## *De Forest System of Wireless Telegraphy.*

Abstract from a Report, dated 2nd December, 1903, by Lieut. A. Yeats-Brown, H.M.S. "Vernon"; Lieut. H. Davies, H.M.S. "Defiance"; and Lieut. F. Loring, Admiralty.

The arrangements for transmission consist of a 3-H.P. petrol engine, driving a 1-kilowatt alternator with a 40 ; 1 transformer.

The receiving system consists of a telephone in circuit with a special form of coherer.

A successful demonstration was given of working between South Stack, Holyhead, and Howth, in Ireland ; distance, about 60 miles. The rate of transmission was extremely rapid, 30 words a minute being possible with experienced operators. This compares very favourably, as far as speed, with the 10 or 15 words possible when using our present apparatus.

Mr. De Forest claims the following advantages for his system :—

### (1.) *A Speed of Transmission of* 30 *Words a Minute.*

This he demonstrated as practicable, but it was attained by the use of an alternator. It is not in any way peculiar to his system, and is readily adapted to our Naval sets.

### (2.) *A Speed of Reception of* 30 *Words a Minute.*

This he demonstrated as practicable, but it was attained by the use of a telephonic receiver. It is not peculiar to his system, and similar results should be attained with the magnetic detectors we now possess.

### *A Means of Tuning ; (a) and (b).*

(*a*) *Electrically.*—The efficacy of this is doubtful. It is improbable that it is as good as the Marconi system.

(*b*) *Mechanically.*—That is, that the operator at the telephone can detect and follow a particular pitch of spark to the exclusion of all other interruptions and atmospheric effects, very much as one can hold a conversation with one person in a room full of conversation. This advantage is also peculiar to the telephone, and not to the De Forest system in particular. Mr. De Forest stated that the Marconi station, 5 miles away, interfered in no way with his working, though the signals were readily

detected in the telephone simultaneously with those emitted by his own station. As it is certain, however, that the Marconi Company's Holyhead station has been closed since July 13th, the station whose working he detected was either Rosslare, an untuned station 80 miles distant, or Liverpool, which works on a plain aerial or tune, and is distant 60 miles from Holyhead. He obtains about 150 miles with the 3-H.P. plant and 350 miles with the 10-H.P. plant, but, relatively, these distances compare unfavourably with those obtained by the Marconi system.

*Conclusion.*

(1.) There is nothing in the De Forest system which cannot be applied to our own installations by substituting alternators for accumulators and magnetic detectors for coherers. Which arrangement is best depends on the training of the operators. With our present operators we cannot afford to dispense with the coherer and recording arrangement. But there is no doubt that the De Forest arrangement (*i.e.*, alternator and telephone), combined with operators of the calibre working at Holyhead, would be more suitable for war purposes than our present Marconi arrangements and Service operators.

Of course there is no reason why both should not be in use. We have the one already installed, and it is the best for our present operators. The other arrangement can readily be fitted at small expense.

Fig. 12 is a diagrammatic sketch of the sending circuit, and is similar to the Braun system.

FIG. 12.

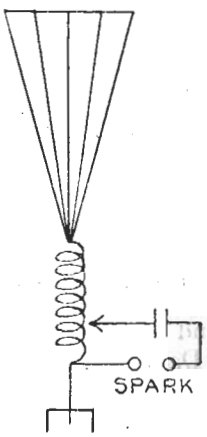
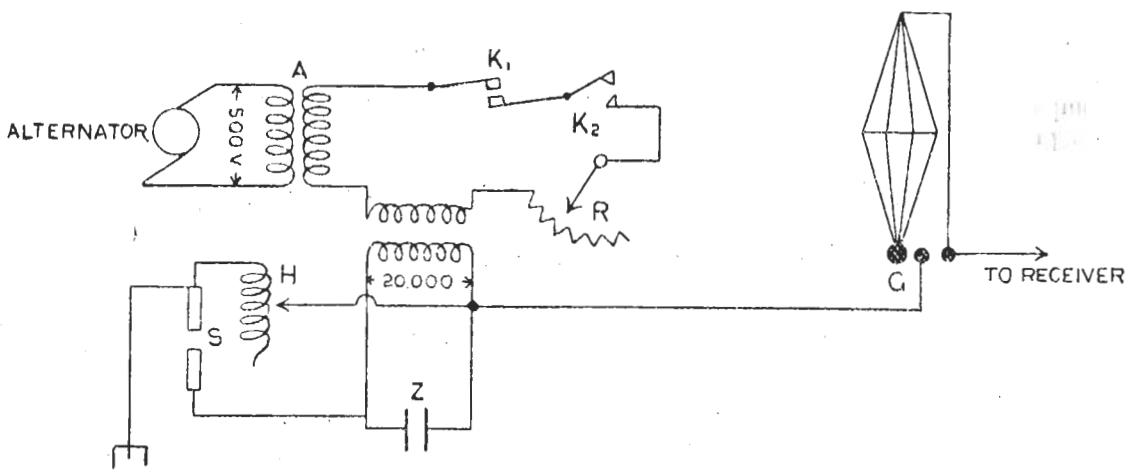



Fig. 13 shows the connections to the transmitting apparatus.

FIG. 13.




A = Transformer. To protect the armature from induced waves and to steady the load. The armature is also earthed through a spark gap.
B = Step up transformer $\frac{1}{40}$.
$K_1$ = Change over switch.
$K_2$ = Sending keys.
R = Reactance regulator.
S = Spark gap, blunt points—brass.
Z = Condensers; 12 jars, 6 in parallel; capacity of each jar, ·005 m.f.
H = Oscillator helix, 4 turns of nickel-plated ¼-inch copper tube, diam 18 inches.
G = Two spark gaps $\frac{1}{32}$-inch, which are bridged by sending potential.

Aerial wire, 5 parts, 200 feet, $\frac{7}{22}$ bare wire.

All parts used for sending.

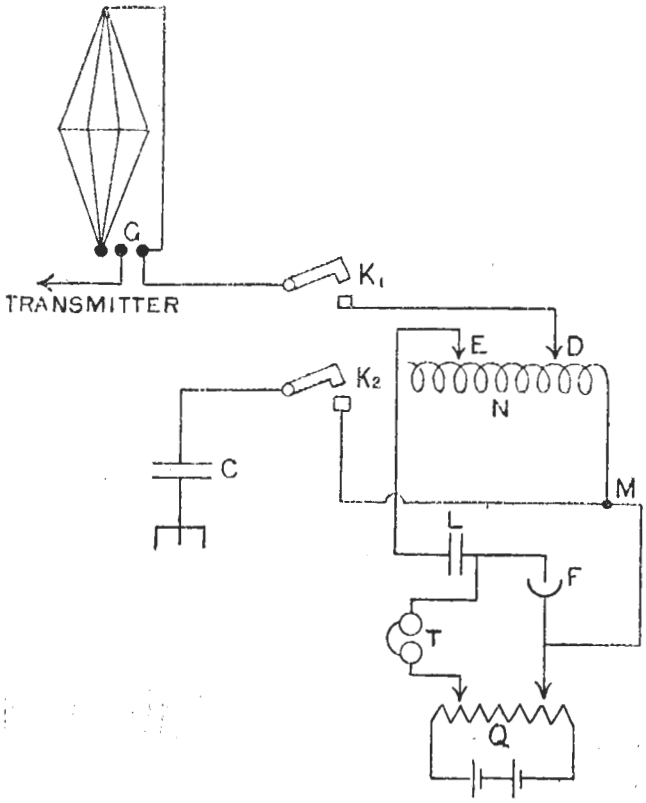
When receiving, the two sides of the aerial are in series, as they are insulated at the bottom by the spark gaps.

*Alternator:—*

1 K.W., 500 V., 2 amps., 1,800 revs., frequency 50 ~ per sec. Driven by 3-H.P. petrol engine.

Fig. 14 shows connections for receiving apparatus.

FIG. 14.




N = Adjustable inductance.
F = Responder.
L = Adjustable capacity, 6 plates, 7-inch × 4-inch glass.
Q = Potentiometer.
T = Telephone.
C = Condenser of large capacity.
$K_1$ = Change over keys. These are connected to $K_1$ of transmitting apparatus.
D, E, L, F, M = Oscillating current circuit.

*Notes on the Electrolytic Detector.*

The "responder" mentioned in this report is now known as the "electrolytic detector."

The essential feature of these instruments is the employment of two electrodes of *dissimilar* size dipping into an electrolyte, and connected to a potentiometer in such manner that the smaller electrode becomes the anode of the electrolytic cell.

The anode is made by the German firm as follows:—A piece of platinum wire ·001 mm. in diameter is fused into a piece of glass, and the glass filed away until the point *just* protrudes. The kathode may be of any size or shape, and is usually in the form of a stout piece of Pt. wire. The electrolyte is usually dilute $H_2 SO_4$ but nitric acid and caustic potash have been used by Fessenden.

*Further Notes on De Forest System.*

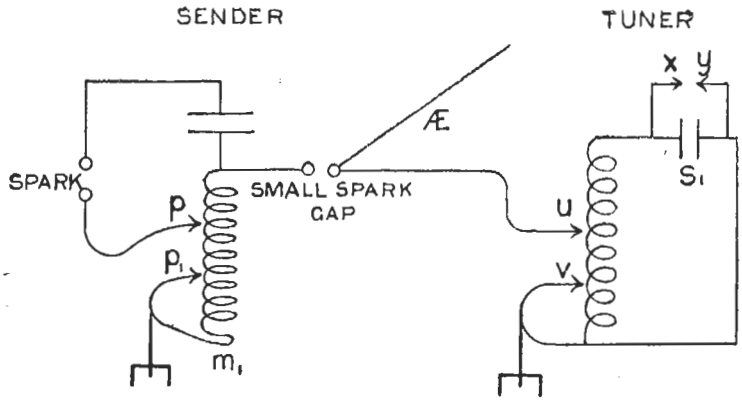
The work of the "Times" correspondent in China showed the great value of this system. According to the practise return of 30 June 1904, from H.M.S. "Andromeda," the system used was identical with the one mentioned in the De Forest report. Distances of 200 miles were achieved with aerials 100 feet high, which shows that the electrolytic detector is comparable with our own instruments in sensitiveness, whilst the great advantage of the "telephone" system of reception was well shown by the fact that great long press messages were successfully transmitted right through the interferences of the Russian and Japanese fleets; whilst the "Andromeda" reports that though the messages hopelessly fogged our own tapes, thereby preventing our signalling, yet the speed was so great that it was impossible to decipher the messages.

**The De Forest Company are now providing the U.S. Government with long-distance stations (p. 26), and the Marconi Company are commencing an action for infringement of patent rights, which should do a good deal towards settling the validity of many W.T. patents.**

*Slaby-D'Arco System.*

**Items gleaned from N.I.D./97/04 — N.I.D./63/04—**

FIG. 15.




The tuner is used for tuning up the primary of sender by obtaining longest sparks at testing spark gap $x$ $y$.

Practically it serves as a wavemeter to the primary circuit of sender. After the primary has been tuned an ammeter is placed in the aerial wire, and the aerial tuned to it.

*Details.*

The spiral $p$ $p_1$ $m_1$ is wound on the case holding the Leyden jars.

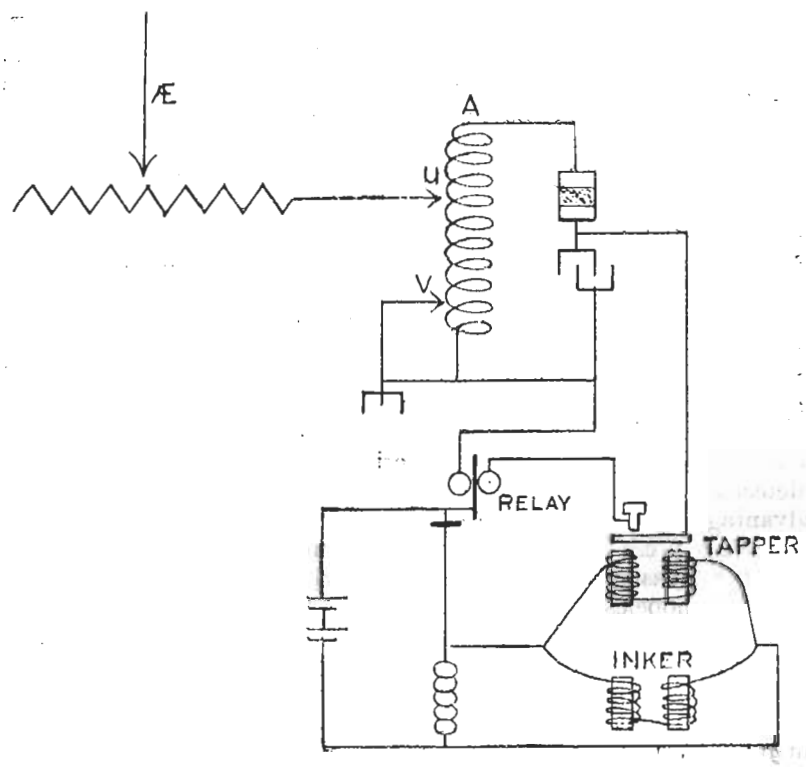
A turbine interruptor works the induction coil, and pure "grain alcohol" is used in it.

The key is fitted with a magnetic blow-out, and the coil condenser is across both it and the interruptor, similarly to our own latest methods.

The capacity $S_1$ is equal to the capacity of the coherer. From calculations this must be much larger than ours.

*Receiver.*

FIG. 16.



The "tuner" is also used for receiving purposes, the contacts *u v* being set as they were when tuning up the sender. The following are believed to be approximate dimensions of tuner. Height 43 cm., diameter 29 cm. (cylindrical). Wound with 126 turns of wire axial spacing, about 0·3 cm. The wave length is said to be about 4 metres per turn. In the U.S. trials of Slaby-D'Arco, the receiving tunes A *v* were 71 and *u v* were 5, which makes the wave length about 290 metres. Distances of 85 miles were achieved.

It is interesting to note the tapper connections.

*Braun System.*

This appears to be identical with Slaby-D'Arco.

*Rochefort and Ducretet Systems.*

These use plain aerial.

*Lodge-Muirhead System.*

The War Office has taken up this system, and it is also believed it will be installed between Trinidad and Tobago in the West Indies.

The connections employed are Marconi's, with a revolving steel wheel and mercury coherer working a siphon recorder.

The aerials and earths are interesting, being of the "roof aerial" type, of which Lodge may be considered the inventor.

The aerial consists of a "hammock" of wires slung on four poles about 20 feet high, and the earth is an exactly similar hammock of wires simply laid on the ground, and with therefore very large ohmic resistance to earth.

Distances of 60 miles have been done on the above arrangement, which is decidedly good, and shows the coherer is very sensitive.

Plain aerial is used with inductance at foot to bring to any desired wave length. The one mostly employed is about 50 (1,450 ft.) and interferes with "B" tune considerably. It is a very persistent and well-tuned wave.

*Anders-Bull Selection System.*

The patent taken out for this system has been carefully examined.

The principle is that a set of "collectors" at the receiving station and "distributors" at the sending station, run synchronously with each other, like in Delaney's system, and that each Morse character sent out consists of a series of impulses given out by the distributors and received by the collectors in such manner as to only make sense when all the intervals between parts of a series are properly maintained.

Some tests made by the Marconi Company would appear to have been successful.

It would appear, however, that a continuous "long" by an enemy would upset any such arrangement, and that therefore the system can have no war value.

No tests have therefore been made with the system.

*Fessenden System.*

This system has been used by the weather bureau of the U.S.A. The sending arrangements are believed to be similar to the Slaby-D'Arco, whilst for receiving a telephone is used, worked by an electrolytic detector employing nitric acid as electrolyte, or by a "hot wire barretter," which consists of a minute filament of platinum wire enclosed in a vacuum, the resistance of which varies with the heating effects of the aerial currents, and so affects the telephone through a local battery. This latter instrument, whilst very suitable for sharp resonance, appears to be very liable to be fuzed out by the "atmospheric" electricity.