country may often be heard stating the nature of the apparatus they are employing, or describing alterations to the equipment, but one seldom hears any communication radiated which extends beyond this scope or a few words of greeting.

Other Countries More Generous

In some other countries, notably in the United States of America, experimental licences are granted on much more generous terms and messages may be freely transmitted from point to point, provided that these transmissions are not made for financial gain.

Since the date of the Wireless Telegraph Act, possible applications of wireless for communication purposes have been very greatly extended, and on ultra-short waves in particular a very valuable and convenient means of communication has been developed. Whilst recognising that these wavelengths are likely to be in great demand for a multitude of important purposes, it nevertheless seems desirable that some opportunity should be given for the establishment of private stations for point to point communication. A new industry could be built up from the sale of compact telephony receivers and transmitters suitable for the equipment of trains, buses and cars requiring to communicate with other points, whilst a little more latitude to amateurs to make use of apparatus would undoubtedly stimulate interest in experimenting.

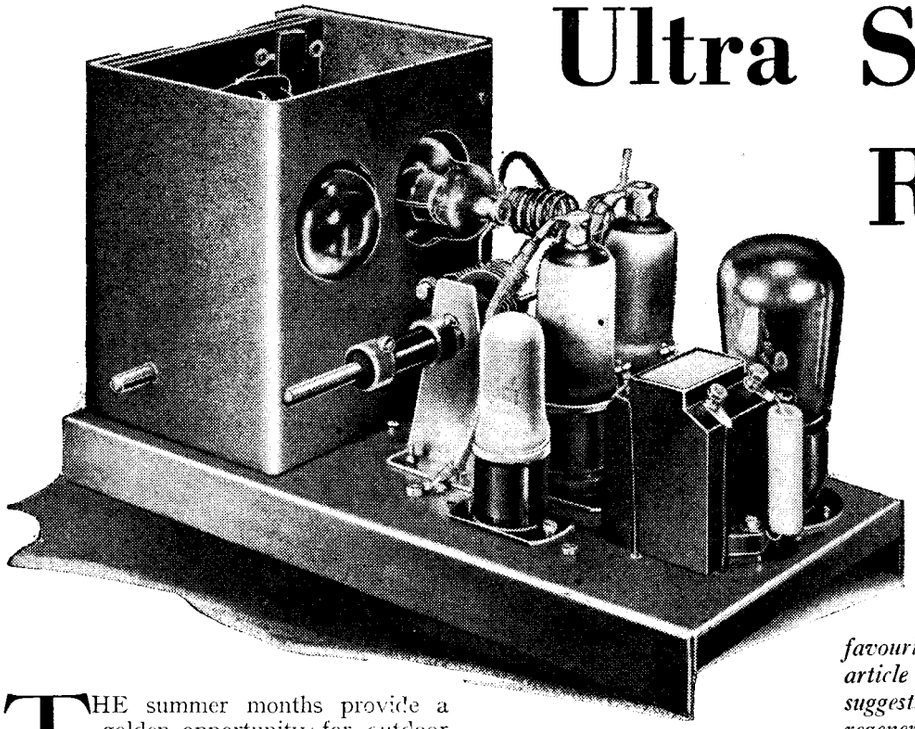
Morse Code and Qualification

Whereas, at present, a knowledge of the Morse code and Morse procedure is required of those who apply for a licence, this should surely not be necessary in the case of those intending to confine themselves to the use of the ultra-short waves, for there would not be the risk, which applies on longer waves, that communications at a distance could be interfered with.

For general use transmitters and receivers could be supplied pre-tuned to fixed wavelengths to ensure that they were not used to intercept transmissions not intended for them.

An adequate charge for a licence would, of course, be made by the P.M.G. with such regulations as were considered necessary, but no change in the Wireless Telegraph Act would be required as the necessary powers for such modifications in the present policy are provided for therein.

Ultra Short-wave Reception



Portable Sets for Field-day Use

By H. B. DENT

AT this time of the year many amateurs turn their attention to outdoor wireless activities, the five-metre band being a particularly favourite one for these experiments. This article deals with some suitable receivers and suggests an alternative to the ubiquitous super-regenerative set that has for long served on these occasions.

THE summer months provide a golden opportunity for outdoor wireless activities which offer a welcome change to the more active pastimes, yet enable full advantage to be taken of the fine weather. Those contemplating taking a part in wireless field days this year might well consider the idea of utilising these occasions to obtain some experience in the handling of ultra short-wave receivers and the compiling of useful data on wave propagation at these very high frequencies.

Many amateurs operating transmitting stations are active on the five-metre band, but helpful data is difficult to obtain unless a particularly favourable transmitting site is available, for it is not always possible to erect an aerial sufficiently high in residential districts to clear all nearby buildings.

There is much that the amateur desires to know regarding the performance of different aerial arrays, and these experiments are capable of being carried through successfully only in fairly open country. The ideal arrangement is for the transmitter to be located on a prominent point, and there are several excellent sites to be found within a reasonable distance of most large cities.

Field days organised on these lines offer a welcome diversion during the summer for radio societies and institutions interested in the experimental side of amateur wireless.

Field Day Procedure

The receiving parties could be equipped with one or more receivers so as to compare the performance of different sets under the same conditions. Each takes a prearranged section of country and tests are made at frequent intervals, the first not more than a mile from the transmitter in order to tune in the station and note its position on the dial.

Subsequent reception should be recorded in a section log, containing such information as strength of signals, time, position and nature of the surrounding country with details of any hills or other topographical features lying between the receiver and the transmitter, for this information when compiled into a report of the day's work will provide extremely useful data for future experiments of a like nature.

One advantage of the five-metre wavelength is that it does not necessitate elaborate or bulky apparatus. Self-contained receivers can be built in easily portable form whilst a comparatively low-power transmitter will suffice for many of the earlier experiments. The writer has obtained very good results with simple super-regenerative receivers using short vertical aerials, dipoles and also loops for directional reception. *The Wireless World* Ultra Short-wave Two, the circuit of which is shown in Fig. 1, is an example of a set of this type.

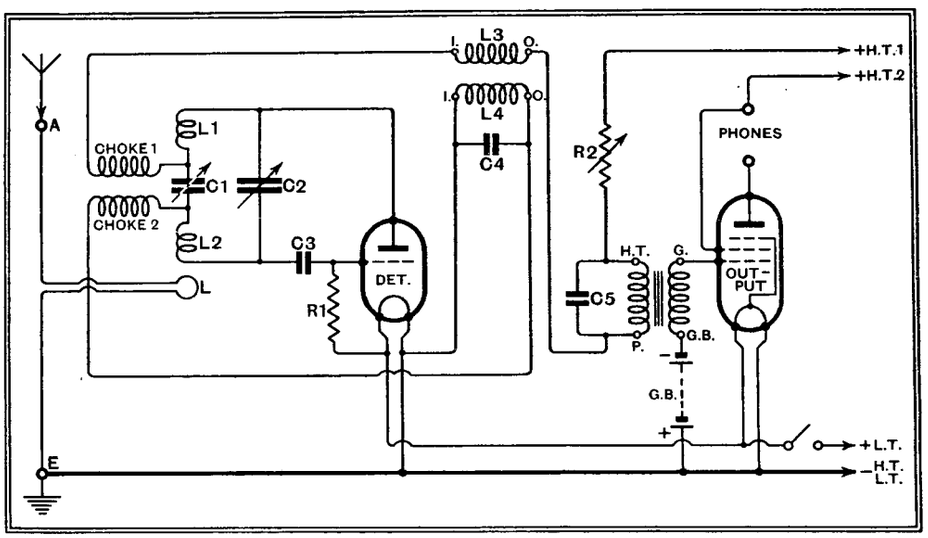


Fig. 1. Circuit diagram of two-valve self-quenching super-regenerative ultra-short wave receiver. Values of components are : C1, 50 m-mfds. max., C2, 35 m-mfds. max., C3, 0.0001 mfd., C4, 0.01 mfd., C5, 0.001 mfd., R1, 2 megohms, R2 = 50,000 ohms variable, L1 and L2 each three turns No. 16 S.W.G. ⅜in. diameter and L one turn. HT = 100 volts.

For outdoor use the receiver should be easily portable and entirely self-contained and, if directional reception using a loop or dipoles is attempted, provision should be made to operate the set in an elevated position, for it was revealed during some five-metre outdoor experiments last year that the aerial required to be raised at least four feet above ground level. This

Ultra Short-wave Reception—

does not apply, of course, when a non-resonant vertical aerial is employed or an elevated dipole with feeders to the receiver. These arrangements, however, are not very conveniently applied to portable-type sets unless the apparatus is fitted in a car and the aerial supported on quickly erected poles in sockets.

A portable receiver embodying a separate quenching valve is shown in Fig. 2; this was designed for use with a loop aerial, though it would be quite an easy matter to modify the input circuit for use with dipoles arranged either horizontal or vertical according to the polarisation of the transmitted wave.

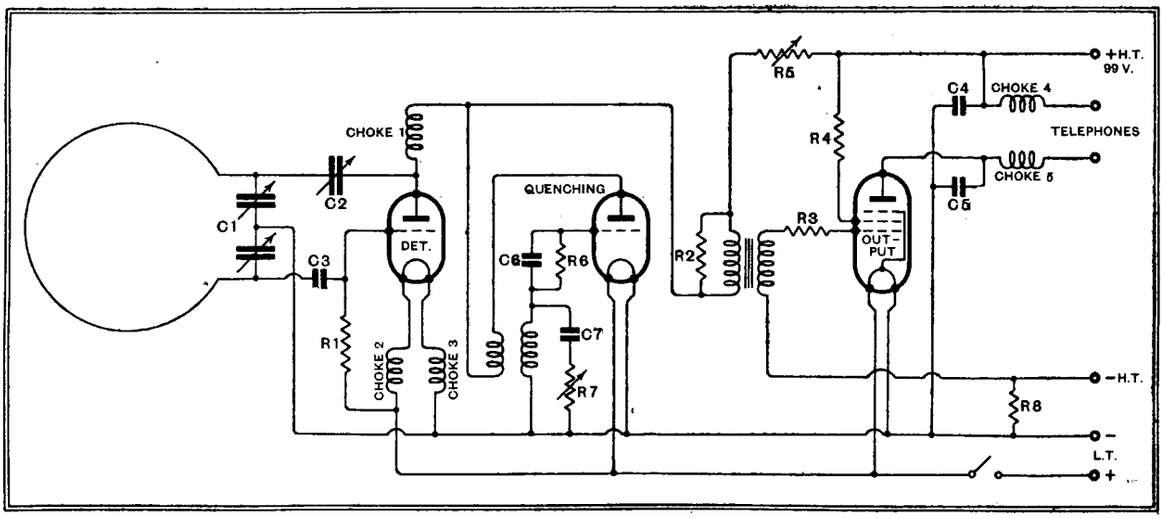
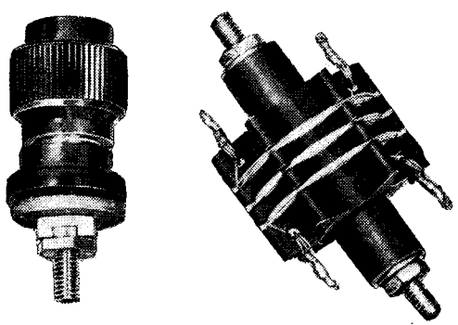


Fig. 2. Three-valve super-regenerative 5-metre receiver; value of components are: C1 = 30 m-mfds. each section, C2 = 15 m-mfds., C3 = 0.0001 mfd., C4, C5 = 0.006 mfd., C6 = 0.005 mfd., C7 = 0.01 mfd., R1 = 1 megohm, R2 = 30,000 ohms, R3 = 50,000 ohms, R4 = 5,000 hms, R5 = 50,000 ohms variable, R6 = 50,000 ohms, R7 = 1,000 variable and R8 = 500 ohms, HT = 100 volts.

Whilst the super-regenerative receiver is simple to construct and to operate its sensitivity is not very high, though undoubtedly superior to the ubiquitous Det.-LF arrangement. The obvious alternative is the superheterodyne. Even a set of this type can be built for battery operation in a very compact form if a little ingenuity is applied to adapting existing components for the purpose.

The intermediate amplifier employed for normal broadcast sets, and for that matter in some special short-wave receivers, is operated at far too low a frequency for really satisfactory results on the ultra short waves. A more suitable frequency would be about 4,000 kc/s (75 metres), and with modern valves a useful stage gain is possible even with the battery type and quite a low HT voltage. Two such IF stages gave an overall amplification of just on 200 in a small portable set operating from a 100-volt battery and intended for headphones only. As we might reasonably expect the frequency changer to contribute about three whilst the detector and one transformer coupled LF amplifier will add a further 200, the overall amplification that such a set will give amounts to approximately 120,000.



Miniature IF transformer used in the 5-metre superheterodyne described in the text. Its size can be gauged by comparison with the terminal alongside.

Compared with ordinary broadcast sets this is not very good, but a super-regenerative set working at its best and fitted with a similar LF circuit could hardly be expected to exceed the 5,000 mark. The figure given for the superheterodyne could be improved upon by applying reaction to the IF amplifier, for in its experimental form it was found to be perfectly stable.

Compact Superheterodyne

The circuit employed is given in Fig. 3, and some idea of the compact form in which it can be built is shown by the illustration of the receiver chassis, which measures 12in. × 6in. and is intended to be housed in a metal cabinet 12in. × 12in. × 6in., with the batteries below the chassis. The cabinet that held the small super-regenerative portable shown on the next page will be used for this set, so that it occupies no more space than the three-valve set. It must be admitted, however, that to accommodate everything in such a small compass requires care in the choice of the components used.

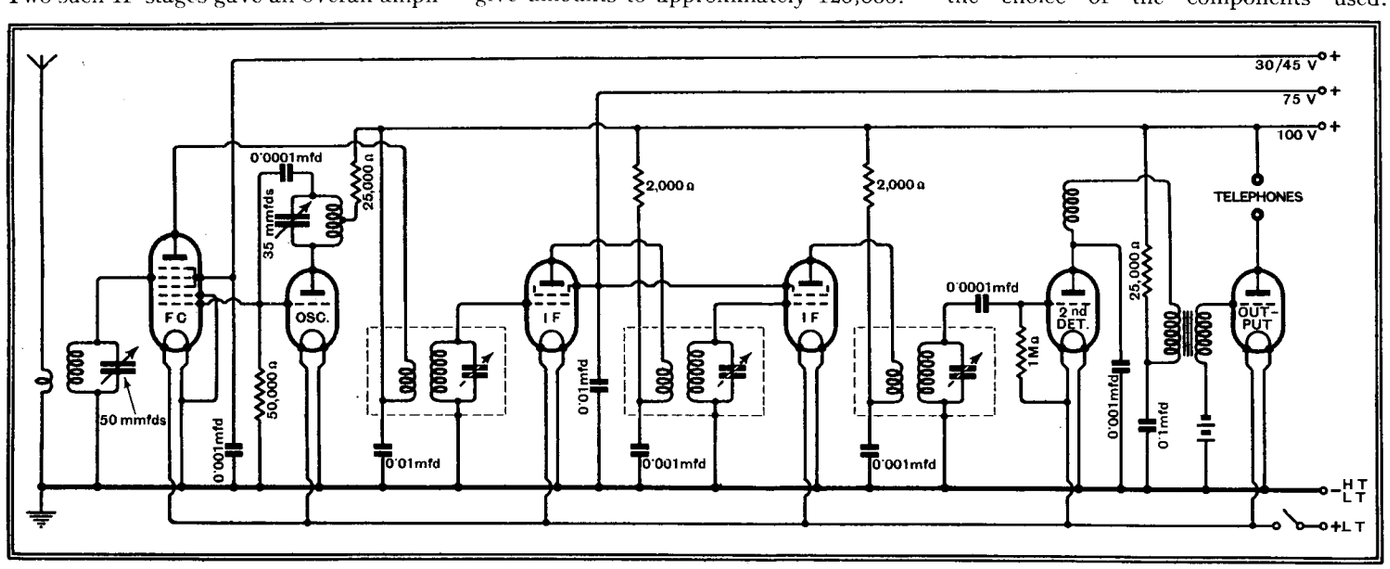
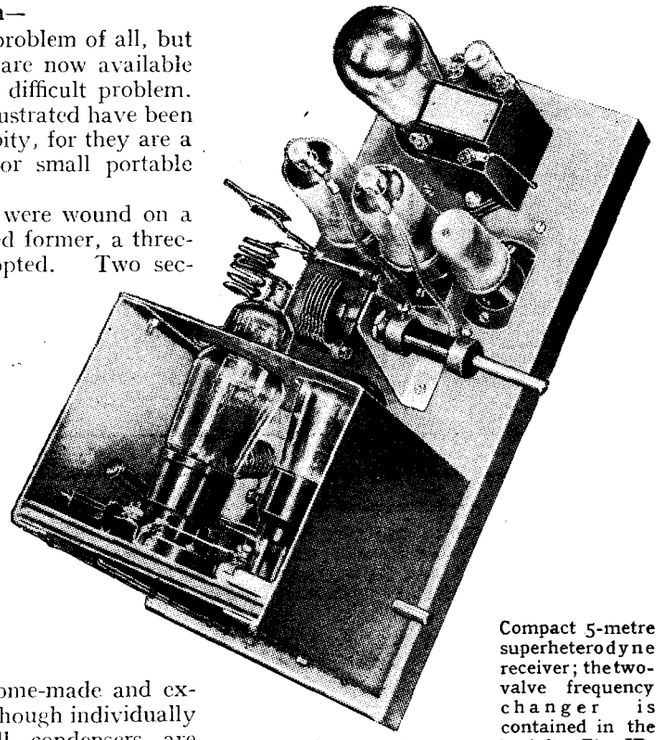


Fig. 3. Circuit diagram of the experimental 5-metre six-valve superheterodyne.

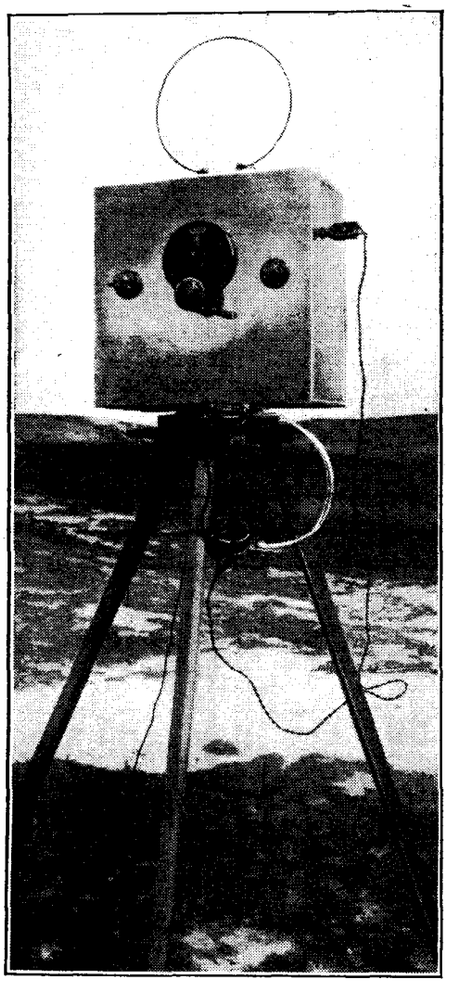
Ultra Short-wave Reception—

Valves are the biggest problem of all, but quite miniature valves are now available so that it is not a too difficult problem. Those used in the set illustrated have been withdrawn, which is a pity, for they are a most convenient size for small portable sets of this nature.

The IF transformers were wound on a one-inch diameter ribbed former, a three-slot winding being adopted. Two sections form the secondary and one the primary, and they measure ¾in. deep only. The illustration shows the form of construction adopted. The grooves are 1/64in. wide, and each contains 25 turns of No. 32 DSC wire. They are enclosed in small metal cans 1⅜in. in diameter and 1½in. high. The small trimmers were home-made and external to the coil cans, though individually screened. Very small condensers are wanted, as the bulk of the capacity is made up of the valve and wiring, the trimmers merely making good discrepancies in the various circuits. Only by employing the highest inductance possible is a reasonable stage gain attainable at these high frequencies.



Compact 5-metre superheterodyne receiver; the two-valve frequency changer is contained in the screened compartment on the left. The IF transformers are mounted below the chassis.



Five-metre self-contained receiver fitted with loop aerial for directional reception.

It was not possible to improve the IF gain to any appreciable extent with the layout and the limited HT voltage employed. Increasing the primary turns tends to convert the IF transformers into band-pass circuits, the primary then resonating at a frequency approaching that of the secondary, for although these circuits are tuned by small additional capacities the trimmers account for a small part only of the total capacity across the coils, which are tuned mainly by the valve and other stray capacities. Furthermore, HF instability was encountered.

Limited Amplification

Applying reaction to the detector stage gives a slight gain, but has the disadvantage of detuning this circuit unless reaction is pre-set and the circuit trimmed with full reaction applied.

It was further revealed that if an amplification of more than about fourteen per stage is attained the background becomes rather objectionable, and this is a point that must be kept always in mind, for it will preclude intelligible reception of very weak signals, which is of particular importance in sets of this type intended solely for headphone use.

Practical tests have shown that of two sets the one that was considerably more sensitive than the other but having a higher background level did not prove as good when listening to weak telephony signals.

In order to better the sensitivity it would seem necessary to rearrange the circuit and add an extra IF stage, making three in all, and accompanying this by a reduction in the gain of the individual IF stages. This line of development is being followed at the present time, and it is hoped that in the near future some further data on the matter will be available.

It is not proposed to give a detailed description of the set at this juncture, since it is still very much in the experimental stage, but the circuit diagram, on which has been marked values of most of the components and the brief description of the 4,000 kc/s IF transformers, may prove of some assistance to those sufficiently interested in this aspect of radio to turn their hand to investigating the possibilities of the superheterodyne for five-metre reception.

Readers desiring further details regarding the two super-regenerative 5-metre sets mentioned in the early part of this article can obtain them from *The Wireless World* of June 16th, 1933, where the construction of the Ultra Short Wave Two was given, while the portable three-valve set was dealt with in the September 28th, 1934, issue of this journal.

Preventing Collision in the Air

Wireless Aid to Safety in Aerial Navigation

At the present rate of increase in the number of aircraft in commission the risk of collision will soon become a very real one, especially in the vicinity of aerodromes. Dr. J. Robinson, the inventor of the Stenode and the pioneer of the direction-finding system known as Homing, is now responsible for introducing apparatus which he describes as an Altimeter-controlled Wireless Klaxon, with the object of minimising this danger to aerial navigation. This apparatus is now being developed.

Briefly, it is proposed that an aircraft in positions where the risk of collision exists should send out, either from a special low-powered transmitter or from the modified main transmitter, a signal to be modulated automatically by the altimeter in order that its presence and height may be made known to other aircraft in the neighbourhood, which would be fitted with suitable receivers.

As an example of "altitude modulation," it is suggested that transmitters of aircraft at ground level should be modulated at 256 c/s per second, corresponding to middle C; at 1,000ft. by 512 c/s equal to an octave higher, and so on.

The success of this scheme obviously depends on the accuracy of the altimeters of all aircraft concerned. As is well known, these instruments are simply specially calibrated barometers, and clearly their accuracy depends on the zero being suitably set to correspond with the prevailing atmospheric pressure at ground level below.

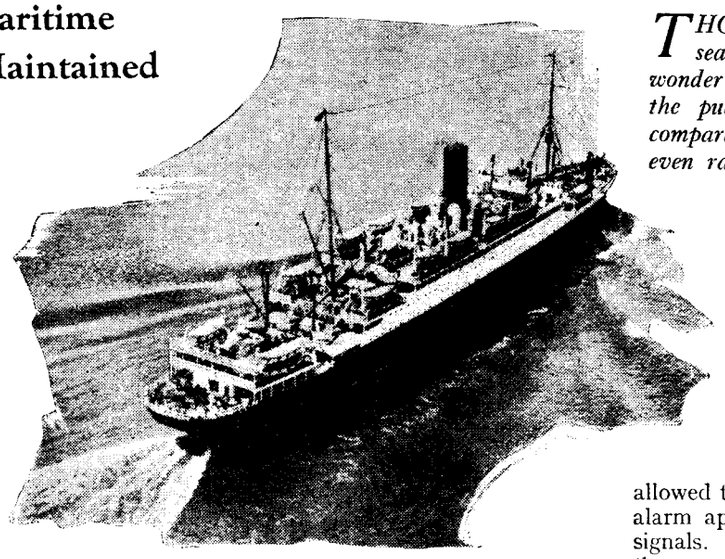
Dr. Robinson proposes, therefore, that at aerodromes or at definite points on air routes where the possibility of collision exists, a wireless transmitter should send out a signal which automatically resets the zero of all altimeters within range. Accuracy will be thus assured, and a pilot could safely depend on warnings received through his "Wireless Klaxon" apparatus.

Wireless Working with Ships

How the Maritime Services are Maintained

By LT.-COL. CHETWODE CRAWLEY, M.I.E.E.

THOUGH the use of wireless at sea has ceased to arouse the wonder and admiration which gripped the public mind in pre-war days, comparatively few "landlubbers"—or even radio amateurs—are aware of the actual conditions governing the operation of the various services. Stringent rules are applied to every department of maritime wireless, the primary aim of which is to secure maximum safety for all ocean travellers.



By courtesy of Cunard White Star Ltd.
Air photo of RMS "Alaunia."

THE regulations in this country and in nearly all others lay down that passenger ships and all other ships of 1,600 tons gross and above must be fitted, for safety purposes, with wireless telegraphy; and that all passenger ships of 5,000 tons gross and upwards must be fitted, in addition, with directional receiving apparatus. In a compulsorily equipped ship the equipment may be simple, such as a ¼-kilowatt installation, as the specified range of working is only 100 miles; and one operator only need be carried for certain periods of watch, provided all other periods are covered for the reception of distress signals by an auto-alarm receiver or a watcher. Many ships, however, find it necessary for traffic purposes to employ a number of operators and to fit far more elaborate installations. For example, in a large liner a dozen operators may be employed, and there may be as many as four transmitters, comprising two medium-wave transmitters for the 600 metre and 2,000 metre bands respectively, and two short-wave transmitters for telegraphy and telephony respectively. This outfit, including the receivers, may require eight aerials, and in addition there would be a receiving aerial for broadcast reception and another for directional purposes, making ten aerials in all, arrangements being made, too, for simultaneous transmission and reception on certain waves.

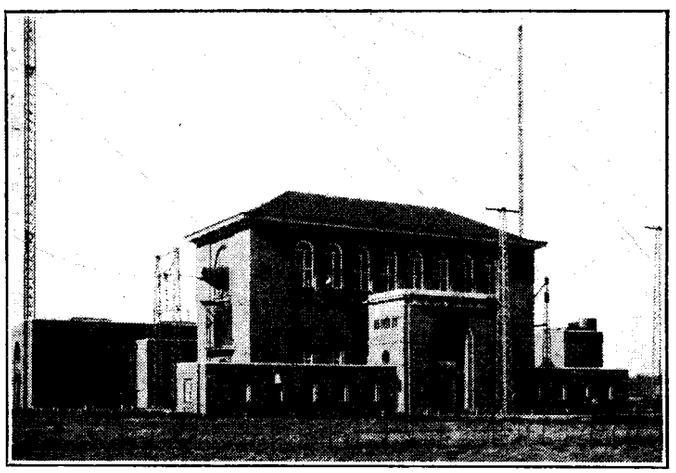
Ships' installations are inspected periodically to ensure that they are in accordance with the licence issued by the Postmaster General, and for this purpose inspectors are stationed at the principal ports. These inspectors act also as Surveyors for the Board of Trade, which is responsible, with the Post Office, for the observance of the regulations in connection with the wireless equipment which must be fitted for safety purposes. This applies to about 3,200 of our ships out of a total of about 4,000 fitted with wireless apparatus. In addition to British ships a number of foreign ships also are inspected to ensure that their installations conform to British requirements when in British ports.

All operators in ships registered in this country must be in possession of a certificate of proficiency issued by the Postmaster General. There are various classes of certificates appropriate to the work to be performed and the class of ship concerned. Ships are allowed to carry watchers instead of auto-alarm apparatus for listening for distress signals. A watcher may be any member of the crew, but even he must be examined and have a certificate of proficiency in these listening duties.

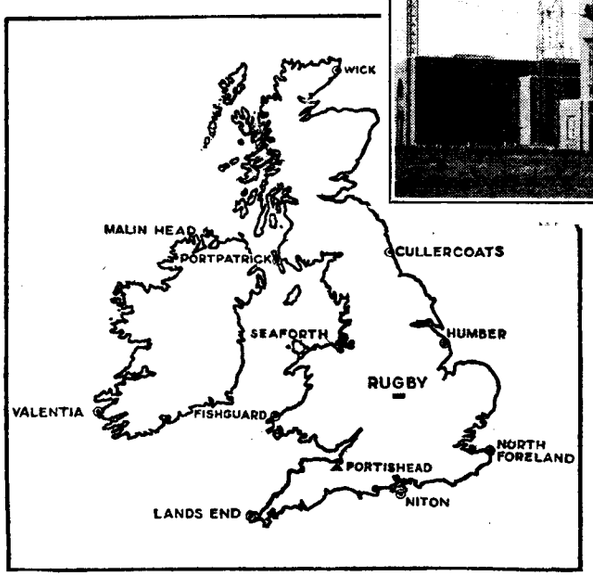
Throughout the world there are now some 15,000 ships equipped with wireless installations. Of British ships there are about 4,000, and of these about 800 are voluntarily fitted. Of these 800 about 500 are small craft, fishing vessels, etc., which are fitted with wireless telephony.

The shore operation with ships is carried out by the Post Office, with the exception of the Beacon Stations, and a few stations belonging to Railway Companies for communication with their own ships. Twelve stations round the coast, and those at Rugby and Baldock, are used for this ship-and-shore communication, and they perform two services, the safety service and the traffic service.

The twelve coast stations are used for the safety service, signalling the Morse Code by hand on a wave of 600 metres. The range of the stations is about 300 miles



The transmitter building and machinery hall at Rugby, the world's largest wireless station.

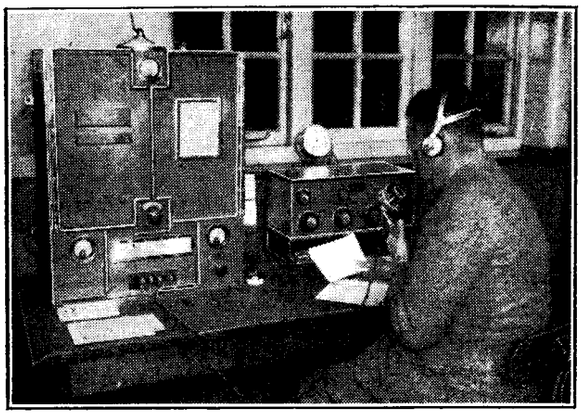


Thirteen stations in the British Isles are used by the Post Office for communication with ships.

Wireless Working with Ships—

—much more, of course, at night, and very often more in the daytime—so that they well overlap one another, and a ship anywhere near the British Isles is always in touch with one or more of them.

The most important safety service is the SOS service. When a ship is in distress, i.e., if the ship itself is in danger, it sends out this signal. The ship then sends out a message giving her position and saying what is the matter. The nearest coast station directs communications, and if necessary repeats the distress message by wireless telephony, so that small ships not fitted with telegraphy may possibly receive it. The coast station communicates



A telephony set at North Foreland Radio for communication with small ships.

on the land side by telephone and telegraph with the coastguards, the Admiralty, Lloyds, and very often with the Air Ministry, harbour authorities and tug owners.

During an SOS case all ships and stations within range, other than those engaged on the case, remain silent, so as not to interfere with the distress communications, and it is often many hours before the coast station can give the all clear signal for normal communications to be resumed.

Before the SOS is sent out the alarm signal may be sent, many ships being now fitted with an automatic receiver so that if the alarm signal is received by wireless a bell is rung to call the operator to the wireless room.

Safety Signals

The most important signal after the SOS is the urgency signal, consisting of the group XXX. This signal precedes a message of urgency, and the coast station proceeds in the same way as for the SOS, informing the authorities concerned and taking whatever other steps are required by the circumstances of the case.

The coast stations also broadcast safety messages on 600 metres—weather reports, etc.—at fixed times, which are published. This broadcast is preceded by the Group TTT, which means that what follows is a safety signal. Similar reports are sent out from the high-power station at Rugby, and the B.B.C. broadcasts weather reports by telephony every night for small craft such as fishing vessels, which do not carry wireless operators, but may be listening on telephone receivers. Arrangements, too, are made for collecting by wireless from ships in the North Atlantic, weather messages for the assistance of the Meteorological Office in making up forecasts.

An important safety service to assist the navigation of ships in thick weather is the direction finding service in which the station informs the ship of its bearing from the station. Seven of the coast stations are fitted for this work—Wick, Cullercoats, Humber, Niton, Land's End, Portpatrick and Malin Head. The accuracy of the bearings, which are given on 600 or 800 metres, is within 2 deg., which is quite sufficient for ships as a rule. Bearings are not given all the way round as those in certain sectors are inaccurate owing to the configuration of the coast, etc.

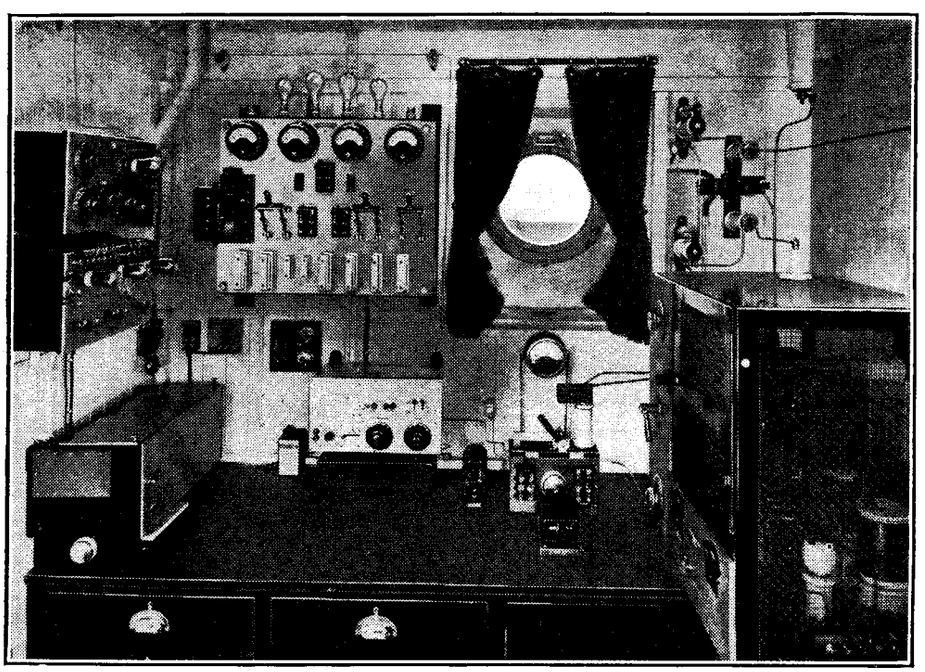
Another important navigational aid is provided by twenty-five beacon stations round the coasts from which ships fitted with directional receivers can obtain bearings. Nearly all these stations in England are worked by the Trinity House, in Scotland by the Northern Lighthouse Board, and in Ireland by the Irish Lights Commissioners. All except two send out waves in all directions like a lighthouse. They operate every six minutes in fog and every half hour in clear weather. The two exceptions are the rotating beacons at Orfordness and Tangmere, where the emissions are rotated, and a ship even without a directional receiver can easily calculate by means of a stop watch its bearing from the station. These rotating beacons allow of a bearing being taken every 12 minutes, day and night, in clear

Photo: Marconi International Marine Communication Co. Ltd.

A senior operator on an Atlantic liner establishing a ship-and-shore telephony link on behalf of a passenger.

or thick weather. Five of them are synchronous beacons, transmitting sound waves and wireless waves at the same time. By noting the difference in time between the reception of the wireless and the sound signal, the ship can easily calculate its distance from the beacon, in addition to obtaining its bearing. These stations send the sound signal through the sea and the wireless signal in the ordinary manner, with the exception of the Cumbrae, which sends the sound signal through the air.

The coast stations which use the 600 metre wave for the safety services, with the exception of some of the directional



Siemens Brothers' ICW and emergency transmitter in the "Clan Macalister." On the left is the Auto-alarm.

Wireless Working with Ships—

work which is carried out on 800 metres, use it also to a great extent for traffic as well as using working waves between 600 and 800 metres, but the most important traffic station is Portishead Radio, which is fitted with medium and short continuous wave sets as well as the ordinary coast station equipment. About 250 ships are fitted with continuous wave sets for traffic purposes. Rugby Radio, too, broadcasts Press and other messages to ships, and is the telephony transmitting station for liners.

Transmitter Operated by Distant Control

Portishead Radio and the coast stations are fitted with telephony as well as telegraphy, for the purpose of communicating with small craft which are equipped with telephony but not telegraphy because of the expense of carrying an operator. Telephony is less efficient than telegraphy for ship communications. The waves used for this telephone service are between 100 and 200 metres, and about 500 of our small ships are now equipped.

Portishead Radio consists of a transmitting station at Portishead operated by distant control from a receiving station at Burnham. At Portishead there are three medium-wave and two short-wave transmitters. The former work up to about 2,000 miles, the latter to world-wide ranges.

The medium wave transmitters have an input power of 15, 6 and 6 kilowatts respectively, the short wave transmitters have each 10 kilowatts. The medium waves are transmitted from T aerials supported by 300ft. masts, the short waves from dipoles, or directional arrays (of which there are 10), or a rotating beam aerial (whose rotation is worked from Burnham), according to the positions of the ships communicating and the waves in use. The medium waves used are in the 2,000-2,400 metre band, and the short waves in the 18, 24 and 36 metre bands. In addition, there is equipment for sending on the ordinary coast station band, and there is a telephone transmitter for small craft communications.

The receiving equipment at Burnham consists of three medium-wave and nine short-wave receivers, and the coast station and telephone receiver. The aerials for the medium-wave receivers consist of Bellini-Tosi loops; those for the short-wave receivers being similar to the short wave transmitting aerials, including a rotating beam aerial.

Short wave working with ships is still much more erratic than medium wave working, and though its range may be considered as world-wide under favourable conditions there are certain areas, such as the North and South Pacific, where difficulty is nearly always experienced.

The transmitting station at Rugby is the largest Post Office station, and is, indeed, the largest station in the world. Messages for ships in any part of the world are broadcast by telegraphy, the actual keying being carried out in the General Post Office in London. Official Press messages are broadcast thrice daily, news agency messages four times daily, and private messages for individual ships twice daily. These messages are sent on an 18,750 metre wave on Rugby's main transmitter of 350 kilowatts input, and are simultaneously sent on a short wave transmitter from the station at Leafield (Oxford) so as to give ships all over the world the best possible chance of reception.

A weather shipping statement is broadcast from Rugby twice a day and a time signal is sent out at 6 p.m. These transmissions are made on long wave only.

Rugby Radio, it will be noticed, is used only for broadcasting messages *to* ships, so far as telegraphy is concerned, and does not deal with any telegraph traffic *from* ships. Its most important use is, of course, for point-to-point communications, not communications with ships.

Rugby is also used, as mentioned above, for a telephony service with certain Atlantic liners. The subscriber on shore is connected, through the radio terminal at the Faraday House Exchange in London, to Rugby Radio when speaking and to Baldock Radio when receiving, and conversation is carried on in the ordinary way over a telephone so far as the subscriber is concerned. Communication with the ship is first established by telegraphy through Portishead Radio, and arrangements made for putting through the call at a certain time. Short waves are used for this telephone service, five waves being utilised between 17 and 94 metres, according to the time of day, the season of the year, and the range. This service can be extended through London to many countries all over the world; and a passenger in mid-Atlantic has no difficulty in holding a conversation with, say, a friend in Sydney.

Short-wave receivers at Burnham.

Will Performance Specifications Become Popular?

Solid Facts Against Meaningless Superlatives

By "CATHODE RAY"

"I KNOW nothing about Wireless!" confesses the humble enquirer on the Exhibition Stand when the Technical Gentleman finally comes back from lunch and starts to talk. "Yes, but what is the sensitivity?" interrupts the hard-head when the chorus of Sales Gentlemen begins murmuring "Marvellous . . . . Colossal . . . !"

Here we have the two types of buyers. The latter fails to understand why manufacturers cannot supply definite technical information about the performance of their products, instead of a lot of meaningless superlatives; and the former fails to understand anything at all, except that all sets seem pretty much alike.

On the face of it, there seems no room for doubt that people who are intending to part with their earnings in exchange for a box of tricks should demand definite and unequivocal information as to what it can do. It is no help to be told that it is "perfect," because that is simply not true; and it is not enough to be told that it can receive 60 stations, because there is no knowing where, at what time of year or day, and by whom this result was obtained—and all these other particulars are quite necessary. Performance figures enable a set operated by a farmer on an outdoor aerial in Cornwall to be compared with another on an indoor aerial in Hampstead handled by an engineer, without fear of argument at cross-purposes.

The technically minded admit that the general use of performance data has been retarded by the difficulties of measuring