The "All-Red" Wireless Chain

DETAILS OF THE MARCONI PROPOSAL.

[Public interest in the Empire's "wireless" needs has been stimulated recently by the announcement, in London, of a proposal submitted by Marconi's Wireless Telegraph Company, Ltd.; and while the reader has already learned from his daily newspaper that the project is of considerable magnitude and provides for a network of wireless stations to serve the entire British Empire, it is reserved for *Sea, Land and Air* to publish the full particulars.

The urgent need for more lines of communication is emphasised—particularly here in the Antipodes—by the seriously congested "traffic" on submarine cables which link the scattered outposts of Empire one with another, and each with Great Britain. Additional cables can, and probably will, be laid, but the cost of that full extension and duplication which alone could relieve the abnormal stress is altogether prohibitive and one must seek cheaper methods. Further, the demand for increased means of inter-Imperial communication, so vital to the development of our post-war trade, makes essential a wide extension of those clogged arteries upon which we are now forced to depend.

In peace one must consider *expense* and *efficiency*, especially the latter, for all inefficiency is waste—whether in our national or commercial affairs; in war we face the possible dislocation or interruption of cable services by enemy action. Wireless telegraphy provides an independent means, not open to these objections, of establishing and maintaining a chain of rapid communications throughout the British Empire, and with its equally important links—the ships at sea. The knowledge gained, and the great advances made, in this science during the war render possible the design of a system which can be guaranteed to give, between any two points, a service at least equal to that of a cable. The sole advantage remaining with the latter is that of greater secrecy in transmission; but this applies only to strategic and political messages—for all commercial purposes present-day wireless is sufficiently secret.

The principles, which the Marconi Company suggests as desirable in the preparation of an Empire-wide scheme of wireless communications, are fully detailed hereunder.—*Ed.*]

(A) GENERAL PRINCIPLES.

(1) That such trunk routes and branch routes be provided, as will enable England to obtain wireless communication with any part of the Empire.

(2) That any part of the Empire be capable of communicating with any ship suitably equipped with modern wireless receivers, in whatever sea she be; roughly speaking, between latitude 60° N. and 50° S.

(3) That no submarine cable be relied upon to form part of this network of communications.

(4) That the use of land telegraph lines be, as far as possible, avoided; and that these lines be restricted to the passage of messages between the public and the nearest wireless station.

(5) That, where alternative routes are available; such as between England and South Africa, *viâ* the East Coast, or West Coast; both routes be provided.

(6) That, on the trunk routes, automatic transmission and reception at a speed of not less than one hundred words per minute be provided; and that separate transmitting and receiving stations be erected, in order that the service may be duplexed, *i.e.*, available for simultaneous transmission and reception.

(7) That as much foreign traffic as possible be attracted to the network, in order that the system be at least self-supporting as a commercial enterprise; it being understood that preferential treatment could be accorded to British traffic. Such an arrangement would clearly be politically and strategically advantageous to the Empire.

(B) CONSTRUCTION OF NETWORK.

In order to construct the wireless network in accordance with the principles above enumerated, it is proposed that the final aims should be as follow:—

(1) That Main Trunk Stations be erected for communication over long distances. (It may not be necessary to erect all the Main Trunk Stations immediately.)

(2) That no Trunk Station be required to communicate with more than one corresponding station; and that, in consequence, each country be provided with a separate Trunk Station for each route to which it forms a terminal.

(3) That, in a country which forms the terminal of more than one route, the various Trunk Transmitting Stations be

erected as close together as avoidance of * mutual induction will allow; and that, consequently, there be only one Trunk Transmitting Area in any country.

(4) That, in conjunction with the Trunk Transmitting Area, smaller transmitting stations be erected, to serve as Main Feeder Transmitting Stations; and that they be situated within one Main Feeder Transmitting Area.

(5) That all Trunk Receiving Stations and Main Feeder Receiving Stations be situated close together within a Main Receiving Area.

(6) That the Main Trunk Transmitting Area, Main Feeder Transmitting Area, and Main Receiving Area, be operated by means of underground cables from a Central Control Office.

(7) That the Central Control Office be situated in a convenient telegraph centre of the country (*e.g.*, London, in the case of England); and that, in order to reduce to a minimum the length of underground cables, the transmitting and receiving areas be situated as near thereto as is consistent with efficient duplexing, cost of land, etc.

(8) That each Main Feeder Station be designed to communicate with one or more corresponding Local Feeder Stations; and that each Local Feeder Station comprise two transmitting stations and two receiving stations all operated from one building, one pair for communication with the Main Feeder Station and the other pair for communication with the various coastal and other small local stations in the neighbourhood of the Local Feeder Station. (*See diagram overleaf.*)

(9) That Trunk and Feeder Stations employ continuous, or "undamped" waves for the transmission of signals.

(10) That, also, small local stations employ continuous waves.

(11) That, if found desirable in the future, arrangements be made to link up the proposed point-to-point network of "fixed" stations with any existing system of "mobile" stations which may be in use to maintain communication with units at sea or in the air.

(12) That, if desirable, arrangements be made at any of the stations to devote a reasonable time in each twenty-four hours to sending messages at hand speed to ships (where the wave length is suitable), to the sending out of *scientific* and ordinary time signals, and to similar services; it being understood, however, that Main Trunk Stations should not be expected to send to ships not specially fitted to receive the long waves which these stations must employ. (It must be borne in mind that; as the earning power per minute of such stations working at automatic speed would be considerable; and as, therefore, it would be commercially most undesirable to use them except for their normal services, so far as possible, such subsidiary services should be performed by the Main or Local Feeder Stations.)

(C) DESIGNS OF STATIONS.

Without entering too deeply into technichal details, the general principles which, it is submitted, should govern the design of the stations, may be indicated.

Choice of Sites.

Modern wireless telegraphy gives great latitude in the choice of the position of stations. Ranges are so great that a few miles more or less are of no importance.

It is recognised that it is undesirable to select sites which are exposed to hostile attack by sea or air; and the use of isolated places, small islands, and similarly vulnerable spots, is as undesirable from a commercial, as it is from a strategic, point of view.

It is proposed that the localities of all important stations should be selected in conference between the Company's engineers, and officers of the fighting Services.

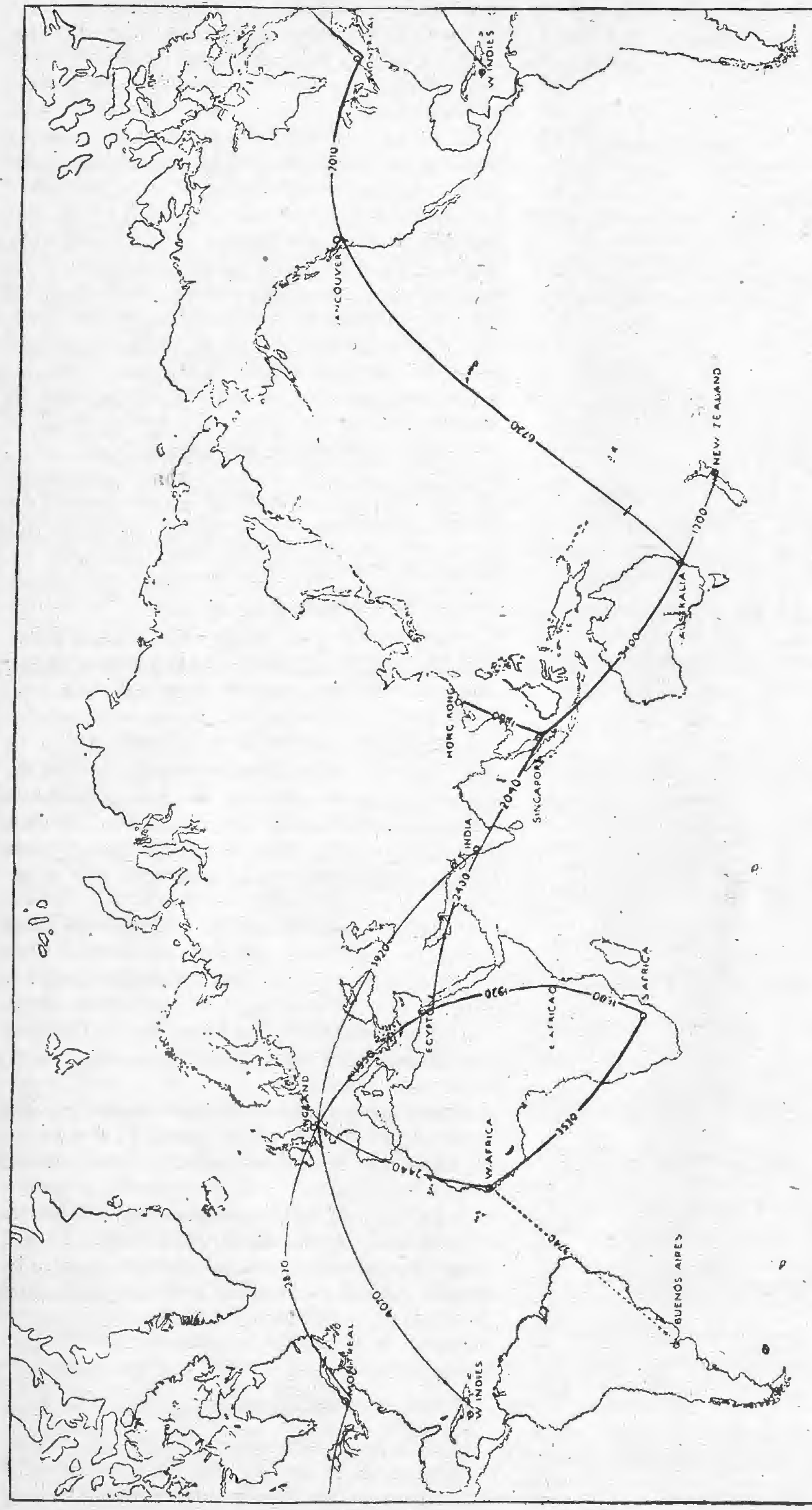
The localities having been decided upon; the choice of actual sites must be left to technical experts.

Masts, and large buildings required for housing the power plant, would necessarily be exposed to aerial attack; but there would be no objection to providing a certain amount of bomb-proof accommodation at stations, such as the English Trunk Stations, which are specially liable to attack. At such stations; the provision of alternative power supply, sufficient to carry on vital war communications after a successful air attack, would be considered.

Wave-Lengths.

It has been mentioned that each Trunk Station and Main Feeder Station should communicate with only one corresponding

* When two or more wireless stations are operated in a small area, the reactionary effect arising therefrom is known as *mutual induction*.—*Ed.*



Proposed Main Trunk Wireless Routes.

The numbers represent great circle distances in nautical miles.

station. Such communication would have to be conducted on a fixed wave length; and the whole question of allotment of wave lengths, with a view to enabling the requisite number of stations to work without mutual interference, would necessitate the most careful consideration.

This matter is clearly an international one, as the ranges of stations are now so great. The technical advances made by the engineers of the Company make the stations referred to in this Proposal practically independent of the actions of other nations. It is clearly, however, of the greatest importance that a claim should be made at the earliest possible moment to the various waves required to carry out this service.

In the event of the present Proposal for a network of communications being only partially adopted in the first instance, it is submitted that wave lengths should be allotted to all stations enumerated, in order to avoid possible changes at a later date.

Power Plant.

It is submitted that, where a thoroughly reliable source of power supply is available, the electrical energy should be purchased, and the transmission mains duplicated. Otherwise, self-contained power plant should be provided; the type chosen depending upon local conditions governing the cost of fuels, water supply, etc.

Type of Transmitter.

It is considered that the transmitters installed at the Trunk and Feeder Stations should employ a continuous, or "undamped," wave system. The advantages of continuous waves over damped waves are so thoroughly realised that stress need not be laid on this point.

The extensive employment of continuous waves has, until recently, been restricted, owing to lack of suitable methods of generating them. We have been limited to the *timed spark* and the *arc*.

Neither of these systems is very efficient, and each has its own disadvantages. Although, therefore, both systems, in the absence of any other, have proved of inestimable value in the development of continuous wave telegraphy, they can no longer be recommended, in view of the rival claims of the *high-frequency alternator* and of the *valve*.

The valve scores greatly over the arc as regards efficiency. Recent experience gained by the Company shows that, to obtain a given aerial current in any aerial, the ratio of power put into a valve to that put into an arc on a "dash" is approximately as two is to five. The valve not only results in a saving of energy, but also, avoids the necessity of an elaborate water-cooling system. Added to this, the valve is steadier and more reliable in operation than is the arc.

Another very great advantage of the valve over any other known continuous wave transmitter, with the exception of the *timed spark*, is that signalling can be effected by interruption of the load. This, not only avoids recourse to complicated precautions for the avoidance of the "spacing wave," but also results in a saving of power. As, during signalling, the load of the valve is interrupted, and that of the arc is continuous; it follows that the overall energy taken during a given period of transmission by the valve, as compared with that taken by the arc, is much less than that represented by the ratio of two to five already stated.

Such rapid strides have been made in the development of valves, and in their application to high power working, that apparatus is already being assembled capable of dealing efficiently with an output of 100 *kilowatts*. The corresponding aerial power is confidently expected to be 75 *kilowatts*, and the design of the set is such that it can readily be adapted to three or four times this power. The figures given are only limited to the value quoted by the capabilities of the power plant to be used for this trial. Recent research with a view to the reduction of the total effective aerial resistance, without loss of radiation, leads to the expectation of an aerial current of upwards of 300 *ampères*.

Such a transmitter retains all the advantages of the smaller installations in respect of prime cost, efficiency, facility of manipulation, and easy avoidance of spacing waves.

It is important, in order that interference between stations may be avoided, that special regard be given to the elimination of harmonics. This is another consideration which operates against the employment of the arc as a transmitter.

The problem of eliminating the higher order of harmonics produced by the valve transmitter, when working at the higher efficiencies (over 50 per cent.), has been successfully attacked by the Company's engineers.

Receiving Aerials.

Separate aerial systems are essential for the several receiving stations on one site.

The newest methods of reception invented and perfected by Mr. Franklin show such enormous improvements on previous methods as regards selectivity and avoidance of atmospheric disturbance, that it is unnecessary to consider a service which does not make use of this invention.

The Franklin aerial is a development of the now well-known Marconi-Bellini-Tosi Direction Finder, which played so important a part in various spheres of military activity during the War. The Direction Finder enables reception, with maximum intensity, within very close limits, of signals emanating from any two opposite directions. Signals from other directions are negligible, or can easily be rendered so. The Direction Finder has, however, the drawback—if such it can be called—that the mathematical *sense* of the signals cannot be determined without recourse to cross bearings.

This peculiarity of the Direction Finder is avoided in the Franklin aerial, which is based on a suitable combination of Direction Finder aerials. Signals can be received, within very close limits, from any one direction; and from no other. It follows that a receiving station can be located between, and in line with, two transmitting stations; and receive signals from one, while rejecting signals from the other.

This is a point of extreme significance, and marks a new era in selectivity. Its effects, together with those resulting from the use of highly efficient and well shielded receiving circuits, from which accidental coupling effects of all kinds are eliminated; and the "limiting" effects which can be developed by the suitable employment of valve receivers; form one of the chief contributory causes which allow the guarantees mentioned in this Proposal to be offered with confidence.

Owing to the ability of the Franklin receiving system to reject signals arriving from practically any direction other than that from which it is desired to receive, any number of receiving stations may be located on one site. No balancing aerials are required.

Even so, the erection of a large number of receiving stations on one site would entail the acquisition of a site of vast proportions, were it not for a most important property of Franklin's invention, which enables the various receiving systems to cross one another; this being due to the absence of long horizontal aerial wires. Small frame aerials are employed, and frames pertaining to different lines of communication may be erected as close together as 600 feet; even where long waves, differing but little from each other, are being received.

Results show that, where the Franklin type of aerial is employed, a very great reduction in atmospheric disturbance is obtained, compared with previous experience; a reduction amounting, in certain observed instances, to as much as ninety per cent.

So great is the importance of the Franklin aerial that the scheme of wireless communications outlined in this Proposal depends fundamentally upon its adoption.

Central Control Office.

An enormous amount of unnecessary work is avoided by the adoption of a Central Control Office. No staff of telegraphists is necessary either at the transmitting or receiving stations, other than that required for the care of the plant and instruments. Reception from the land lines, and retransmission by wireless, at the transmission stations; and reception by wireless, and retransmission on the land lines, at the receiving stations; is entirely eliminated.

In addition, the exchange of service messages between the operating staffs at the various transmitting and receiving stations is avoided, as all the operating staff is located under one roof. The land lines connecting the various stations are, therefore, kept free from a quantity of unremunerative traffic. The ease of control, and consequent saving of time, are too apparent to need further comment.

The organisation of a Central Control Office presents no practical difficulty. The operation of transmitting plants from a distance has been proved to be perfectly reliable in practice. As regards the relaying of received wireless signals through underground cables to a Central Control Office; recent experiments, carried out over some 130 miles of ordinary Post Office land-line in poor condition, show that this is an undertaking which can safely be relied upon to give satisfactory results.

(D) PROPOSED ROUTES AND BRANCHES.

Scheme of Trunk Routes.

Route 1.—England to India, and thence to Singapore, *Australia and New Zealand*, with a branch from Singapore to Hong Kong.

Route 2.—England to Egypt, and thence to East Africa, and South Africa.

Route 2a.—England to Egypt, and thence to India, Singapore, *Australia and New Zealand*.

Route 3.—England to West Africa, and thence to South Africa; with a branch from West Africa to South America.

Route. 4.—England to West Indies.

Route 5.—England to Montreal, and thence to Vancouver.

Route 6.—*Australia to Vancouver* (only night service to begin with).

The above will necessitate the following Main Trunk Stations:—

In England: Five.
In Egypt: Three.
In India: Three.
In East Africa: Two.
In Montreal: Two.
In Vancouver: Two.
In South Africa: Two.
In West Indies: One.
In West Africa: Two (and one Auxiliary Trunk Station for South America).
In Singapore: Two (and one Auxiliary Trunk Station for Hong Kong).
In Australia: Two (connection to New Zealand by Main Feeder Station).

Scheme of Feeder Stations.

The number of Main Feeder Stations provided in each country will depend upon the number of Local Feeder Stations required, and may, from time to time, as the requirements of the service warrant, be increased; without in any way affecting the scheme of Trunk Stations.

In some instances, existing stations might be utilised as Feeder Stations, if no longer required by the Governments concerned.

It is estimated that the following Feeder Stations would be required as a start:—

In England: A Feeder Station for each European Capital in which a station may be erected for communication with England; also any additional Feeder Stations which may be required for Government services.

In Egypt: Feeder Stations for Malta, Gibraltar, Khartoum and other places in the interior, Greece, Turkey, Bulgaria, Roumania, etc.

In India: Feeder Stations for Ceylon, and Karachi, and such others as may be found necessary for internal traffic. The number eventually erected would be determined by strategic considerations and by the extent to which existing Feeder Stations were loaded.

In Singapore: Feeder stations for the Straits Settlements, Malay Archipelago, Philippines, etc.

In Australia: Feeder Stations for New Zealand, and for each important city of the Commonwealth.

In East Africa: Feeder Stations for Zanzibar, Mombasa, Uganda, and North-Eastern Rhodesia.

In South Africa: A Feeder Station for each important town in South Africa.

In West Africa: Feeder Stations for Sierra Leone, and such other areas as may be provided with local stations.

In West Indies: Feeder Stations to embrace Jamaica, British Honduras, British Guiana, Trinidad, Bahamas, Bermuda, Virgin Islands, Windward Islands, and Leeward Islands. So far as possible traffic from Central and South American States should also be carried by this line.

In Canada: Feeder Stations for Western, and Eastern communication.

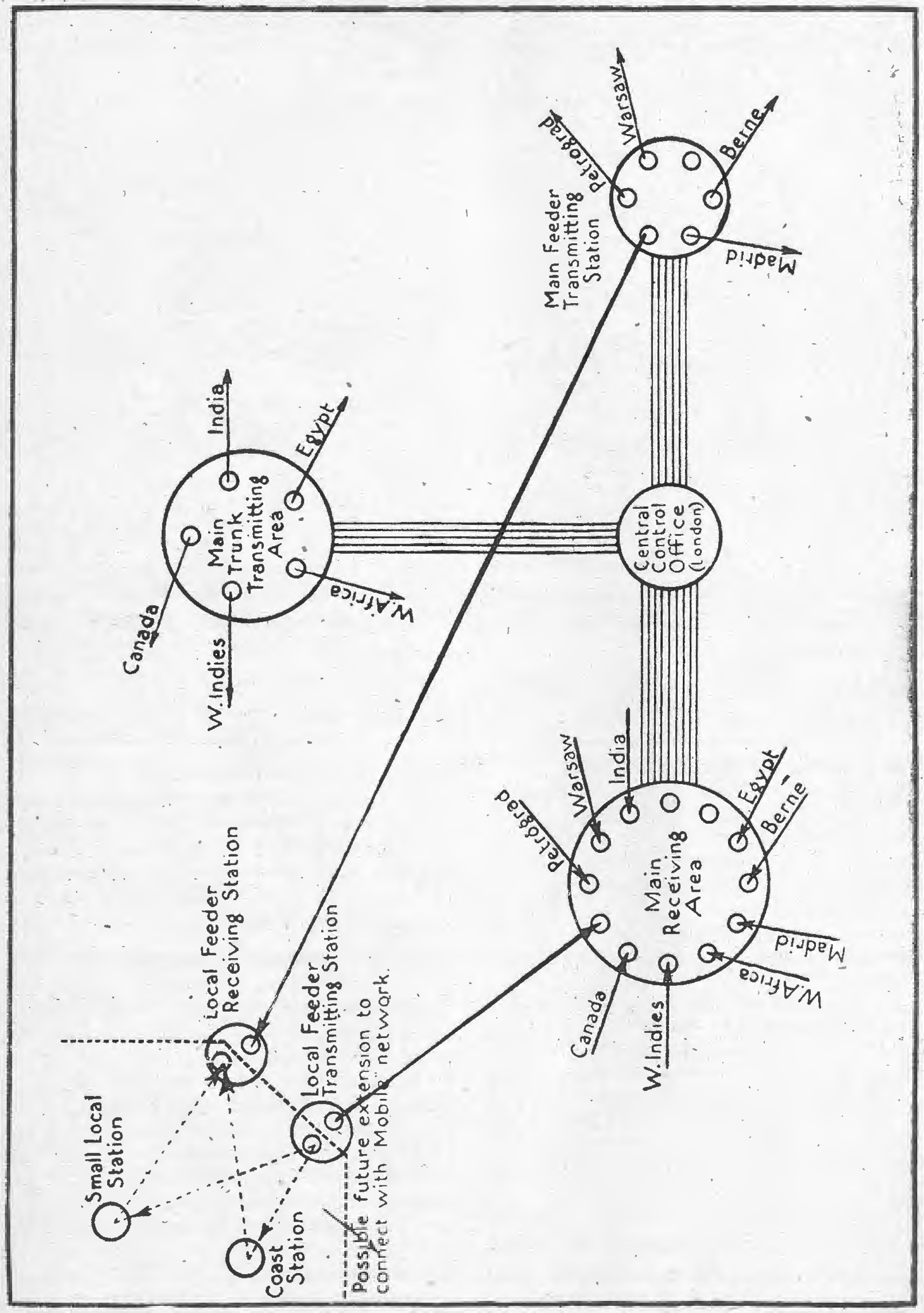
Local Networks.

The purely internal communications of each State or Colony would be catered for by a network of small inter-communicating stations, adapted to meet the requirements of the country; provision being made for efficient connection with the Main Network.

Number of Stations.

It will be noted that the foregoing Proposal allows for 26 Main Trunk Stations. Once the suggestions contained in this Proposal have been generally approved, it will be necessary for details to be discussed, in consultation between the Company's engineers and representatives of the Government and the Dominions concerned. Until this stage has been reached, it is not possible to arrive at a trustworthy estimate of the total number of stations of all kinds which the carrying out of the network would involve.

In order, however, to give a rough idea of the magnitude of the scheme, and also to establish a basis for the calculation of *personnel* to be provided for, the following figures are tentatively submitted:—



Diagrammatic Representation of English Wireless Stations.
The communications shown are not necessarily to be adopted.

30 Main Trunk Stations, 50 Main Feeder Stations, 100 Local Feeder Stations, and 200 Small Local Stations.

(E) PERSONNEL.

Estimate.

In *Tables I.* to *VIII.* will be found an analysis of the personnel which it is estimated will be required for running the full network of stations. The basis adopted for this estimate is that there will be 30 Main Trunk Stations, 50 Main Feeder Stations, 100 Local Feeder Stations, and 200 Small Local Stations.

Such stations would naturally be unevenly distributed among the various countries comprised in the scheme. In order to arrive at an accurate estimate of personnel, each country should, therefore, be considered separately. This procedure would, however, involve such a mass of detail, that it is felt it would be out of place in a preliminary proposal such as that contained in these pages.

It has, therefore, been assumed, for the sake of simplicity, that there will be 10 countries; each containing 3 Main Trunk Stations, 5 Main Feeder Stations, 10 Local Feeder Stations, and 20 Small Local Stations.

It will be observed that the total number of men required is very large. It is, of course, impossible to forecast what it will be at any far distant date; but annual returns could be rendered if desirable.

The proportion of wireless operators, in the accepted sense of the word (that is to say, fully qualified operators possessing Postmaster General's Certificates), is small; on account of the large proportion of work done by automatic means.

Subsequent to an outbreak of war, the men operating automatic apparatus could be replaced by women, or old and unfit men; but they would first have to be trained. For this reason, a training staff has been included in the estimate.

A considerable staff would be required in the office of the General Manager of the network. No attempt has, however, been made to include such staff in the estimate of personnel; owing to the difficulty of arriving at even an approximate estimate, until discussion of the scheme is further advanced.

Organisation.

In view of the experience gained during the recent struggle as to the vital importance of good communications in war-time, it is considered that war organisation should be completed in detail during peace time; so that it may be assumed, without confusion or delay, in time of national emergency. For this reason, it is proposed that the following should form the basis of such organisation, in so far as personnel is concerned:—

All persons concerned in the network system (other than native servants, cooks, messengers, labourers, etc.) must be British subjects.

All white men must be members of a Naval or Military reserve force, and capable of immediate mobilisation in ranks comparable with the positions which they hold at their stations. It should be observed that such mobilisation would have to be carried out with discretion; as it is obviously most desirable that, not only all stations in British Territory, but also, all stations on foreign soil linked up with the Imperial network, should be retained in full working order. It is equally obvious that it would be impossible to mobilise the personnel of such stations; unless the country concerned happened to be, or to become, an ally.

The action to be taken by the crews of stations in countries which happened to become enemies, would have to be decided by the Government, and reviewed periodically. Complete war orders would doubtless be framed, and issued under seal, together with any necessary code books.

It is considered that the Government should decide to which service the system should be attached; as it appears to be convenient that it should be controlled, in times of national emergency, by the Government Department most actively concern in the use of wireless telegraphy.

In *Table IX.* will be found a list of personnel, derived from the estimates contained in the previous tables. The list has been arranged in accordance with status in the Company's service, but what are considered to be the equivalent naval and military ranks have been appended in parallel columns. It should be observed that, as all ranks would continue to draw civil rates of pay, the ranks have been chosen solely on a basis of corresponding responsibility; and not with respect to the pay attaching to them.

In whatever arm the men be embodied, it should be laid down as a first essential that they must on no account be removed from their duties on mobilisation; and that no part of them can be considered in any sense supplementary to the regular forces of the Crown; at any rate, until such time as others be trained in the manner already indicated.

It is possible that the Company will, in the future, administer a more or less complete system of stations for communication with ships and aircraft, but such a system is not under review in this Proposal. The personnel concerned therein; as well as operators on board merchant ships; should, without doubt, form part of the whole Reserve Force alluded to above, which would automatically become part of the Imperial resources for the successful prosecution of war.

TABLE I.—CENTRAL CONTROL OFFICE.

(Assuming 10 Offices, each handling 3 Trunk Circuits (100 * w.p.m.) and 5 Feeder Circuits (60 w.p.m.)

Duties.				Status in Company.	Numbers.
Territorial Manager		per office 1		Territorial Managers	10
Assistant Manager		" 1		Superintending Engineers	10
Personal Staff		" 3		Engineers	30
Chief Accountant		" 1	2	Accountants	20
Assistant Accountant		" 1			
Control Superintendent		" 1	2	Superintending Operators	20
Instructor		" 1			
Supervisors	per shift 3	" 12	15	Chief Operators	150
Assistant Instructors		" 3			
Recorders	per shift 2				
Transcribers	" 30				
Transmitters	" 3				
Perforators	" 30				
Service, Routing, Counter and Delivery Clerks and Reliefs	" 20	85 " 340		Operators	3,400
Accountants' Staff, say 10% of Operators		" 34		Clerks	340
Inside Messengers		" 20	70	Boys	700
Outside Messengers		" 50			

* Words per minute.

TABLE II.—MAIN TRUNK TRANSMITTING GROUPS.

(Assuming 10 average groups of 3 stations each.)

Duties.			Status in Company.		Number.
Engineer in charge of group			Superintending Engineer	per group	1
Assistant Engineer in charge of group			Engineer, 1st class	" "	1
Engineer in charge of Power House and Workshops			Engineer	" "	1
Engineers, shift			Assistant Engineers	" "	4
Engine Drivers	(4)				
Firemen	(8)				
Turner	(1)				
Fitters	(2)				
Blacksmith	(1)		Artisans	" "	26
Tinsmith and Plumber	(1)				
Carpenters	(2)				
Wiremen	(2)				
Riggers and Painters	(5)				
Storekeeper	(1)				
Wages Clerk and Timekeeper	(1)		Clerks	" "	3
Typist	(1)				
Labourers			Labourers	" "	12
Engineer in charge of station			Engineer	per station	1
Shift Engineers			Assistant Engineers	" "	4
Dynamo Attendants			Technical Assistants	" "	4

SUMMARY.

Superintending Engineers	10
Engineers, 1st class	10
Engineers	40
Assistant Engineers	160
Artisans	260
Clerks	30
Technical Assistants	120
Labourers	120

TABLE III.—MAIN FEEDER TRANSMITTING GROUPS.

(Assuming 10 average groups of 5 stations each.)

Duties.		Status in Company.		Numbers.
Engineer in charge of group		Engineer, 1st class	per group	1
Assistant Engineer in charge of group		Engineer	" "	1
Shift Engineers		Assistant Engineers	" "	4
Engine Drivers	(4)			
Turner	(1)			
Fitter	(1)			
Blacksmith	(1)	Artisans	" "	11
Carpenter	(1)			
Wireman	(1)			
Riggers and Painters	(2)			
Storekeeper	(1)	Clerks	" "	2
Clerk	(1)			
Labourers		Labourers	" "	6
Engineer in charge of station		Engineer	per station	1
Shift Engineers		Assistant Engineers	" "	4
Dynamo Attendants		Technical Assistants	" "	4

SUMMARY.

Engineers, 1st class	10
Engineers	60
Assistant Engineers	240
Artisans	110
Clerks	20
Technical Assistants	200
Labourers	60

TABLE IV.—MAIN RECEIVING GROUP.

(Assuming 10 groups.)

Duties.		Status in Company.		Number.
Electrician in charge		Engineers, 1st class	(1)	10
Shift Electricians		Engineers	(4)	40
		Assistant Engineers	(4)	40
Engine Driver	(1)	Artisans	(2)	20
Rigger	(1)			
Labourers		Labourers	(3)	30

TABLE V.—LOCAL FEEDER TRANSMITTING GROUPS.

(Assuming 100 groups each compring 1 25-KW. and 1 5-KW. stations.)

Duties.		Status in Company.		Number.
Engineer in charge of group		Engineers	(1)	100
Shift Engineers		Assistant Engineers	(8)	800
Engine Drivers	(4)			
Fitter	(1)	Artisans	(6)	600
Rigger	(1)			
Dynamo Attendants		Technical Assistants	(4)	400
Labourers		Labourers	(2)	200
Clerk		Clerks	(1)	100

TABLE VI.—LOCAL FEEDER RECEIVING GROUPS.

(Assuming 100 groups, each comprising 1 60-w.p.m. duplex circuit, and 1 hand-speed simplex circuit.)

Duties.		Status in Company.		Number.
Electrician in charge of group		Engineers	(1)	100
Shift Electricians		Assistant Engineers	(4)	400
Chief Operator	(1)	Chief Operators	(5)	500
Supervisors	(4)			
Wireless Operators		Wireless Operators	(4)	400
Perforators	(12)			
Transcribers	(12)			
Recorders	(4)	Operators	(34)	3,400
Transmitters	(4)			
Counter Clerks	(2)			
Mechanics	(2)	Artisans	(3)	300
Rigger	(1)			
Messengers		Boys	(10)	1,000

TABLE VII.—SMALL LOCAL STATIONS.

(Assuming 200 stations.)

Duties.	Status in Company.		Number.
Engineer in charge	Assistant Engineers	(1)	200
Wireless Operators	Wireless Operators	(4)	800
Counter Clerks	Operators	(2)	400
Labourers	Labourers	(4)	800
Messengers	Boys	(4)	800

TABLE VIII.

	Central Control Office	Trunk Trans-mitting Stations	Main Feeder Trans-mitting Stations	Main Receiving Stations	Local Feeder Trans-mitting Stations	Local Feeder Receiving Stations	Small Local Stations	Totals
Territorial Managers	10	—	—	—	—	—	—	10
Superintending Engineers	10	10	—	—	—	—	—	20
Engineers, 1st class	—	10	10	10	—	—	—	30
Engineers	30	40	60	40	100	100	—	370
Assistant Engineers	—	160	240	40	800	400	200	1,840
Superintending Operators	20	—	—	—	—	—	—	20
Chief Operators	150	—	—	—	—	500	—	650
Wireless Operators	—	—	—	—	—	400	800	1,200
Operators	3,400	—	—	—	—	3,400	400	7,200
Accountants	20	—	—	—	—	—	—	20
Clerks	340	30	20	—	100	—	—	490
Technical Assistants	—	120	200	—	400	—	—	720
Artisans	—	260	110	20	600	300	—	1,290
Labourers	—	120	60	30	200	—	400	810
Boys	700	—	—	—	—	1,000	800	2,500
Totals	4,680	750	700	140	2,200	6,100	2,600	17,170

TABLE IX.—STATUS AND RANK OF PERSONNEL.

Status in Company.	Naval Rank, * R.N.V.R.	Military Rank, † T.F.	Nos.
Territorial Managers	Captains	Colonels	10
Superintending Engineers	Commanders	Lieutenant-Colonels	20
Engineers, 1st class	Lieutenant-Commanders	Majors	30
Engineers	Lieutenants	Captains	370
Assistant Engineers	Sub-Lieutenants	Lieutenants	1,840
Superintending Operators	Lieutenant-Commanders	Majors	20
Chief Operators	Lieutenants	Captains	650
Wireless Operators	Sub-Lieutenants / Chief Petty Officers	Second-Lieutenants / Sergeants	1,200
Operators	Petty Officers	Corporals	7,200
Accountants	Lieutenant-Commanders / Lieutenants	Majors / Captains	20
Clerks	Chief Petty Officers / Petty Officers	Sergeants / Corporals	490
Technical Assistants	Chief Petty Officers	Sergeants	720
Artisans	Petty Officers / Leading Seamen	Corporals / Lance-Corporals	1,290
Labourers	A.B.'s	Privates	810
Boys	Boys	Privates	2,500

* Royal Naval Volunteer Reserve. † Territorial Forces.

Terms Upon Which the Proposal is Submitted.

(1) The Marconi Company offers, entirely at its own cost, to construct, maintain, and operate, a complete and efficient network of Imperial wireless communications, in accordance with the Proposal set out in the preceding pages.

(2) The Company will pay yearly into the Treasury of each Government, in whose territory one or more stations may be situated, a sum equal to 25% of the net profits earned by the said station or stations.

(3) On the expiration of a period of 30 years, dating from the inauguration of any wireless service comprised in the network, the stations conducting such service will become, if so desired, the property of the

Government or Governments concerned, free of any payment.

(4) The Company guarantees to complete the Trunk Stations within a period of 3 years from the date on which permission to commence work is given.

(5) The Government or Governments concerned will have the right to take over the stations at any time by paying for them the value at which they stand in the Company's books, plus any sum which may have been expended on the creation of the services, and by paying to the Company 10% of the gross receipts for the remainder of a period of 30 years dating from the inauguration of the services.

(6) The Government will have the right to take over the control of the stations during any period of war or national emergency, all arrangements for such control being settled between the fighting services and the Company, and to be subject to periodical revision.

(7) This offer is subject to the following conditions:—

(a) That the Government or Governments concerned shall issue all requisite licenses for a period of 30 years, shall grant every facility for the acquisition of sites (by compulsory purchase if necessary), and shall carry out, as a repayment service, the work of building, laying, and maintaining all the underground and overhead telegraph and telephone lines required. Where such work is not the monopoly of the Government concerned, the Government shall grant all reasonable facilities for carrying out the work.

(b) That the stations, when erected, shall not be diverted from the duties for which they were constructed, except in the event of national emergency.

(c) That the Company shall reserve the right to extend the system to foreign countries to any extent and on any terms that may be commercially advantageous, provided that Imperial traffic shall invariably have preference over foreign traffic.

(d) That the Government or Governments concerned shall secure the allocation of suitable international wave-lengths to the stations comprised in the network, and shall see that stations belonging to other Companies shall not be allowed to use unscientific apparatus or be granted wave-lengths which would interfere with the working of the Imperial network; and that, except in the event of national emergency, the stations comprised in the network shall not be compelled to communicate with other stations which would interfere with the Imperial services. The Company asks for no monopoly; it is prepared to stand on its own merits. The offer is, however, conditional upon adequate protection on these lines being given to the service.

(8) The Company is also prepared to undertake the work of establishing local networks in any country, or district whether they are required to link up with the Imperial Network or not.

(9) Where the Government or Governments so desire, the Company is also willing to undertake the construction and maintenance, under similar conditions, of stations for communication with ships at sea and aircraft in flight, and to link up such a system of stations with the main Imperial Network should it be practicable to do so.

(10) In view of the present trade requirements of the Empire, the Company urges that this offer may be considered without delay. Should it be entertained, it is proposed that all necessary detailed arrangements between the Company and the Government or Governments concerned shall be elaborated in conference, and that a broadly worded covering agreement on the above lines shall be completed at the earliest possible date, in order that the work may be put in hand.

Government Wireless in Papua.

The *Commonwealth Gazette* statement of receipts and expenditure of the Trust Fund of Papua, for the half-year ended December 31, 1919, includes the following entry concerning the Government wireless station at Port Moresby:—

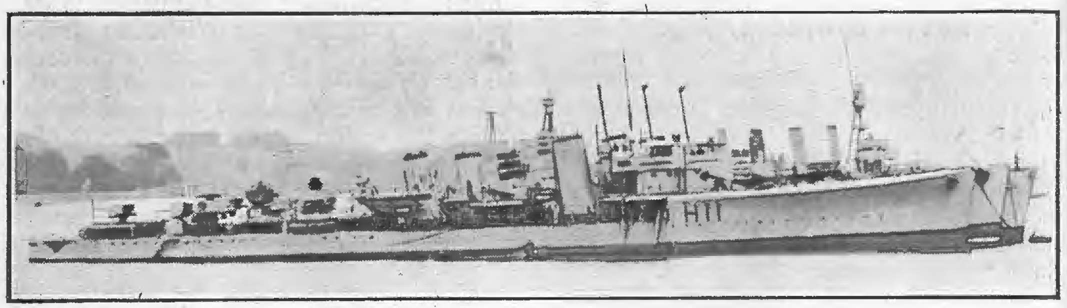
Receipts	£1,031 18 11
Expenditure	£1,232 2 7

She has twin screws and a draught of 9 ft., her oil fuel capacity being 267 tons. Her engines develop 27,000 h.p., giving a speed of 36 knots. She carries four 4-in. Q.F. guns, three A.A., and has four torpedo tubes. She was built at Denny's yard, Dumbarton, in 1917.

Each of the five gift destroyers is considerably larger than those at present on the Australian station, being 1,075 tons, with engines of 27,000 h.p., capable of giving them a speed equal to that of their leader. Each is 265 ft. in length, with a beam of 26 ft. 8 in., and a draught of 9 ft. Their armament consists of three 4-in. Q.F.'s and one two-pounder, with six torpedo tubes. They were built as follow: The *Swordsman* at Scott's yard, on the Clyde; the *Stalwart* at Swan and Hunter's; the *Success* at Doxford's, and the *Tattoo* and *Tasmania* at Beardmore's.

The *Anzac* is under the command of Commander S. H. Simpson; the *Tasmania*, under Lieutenant-Commander H. O. Joyce, D.S.O.; the *Tattoo*, under Lieutenant-Commander A. M. Roberts, D.S.O., the *Swordsman*, under Lieutenant-Commander Hughes White, D.S.O., the *Success*, under Lieutenant Oliver Wace and the *Stalwart*, under Lieutenant F. C. Cavage—they are all war-worn veterans. Lieutenant Marden, of the *Tattoo*, commenced his naval career at the Naval College, Geelong, afterwards transferring to Jervis Bay. He went to England at the opening of hostilities and was appointed senior engineer-lieutenant on H.M.S. *Centaur*. Whilst chasing German mine layers she struck a mine, but eventually was brought safely into Chatham. Subsequently Lieutenant Marden joined the *Curocea*, flagship of the Baltic Squadron, she also being mined, with the loss of one man killed and nine officers injured.

Lieutenant-Commander Joyce spent many months chasing submarines, and Lieutenant Cobby, of the *Tattoo*, was, when a gunner on the *Vindictive*, one of the first to land on the Mole at Zeebrugge. With him on that historic occasion was Seaman Taylor, now one of the crew of the *Anzac*.



A Triple Alliance—The "Swordsman," "Success" and "Tattoo."

AVIATION IN AUSTRALIA

NEW SOUTH WALES.

The latest entrant to the growing list of commercial and joyriding activities is Captain Edgar Wikner Percival (ex-R.A.F.), now operating two machines in New South Wales. These are a 3-seater *Avro*, fitted with 110 h.p. *Le Rhône* engine, and a *D.H.-6*, with 80 h.p. *Rénault* engine. They accompanied their owner from England aboard the *Calulu*, reached Sydney at the end of March, and were assembled at the Government aerodrome at Richmond.

Passenger flights have been made to Bathurst and Orange, the return journey in the latter instance being completed in 230 minutes, over a distance of 386 miles.

Captain Percival's next tour, commencing May 15 and extending over a period of about three weeks, will include Cowra, Wellington and Peak Hill districts.

* * * *

Sydney to Brisbane Flight.

From Mr. J. H. Butler (ex-A.F.C.), who recently flew a *B.E.2e.* from Sydney to Brisbane on behalf of the Perdriau Rubber Co., Ltd., we have received some interesting aerial photographs (published herewith) of towns along the route, taken mostly at an altitude of 6,000 feet.

Gunnedah, from 2,500 feet.

Writing, early in May, from Inverell (N.S.W.), he stated that ideal weather conditions prevailed and that he had pioneered a new airway between Gunnedah and Coonabarabran. This district is very rough and heavily timbered, and the safest air-route, between the two towns, is by way of Tambar Springs, where the racecourse, a mile to the south of the township, offers good landing facilities, although, being situated in the heart of a forest, is dangerous to take-off from. Four miles east a very satisfactory alternative is provided by the Brown paddock, joint property of Major and Captain Brown (both

The Perdriau Company's "B.E.2e." at Scone.

FOR THE WIRELESS EXPERIMENTER

THE HIGH COST OF RECEIVING

HOW IT CAN BE REDUCED

BY

JOSEPH V. REED.

This article deals drastically with the "High Cost of Receiving."

Having obtained your valve, the orthodox method of supplying sufficient current to operate it is to use a storage battery for the filament and a battery of flash-light cells for the plate.

If alternating current is applied to the filament of a set connected in the usual manner, the interference caused by the alternations is very considerable, and a brief explanation of the reason for this will, perhaps, be of interest.

Those who have operated on an ordinary direct current valve set will have noticed that a variation in signal strength occurs if the direction of the current from the filament battery is reversed. This is because the potential of the grid relative to the negative side of the filament, is changed with each reversal. Considering the effect of even a minute variation of potential upon this member, what will happen when the current changes direction approximately 100 times per second! Could one make a centre connection to the filament, this point, theoretically, would be in a neutral position relative to the ends of the filament. But, in practice, it would prove an extremely difficult operation. I tried the effect of using a double filament *Expanse* valve with both filaments in series, and using the common lead as centre tap; but without success, because the filaments were not exactly electrically balanced.

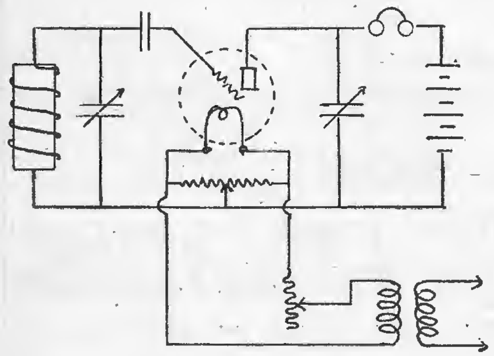


Figure 1.
Circuit Using A.C. for Filament.

If a potentiometer is connected across the filament terminals, the exact electric centre of the system so formed is easily found by experiment, and by connecting up the set, as shown in *Figure 1*, the humming caused by the A.C. is reduced to a negligible factor.

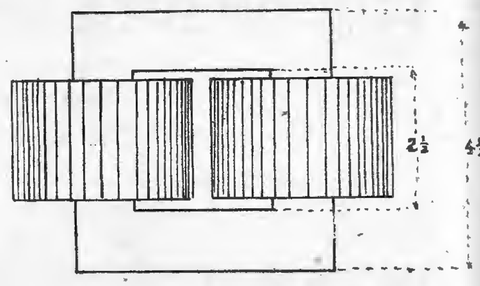


Figure 2.
Plan of Transformer.

Primary—2,000 turns, No. 26 D.S.C.
Secondary—10 turns, No. 16 D.C.C. per volt.
Laminations—14 mil. sheet iron.
Area of core—1 square inch.

The transformer used may be of the small, bell-ringing pattern, with a 4- to 8-volt secondary, or (if the experimenter has a good practical knowledge of power work), according to the data given in the drawing. The design is for a 240-volt, 50-cycle supply. The potentiometer is of the pattern commonly used for crystal working. Both articles can be supplied by the Australectric Company at a reasonable figure.

Next comes the high-voltage battery for the plate circuit. The first cost of this unit will be about half that of the flash-light type and renewal costs are very small. The cells are miniature Minotto cells—a modification of the Gravity Daniell cell—and each gives almost exactly one volt. Having decided upon the number of cells, obtain sufficient 1 in. by 6in. glass test tubes, No. 18-gauge electric light wire, sheet zinc, copper sulphate, sulphate of magnesium, marine glue, sand and sawdust for the job, and begin as follows:—

Cut the rubber-covered wire into 15-inch lengths—one for each cell. Pare 6 inches

at one end, remove the tinning with emery paper, and form into a spiral as in *Figure 3*. The braiding and tape must be removed to avoid subsequent trouble due to capillary action. Place the wire in the tube and cover the spiral with 1in. of dry, powdered copper sulphate, and, over it, a layer of

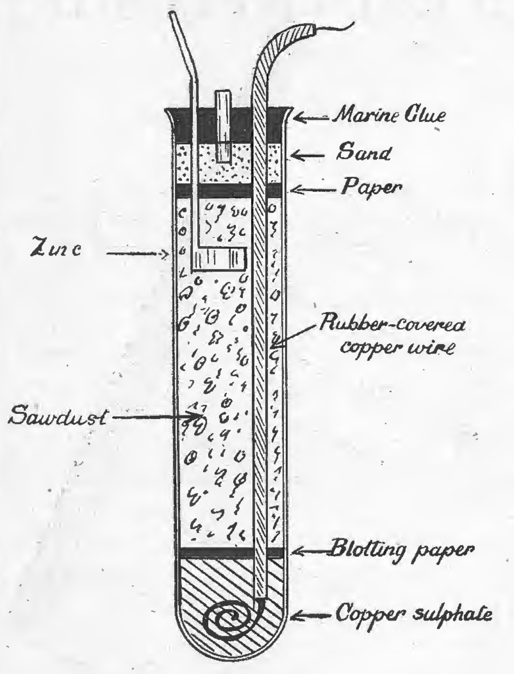


Figure 3.
Details of Cell for Plate Battery.

thick blotting paper. Then prepare a mixture of Oregon pine sawdust and water, to which has been added about 10 per cent. of magnesium sulphate to increase its conductivity. Pour this mixture, which must not be too thin, into the tube, filling it to within 2 inches of the top; insert a spiral of zinc sheet, from a strip 9 in. by ¼ in., then cover with more sawdust to within ¾ in. of the top.

Allow the cells to stand for about 15 minutes, pour off any liquid which has collected at the top, and seal up in the following manner:—

Place a layer of paper or thin cardboard on top of the sawdust, then half an inch of clean, dry sand which has been washed clear of chlorides; insert into the sand a piece of very small glass tubing and pour into it sufficient molten marine glue or Chatterton's Compound to efficiently seal the top of the cell. A hot soldering-iron will greatly assist this operation. When all the cells are completed they should be connected in series and arranged in a box as shown in *Figure 4*—(suitable for a 49-cell battery).

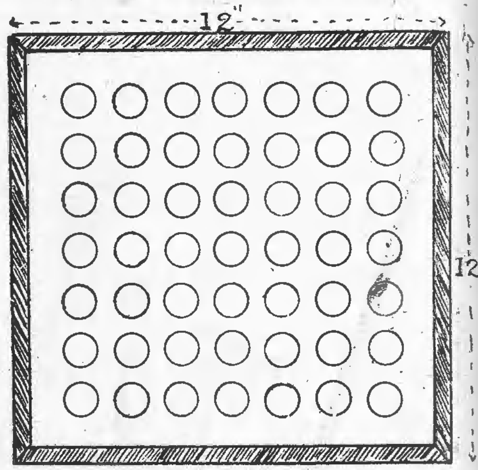


Figure 4.
Plan of Box for H.V. Battery.

The following advice, gleaned from personal experience, will greatly help the prospective battery-constructor. Allow the sawdust mixture to stand for at least 12 hours before placing in the cells, to ensure thorough saturation and to obviate any disastrous fermentation after sealing. Oregon pine sawdust is superior to other varieties owing to its very absorbent and porous nature. The zincs should be amalgamated with mercury to ensure clean working and freedom from corrosion. Cells must not be allowed to lie on their side, or subjected to rough handling. Their capacity is in the neighbourhood of one *ampère* hour and, for a one- or two-valve set, should be good for at least 1,000 hours continuous use, or (with average amateur treatment), well over a year, without requiring a renewal of the elements. The glass tube and copper wire do not deteriorate and may be used repeatedly. The internal resistance of the cells is between 50 and 100 *ohms* each, which is practically negligible when one considers that they have to work on a circuit possessing a resistance of anything between 100,000 and 500,000 *ohms.*

Another Aerial View of Perth

WIRELESS "CALL-LETTERS"

In compliance with numerous requests we have compiled the following list of "land"- and "ship"-stations, with their corresponding "call-letters." The list covers the whole of Australasia and Oceania, also vessels trading in these waters, and will be revised monthly.

Call Signal.	Name of Station.	
VHB	*Levuka*	S.S.
VHD	*Kanowna*	S.S.
VHE	*Karoola*	S.S.
VHF	*Bombala*	S.S.
VHI	*Wandilla*	S.S.
VHJ	*Coolgardie*	S.S.
VHK	*Wodonga*	S.S.
VHL	*Dimboola*	S.S.
VHN	*Katoomba*	S.S.
VHO	*Canberra*	S.S.
VHP	*Indarra*	S.S.
VHQ	*Fiona*	S.S.
VHT	*Montoro*	S.S.
VHU	*Mataram*	S.S.
VHW	*Wyandra*	S.S.
VHX	*Victoria*	S.S.
VHY	*Ulimaroa*	S.S.
VIA	Adelaide	L.S.
VIB	Brisbane	L.S.
VIC	Cooktown	L.S.
VID	Darwin	L.S.
VIE	Esperance	L.S.
VIF	Woodlark Island	L.S.
VIG	Port Moresby	L.S.
VIH	Hobart	L.S.
VII	Thursday Island	L.S.
VIJ	Samarai	L.S.
VIL	Flinders Island	L.S.
VIM	Melbourne	L.S.
VIN	Geraldton	L.S.
VIO	Broome	L.S.
VIP	Perth	L.S.
VIQ	Macquarie Island	L.S.
VIR	Rockhampton	L.S.
VIS	Sydney	L.S.
VIT	Townsville	L.S.
VIU	Kieta	L.S.
VIV	Madang	L.S.
VIW	Wyndham	L.S.
VIX	Misima	L.S.
VIY	Mount Gambier	L.S.
VIZ	Roebourne	L.S.
VJA	*Riverina*	S.S.
VJB	*Westralia*	S.S.
VJC	*Zealandia*	S.S.
VJD	*Bingera*	S.S.
VJE	*Cooma*	S.S.
VJF	*Morinda*	S.S.
VJG	*Wyreema*	S.S.
VJH	*Loongana*	S.S.
VJI	*Suva*	S.S.
VJJ	*Aramac*	S.S.
VJK	*Gilgai*	S.S.
VJM	*Charon*	S.S.
VJP	*Bulla*	S.S.
VJQ	*Boonah*	S.S.
VJR	*Barambah*	S.S.
VJS	*Bakara*	S.S.
VJT	*Boorara*	S.S.
VJV	*Araluen*	S.S.
VJW	*Dongarra*	S.S.
VJZ	Bita Paka	L.S.
VKN	Navy Officer, Melbourne	L.S.
VKO	*Cerberus*	H.M.A.S.
VKP	Flinders Is. Base	L.S.
VKQ	Garden Is. Base	L.S.
VKR	Cockburn Sound Base	L.S.
VKS	Port Stephens Base	L.S.
VKT	Nauru.	L.S.
VKU	*Parattah*	S.S
VKV	*Arawatta*	S.S.
VKW	*Gorgon*	S.S.
VKX	*Minderoo*	S.S.
VKY	*Marsina*	S.S.
VLA	Awanui	L.S.
VLB	Awarua	L.S.
VLC	Chatham Islands	L.S.
VLD	Auckland	L.S.
VLE	*Maheno*	S.S.
VLF	*Tofua*	S.S.
VLG	*Maunganui*	S.S.
VLH	*Kaiapoi*	S.S.
VLI	*Kaitangata*	S.S.
VLJ	*Wahine*	S.S.
VLK	*Makura*	S.S.
VLL	*Talune*	S.S.
VLM	*Moeraki*	S.S.
VLN	*Manuka*	S.S.
VLO	*Moana*	S.S.
VLP	*Kurow*	S.S.
VLR	*Marama*	S.S.
VLT	*Kaituna*	S.S.
VLU	*Atua*	S.S.
VLV	*Navua*	S.S.
VLW	Wellington	L.S.
VLX	*Tutanekai*	S.S.
VLY	*Paloona*	S.S.
VLZ	*Maori*	S.S.
VMA	*Arahura*	S.S.
VMB	*Karori*	S.S.
VMC	*Kauri*	S.S.
VMD	*Korimiko*	S.S.
VME	*Rakanoa*	S.S.
VMF	*Tarawera*	S.S.
VMG	Apia	L.S.
VMH	*Terawhiti*	S.S.
VML	*Whangape*	S.S.
VMM	*Monowai*	S.S.
VMN	*Katoa*	S.S.
VMO	*Waipori*	S.S.
VMP	*Wanaka*	S.S.
VMV	*Waitomo*	S.S.
VMW	*Waihora*	S.S.
VMX	*Rotomahana*	S.S.
VMZ	*Mararoa*	S.S.
VXA	*Oonah*	S.S.
VXB	*Bambra*	S.S.
VXD	*Talawa*	S.S.
VXH	*Eucla*	S.S.
VXL	*Shandon*	S.V.
VXN	*Ooma*	S.S.
VXP	*Dromana*	S.S.
VXQ	*Rona*	S.S.
VXS	*Mawatta*	S.S.
VXT	*Delungra*	S.S.
VXU	*Dinoga*	S.S.
VXV	*Dumosa*	S.S.
VXW	*Dundula*	S.S.
VXX	*Mackarra*	S.S.
VXY	*Macumba*	S.S.
VXZ	Naval College, Jervis Bay	L.S.
VZB	*Makambo*	S.S.
VZC	*Paringa*	S.S.
VZD	*Pateena*	S.S.
VZE	King Island	L.S.
VZF	*Flora*	S.S.
VZG	*Governor Musgrave*	S.S.
VZH	*Karuah*	S.S.
VZI	*Alacrity*	S.S.
VZK	Morobe	L.S.
VZL	——	
VZM	*Carina*	S.S.
VZN	——	
VZO	Manus	L.S.
VZP	*Australpool*	S.S.
VZQ	*Australcrag*	S.S.
VZR	*Kaewieng*	S.S.
VZS	*Australpeak*	S.S.
VZT	*Australport*	S.S.
VZU	*Australfield*	S.S.
VZV	*Calulu*	S.S.
VZW	*Australmead*	S.S.
VZX	Eitape	L.S.
VZY	*Australmount*	S.S.
CGA	*Australrange*	S.S.
CGB	*Australplain*	S.S.
CGC	*Australbush*	S.S.
CGD	*Australglen*	S.S.
CGE	*Australford*	S.S.
CGF	*Australdale*	S.S.
CGG	*Australstream*	S.S.
CGT	*Melusia*	S.S.
CGU	*Changsha*	S.S.
CGX	*Macedon*	S.S.
CGY	*Taiyuan*	S.S.
CGZ	*Apolda*	S.S.
CGK	*Sir William Mathews*	S.S.
CGL	*Torromeo*	S.S.
CGM	*Cooee*	S.S.
CGO	*Carawa*	S.S.
CGP	*Sumatra*	S.S.
CGQ	*Kurumba*	S.S.
CGV	*Wyola*	S.S.
FMB	*Armand Béhic*	S.S.
FNC	*Calédonien*	S.S.
FND	*Dumbea*	S.S.
FNK	*El Kantara*	S.S.
FNM	*Melbourne*	S.S.
FNN	*Nera*	S.S.
FNO	*Oceanien*	S.S.
FNW	*Pacifique*	S.S.
FNY	*Sydney*	S.S.
FOP	Papeete (Tahiti)	L.S.
FQN	Nouméa	L.S.
GAO	*City of York*	S.S.
GAP	*Isis*	S.S.

L.S.: Land Stations. S.S.: Ship Stations. S.V.: Sailing Vessels

(Continued on Page 134.)

Call. Signal.	Name of Station.	
GBB	*City of Poona*	S.S.
GBE	*Niagara*	S.S.
GBG	*Nevasa*	S.S.
GBJ	*Benalla*	S.S.
GBQ	*Nestor*	S.S.
GBU	*Ulysses*	S.S.
GBW	*City of Karachi*	S.S.
GCZ	*Euryalus*	S.S.
GDA	*Fazilka*	S.S.
GDC	*Fultala*	S.S.
GDD	*City of Dunkirk*	S.S.
GDF	*Gracchus*	S.S.
GDP	*City of Lincoln*	S.S.
GDR	*Cufic*	S.S.
GDU	*Tropic*	S.S.
GEF	*Hymettus*	S.S.
GGH	*Commonwealth*	S.S.
GHB	*Janus*	S.S.
GHD	*Wiltshire*	S.S.
GIC	*City of Delhi*	S.S.
GJK	*Irishman*	S.S.
GJP	*Kai-ora*	S.S.
GKE	*Mamari*	S.S.
GKH	*Manchester City*	S.S.
GKL	*Matatua*	S.S.
GLG	*Pakeha*	S.S.
GLK	*Parana*	S.S.
GML	*Obra*	S.S.
GNE	*Waimana*	S.S.
GNK	*Waipara*	S.S.
GNY	*Orna*	S.S.
GNZ	*Ozarda*	S.S.
GOC	*Quiloa*	S.S.
GOD	*Sangola*	S.S.
GPB	*Kasama*	S.S.
GQA	*Ayrshire*	S.S.
GQC	*Durham*	S.S.
GQW	*Australind*	S.S.
GRB	*Baron-Polwarth*	S.S.
GRV	*Suffolk*	S.S.
GRY	*Dorset*	S.S.
GSB	*Port Macquarie*	S.S.
GSF	*Shropshire*	S.S.
GTD	*Bellerophon*	S.S.
GTI	*Ajana*	S.S.
GTJ	*Argyllshire*	S.S.
GTZ	*Port Lincoln*	S.S.
GUJ	*City of Bombay*	S.S.
GWI	*Port Albany*	S.S.
GXE	*Essex*	S.S.
GYY	*Koranna*	S.S.
GFC	*City of Bristol*	S.S.
GEH	*Katuna*	S.S.
GEI	*Kabinga*	S.S.
GFB	*Ismaila*	S.S.
GFD	*Itola*	S.S.
GKS	*Knight Companion*	S.S.
GKT	*Knight Templar*	S.S.
GMO	*Suveric*	S.S.
GNS	*Karoo*	S.S.
GNW	*Orissa*	S.S.
GOA	*Queda*	S.S.
GOB	*Querimba*	S.S.
GJQ	*Kumeric*	S.S.
GKD	*Malta*	S.S.
GOF	*Sealda*	S.S.

Call. Signal.	Name of Station.	
GON	*Umta*	S.S.
GVH	*Clan Macewen*	S.S.
GVM	*Clan Macrae*	S.S.
MAB	*Kandahar*	S.S.
MAM	*Matoppo*	S.S.
MAV	*Swazi*	S.S.
MBT	*Rimutaka*	S.S.
MCE	*Khyber*	S.S.
MCP	*Ceramic*	S.S.
MCY	*City of Madras*	S.S.
MFG	*Kumara*	S.S.
MFQ	*Borda*	S.S.
MFU	*Aeneas*	S.S.
MFV	*Ascanius*	S.S.
MFW	*Anchises*	S.S.
MGF	*Miltiades*	S.S.
MGG	*St. Albans*	S.S.
MGJ	*Marathon*	S.S.
MGK	*Demosthenes*	S.S.
MGM	*Themistocles*	S.S.
MHG	*Carpentaria*	S.S.
MHY	*Paparoa*	S.S.
MIL	*Palermo*	S.S.
MJC	*Suevic*	S.S.
MJC	*Suevic*	S.S.
MJG	*Orita*	S.S.
MJQ	*Westmeath*	S.S.
MKA	*Ruahine*	S.S.
MKB	*Ruapehu*	S.S.
MKD	*Palma*	S.S.
MKG	*Delta*	S.S.
MKK	*Medic*	S.S.
MKR	*Beltana*	S.S.
MKV	*Remuera*	S.S.
MKZ	*Ascot*	S.S.
MMD	*Malwa*	S.S.
MME	*Mantua*	S.S.
MMF	*Morea*	S.S.
MMG	*Egypt*	S.S.
MML	*Macedonia*	S.S.
MMU	*China*	S.S.
MNH	*Dongola*	S.S.
MNJ	*Plassy*	S.S.
MNY	*Himalaya*	S.S.
MOF	*Orsova*	S.S.
MOJ	*Orvieto*	S.S.
MOS	*Waimate*	S.S.
MOY	*Osterley*	S.S.
MOZ	*Orontes*	S.S.
MPS	*San Zeferino*	S.S.
MQC	*Persic*	S.S.
MRF	*Hororata*	S.S.
MRG	*Opawa*	S.S.
MRI	*Whakatane*	S.S.
MRM	*Orari*	S.S.
MRS	*Kaikora*	S.S.
MRV	*Waiwera*	S.S.
MSB	*Karamea*	S.S.
MSE	*Euripides*	S.S.
MSI	*Kaisar-i-Hind*	S.S.
MSL	*Trafford Hall*	S.S.
MSO	*Poona*	S.S.
MSQ	*Knight of the Garter*	S.S.
MSW	*City of Exeter*	S.S.
MTF	*Karmala*	S.S.

Call. Signal.	Name of Station.	
MTP	*City of Rangoon*	S.S.
MUP	*Morvada*	S.S.
MUZ	*Zealandic*	S.S.
MVS	*Sussex*	S.S.
MWC	*Runic*	S.S.
MWE	*Arawa*	S.S.
MWF	*Tainui*	S.S.
MWI	*Ionic*	S.S.
MWN	*Athenic*	S.S.
MWT	*Corinthic*	S.S.
MWW	*Baron Ardrossan*	S.S.
MYE	*Oxfordshire*	S.S.
MYN	*Tahiti*	S.S.
MZC	*Megantic*	S.S.
UAS	*St. Louis*	S.S.
JAI	*Aki Maru*	S.S.
JBH	*Kureha Maru*	S.S.
JBT	*Tosa Maru*	S.S.
JBY	*Yoshida Maru No. 2*	S.S.
JCA	*Meikai Maru*	S.S.
JCB	*Akita Maru*	S.S.
JCG	*Nanking Maru*	S.S.
JCH	*Tensho Maru*	S.S.
JCP	*Yamagata Maru*	S.S.
JCT	*Yeitai Maru*	S.S.
JCW	*Taiyu Maru*	S.S.
JDL	*Hwah Ping*	S.S.
JDQ	*Luzon Maru*	S.S.
JDV	*Komagata Maru*	S.S.
JER	*Rashu Maru*	S.S.
JFL	*Kofuku Maru*	S.S.
JFO	*Koan Maru*	S.S.
JIB	*Inaba Maru*	S.S.
JKU	*Kunajiri Maru*	S.S.
JNL	*Nikko Maru*	S.S.
JNP	*Nippon Maru*	S.S.
JTC	*Taichu Maru*	S.S.
JTG	*Tango Maru*	S.S.
JTN	*Tainan Maru*	S.S.
JYJ	*Mandasan Maru*	S.S.
JYT	*Fukui Maru*	S.S.
PKA	Sabang	L.S.
PKB	Weltevreden	L.S.
PKC	Sitoebondo	L.S.
PKD	Koepang	L.S.
PKE	Amboina	L.S.
PMC	*Houtman*	S.S.
PME	*Van Overstraten*	S.S.
PMH	*Roggeveen*	S.S.
PMJ	*Van Cloon*	S.S.
SFE	*Indianic*	S.S.
SFF	*Hellenic*	S.S.
SFG	*Tasmanic*	S.S.
SFH	*Australic*	S.S.
WHL	*Ventura*	S.S.
WHM	*Sonoma*	S.S.
WIS	*E. R. Sterling*	S.V.
YUH	*Eastern*	S.S.
YYC	*Anglo Mexican*	S.S.
YYU	*City of Newcastle*	S.S.
YYV	*City of Cairo*	S.S.
YZA	*Clan Colquhoun*	S.S.
YZB	*Clan Sinclair*	S.S.
YZG	*Clan Urquhart*	S.S.

WIRELESS OFFICERS ATTACHED TO VESSELS OF THE AUSTRALASIAN MERCANTILE MARINE.

Revised to May 19, 1920.

SHIP.	OPERATOR.
Apolda	J. W. McKay
Arawatta	V. Blight
Arahura	W. C. Brown
Aramac	N. H. Brown
Australbrook	J. F. McGinley
Australcrag	V. E. Stanley
Australford	T. W. Bearup
Australglen	J. R. Gilligan
Australmead	G. Pow
Australmount	A. R. Catford
Australpeak	R. H. Alexander
Australplain	S. R. Dixon
Australpool	K. J. Dines
Australport	A. H. Jeremy
Australrange	C. Black
Atua	L. N. Callaghan
Bingera	H. L. Miller
Bombala	——
Bundarra	H. K. Burbury
Canberra	H. Tuson
Changsha	S. J. McVeigh
Charon	J. E. Cleary
Cooma	J. H. Hawkins
Dimboola	A. F. Vipan
Eastern	P. C. Gillon
Indarra	H. Firth (s) A. G. Ross (j)
Kaiapoi	A. E. Sheppherd
Kaitangata	R. W. Barnes
Kaituna	G. Illingworth
Kaiwarra	L. H. Jones
Kanowna	——
Karori	S. G. Jones
Karoola	R. R. Pilmore
Katoa	B. Boni
Katoomba	T. A. Jones
Kauri	H. G. Reilly
Koromiko	W. C. Smith
Kowarra	H. Fullerton
Kurow	D. C. Lane
Levuka	S. A. Ludlow
Loongana	N. W. G. Scott
Macedon	N. W. Marshall
Mackarra	A. R. D. Davis
Macumba	F. L. Dawes
Maheno	C. F. Griffiths
Makambo	L. J. Glyde
Makura	D. N. Quinn (s) E. A. Hunter (j)
Manuka	J. A. Heavey
Maori	H. A. Bloxham
Marama	——
Mararoa	——
Marsina	W. H. Richardson
Mataram	C. Williamson
Maunganui	——
Mawatta	H. W. Barnfield
Melusia	S. F. Stafford
Minderoo	J. G. C. Higgins
Mindini	A. Stuart
Moana	J. F. Hutton (s) E. N. Williams (j)
Moeraki	H. M. Lamb
Monowai	G. Donnelly
Mokoia	L. V. B. Sutton
Montoro	L. G. Devenport
Morinda	F. C. Davies
Navau	H. Speed
Ngakuta	H. Bargrove
Niagara	W. J. Martin (s) V. P. Nevins (j)
Ooma	E. A. Miller
Oonah	R. M. Firminger
Paloona	R. P. Ginders
Paringa	H. A. de Dassel
Pateena	J. H. Bennett
Rakanoa	V. M. Simpson
Riverina	A. H. Beard
Rotomahana	W. E. C. Sawyer
South Africa	E. J. Giles
St. Albans	W. H. Harris
Suva	L. S. Lane
Taiyuan	M. Sedgers
Tahiti	E. M. Bain (s) G. M. Whiteside (j)
Talune	H. F. Harman
Tarawera	G. H. Hugman
Tofua	W. A. Hawkins (s) J. G. Campion (j)
Ulimaroa	W. J. Washbourne
Victoria	F. A. Hunter
Wahine	F. E. Duggan
Waihemo	F. A. Cook
Waihora	V. M. Brooker
Waikawa	F. L. Scott
Waimarino	K. L. Freeman (s) J. A. Guy (j)
Waipori	T. H. McWilliams
Wairuna	A. Cuthill (s) L. R. Dickson (j)
Waitemata	H. F. Hartley (s) C. H. Hart (j)
Waitomo	A. S. Dening
Wanaka	R. R. Robinson
Wandilla	T. Chalmers
Westralia	M. A. H. Ryan
Whangape	A. O. Sutherland
Wodonga	J. Welch
Wyandra	T. Bannister
Wyreema	
Zealandia	M. A. Prudence

Amalgamated Wireless Operators Temporarily Employed on M.I.M.C.C. Ships.

Havre	A. E. Lawrence
Zealandic	J. Elmore
Morialta	E. F. Hayes
Rupara	G. Cook
Coolgardie	R. S. Taylor

On Home Port Leave.

H. E. Young	S. A. Ludlow