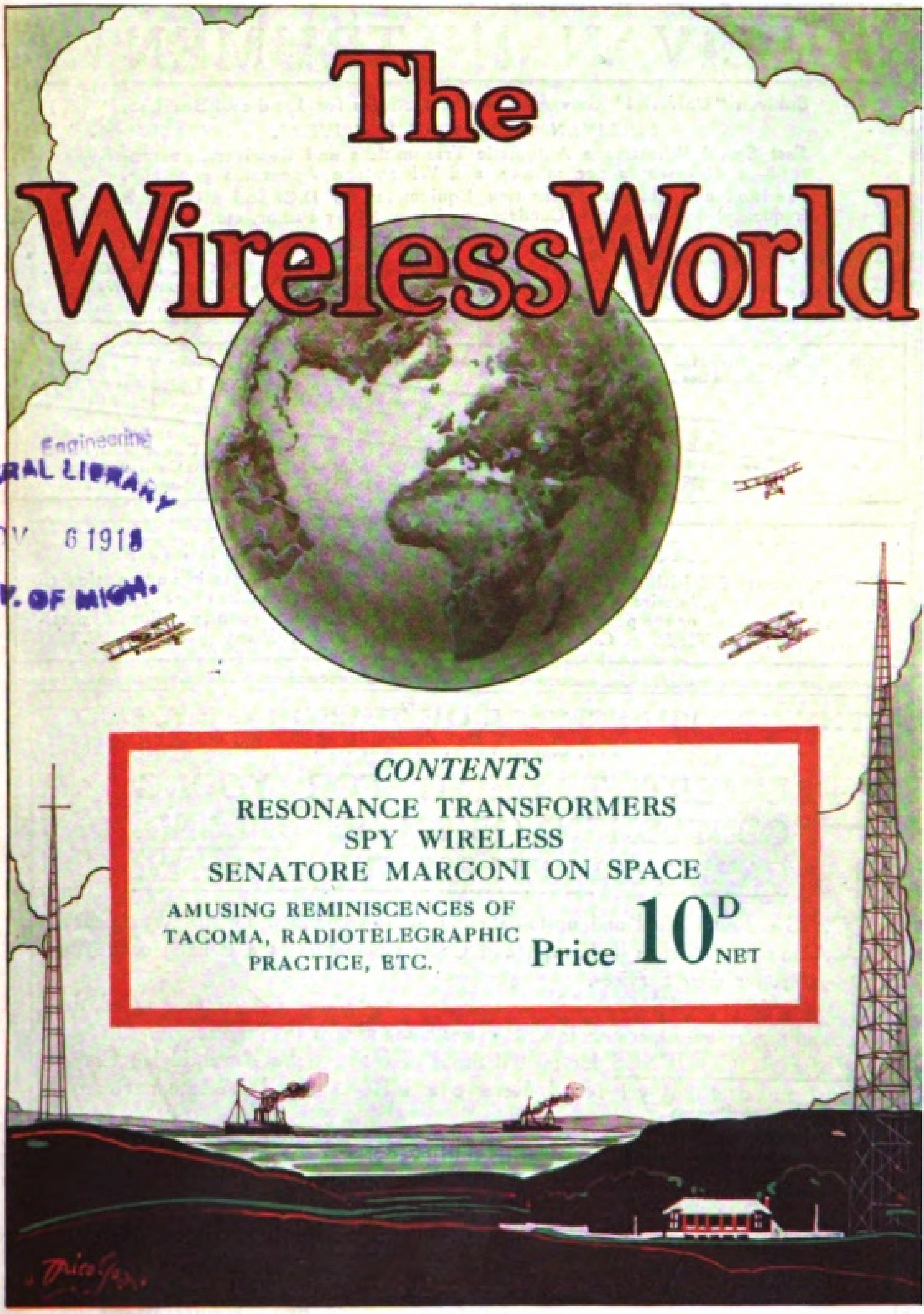


The Wireless World

CONTENTS

RESONANCE TRANSFORMERS
SPY WIRELESS
SENATORE MARCONI ON SPACE
AMUSING REMINISCENCES OF TACOMA, RADIOTELEGRAPHIC PRACTICE, ETC.

Price 10D NET

THE WIRELESS WORLD

With which is incorporated "The Marconigraph."

A MAGAZINE DEVOTED TO WIRELESS TELEGRAPHY AND TELEPHONY

Registered at the G.P.O. for transmission by Magazine Post to Canada and Newfoundland.

SUBSCRIPTION RATES.—United Kingdom and British Empire (outside North America), 12s. per annum, post free; United States, Canada, and Newfoundland, $3.00 per annum, post free; and Europe, frs. 15 per annum, post free.

Single copies, 10d. each, or post free 1s. 1d.

Articles submitted for acceptance by the Editor (which will be paid for on publication) should be addressed to Marconi House, Strand, London, W.C. *No responsibility can be taken for MSS. or Photographs sent without stamps to defray cost of return postage.*

Telegraphic Address: "Expanse, Estrand, London." Tel. No.: City 8710 (10 lines).

CONTENTS.

TECHNICAL ARTICLES.

GENERAL ARTICLES.

MISCELLANEOUS ARTICLES.

Telephone: 2168 Central

Telegrams: "Britannia, London"

BRITANNIA RUBBER AND KAMPTULICON CO., LTD.

7 NEWGATE ST.
LONDON, E.C.

EBONITE & VULCANITE

TUBES—RODS—SHEETS

WATERPROOF COATS

in great variety for all Climates

MECHANICAL RUBBER
MATS — HOSE — TUBES

STEAM JOINTING AND
RUBBER COMPOUNDS

DAVIS & TIMMINS,

LIMITED,

**KING'S CROSS,
LONDON, N.**

TRADE DAVIS & TIMMINS LIMITED MARK.

Established 1876.

METAL THREAD SCREWS

Nuts, Bolts, Terminals &c.

Telephone: North 580 (2 lines)
Telegrams: "Conductivity, London."

"You cannot charge me with not preparing betimes to assist you to secure your due share of World Trade after the War"

J. C.H. Macbeth

MR. J.C.H. MACBETH,
THE CODE COMPILER.

HAVE YOU HEARD ABOUT THE WONDERFUL

Marconi International Code?

The Code that is more than a Code.

It halves the cost of Cabling, and is an Interpreting Agent and Phraseological Dictionary in Nine Languages

It places in your hands the Master Key to the Trade of the Globe!

We shall be pleased to send you, free of charge, our Linguistic Map of the World and Handsome Illustrated Booklet if you will cut off this corner, pin it to one of your letter headings and post it to us.

The Marconi International Code Co.,
LIMITED,
Marconi House,
STRAND,
LONDON.

To Marconi International Code Co., Ltd., Marconi House, Strand, London.
Please send Book and Map free to name and address at attached heading.
W W

The
WIRELESS
· WORLD ·

Volume VI. No. 67. OCTOBER, 1918.

Reminiscences of an Operator

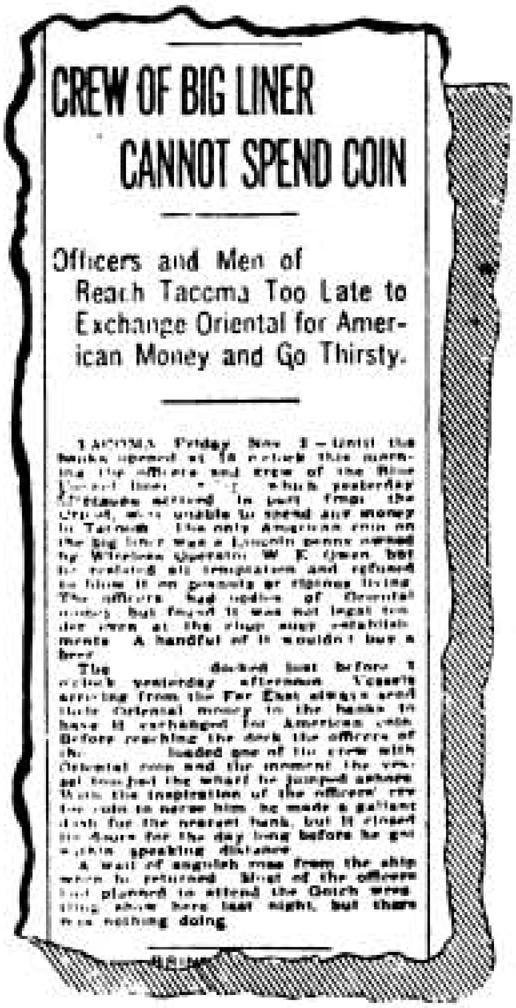
Tacoma, Washington, U.S.A.

By WILLIAM D. OWEN

ONE would have thought that our arrival in Tacoma was an event of prime importance if one had taken the local papers seriously. Judging by the publicity we got it seems that they were short of news.

Among the first to board our vessel was a small crowd of reporters, who appeared to think that the wireless operator, by virtue of his office, would be able to provide them with much "copy." Unfortunately for them I had been warned beforehand to be on my guard when dealing with these estimable fellows if I wished to avoid notoriety. So, emulating Billy Muggins in the popular song, I stuck to generalities.

One reporter, more persistent than his colleagues, remained behind after the main body had retreated. He asked me if I knew the *value* of news. I told him that I did not know much about the value of news, but that I knew a great deal about the value of silence. "Sheer bunk!" he replied; "three parts of the vain regrets of life are over wasted opportunities. Tell me what you know of the Agadir incident" (this was in 1911). "I'll work it up into a big feature for to-morrow's issue and we'll share the dough." When I told him that all I knew about the incident in question had been learned from the American papers he shut up his notebook smartly and said, "Wal, I guess the deal's off." Then changing the subject he asked if I intended to go to the Gotch wrestling match that night. In reply I put my hand into my pocket and pulled out a miscellaneous collection of coins that had accumulated



CRER OF BIG LINER CANNOT SPEND COIN

Officers and Men of Reach Tacoma Too Late to Exchange Oriental for American Money and Go Thirsty.

[illegible]

in the course of a twenty-thousand mile voyage. "I don't suppose any of this is legal tender over here," I said; "the only American money on the ship is this Lincoln cent and that's a keepsake." He raked about among the coins for a moment, smiling to himself the while, and then he left. Next morning I woke to find myself a local celebrity, as famous as though I'd been snatched from death by a timely dose of Seagull's Syrup or had mended a broken leg with Dr. Jess's Lying Ointment. The newspaper cutting* reproduced explains my sudden ascension to fame.

I was not enamoured of Tacoma at first. It struck me as being a dull sort of place, but I soon changed my opinion after having seen its Fire Brigade. I happened one day to be strolling along Pacific Avenue when suddenly a large electric bell upon one of the light standards began to ring excitedly. The effect of that bell upon the populace was rather curious; all who happened to be on the scene rushed to the sidewalk and lined the streets, craning their necks eagerly in a certain direction. Now a fire in Tacoma is a serious matter, because the older buildings are made largely of wood and the more modern ones are very tall. So they have to be smart in their counter measures. And they are. Within twenty seconds of the first stroke of that bell—which apparently was to warn the users of the streets that the roadway was unhealthy—a huge nightmare fire-engine swung round the corner on two wheels and flew up the road at a speed something like forty miles an hour. It carried a complement of grotesquely attired firemen and a nerve-shattering bell which had the phantom characteristic of being invisible. Following close behind it was another and a third, each successive one more speedy than the former. I had just begun to breathe again when a little red car consisting of three parts engine and the other part noise tore past at a speed I had never seen equalled on the road. It went up a one-in-six hill as though no hill existed. That car contained the Superintendent and his chauffeur. My neighbour, recognising that I was a stranger, volunteered the information that its speed was seventy miles an hour, and I did not doubt him.

Next moment a weird sound assailed us, like the moaning of a lost soul. It was the signal for a fresh outburst of excitability on the part of those around me. "Here comes the doggoned six-wheeler!" yelled my neighbour into my starboard ear. The crowd moved bodily toward another corner; I did likewise—I had no option in the matter—and I saw the centre of disturbance. It appeared to be a bright light and a cloud of smoke moving rapidly towards us, and in a few seconds it evolved into the most fantastic fire fighting machine I had ever seen or imagined: a six-wheeled motor fire-escape of 100 horse-power, so long that steering gear was fitted to the back wheels as well as the front. In less than three minutes there were no less than ten mechanical abortions belching forth petrol, gas, hell-fire and Brock's benefit. They encircled a cinematograph theatre, where apparently a film had ignited, thus giving rise to the alarm. That it was extinguished without so much as a spark being seen by the eager crowd outside may be regarded as an indication of the efficiency of the Tacoma Fire Brigade. But those machines fascinated me. I walked round one monster, paying it silent homage with every fibre of my being. I even touched it. I peeped under the open sides of the engine-bonnet and watched the camshaft

* The name of the liner has been deleted by the Censor.

playing an andantino upon the valve-stems. I looked at the superman who handled the thing. I wanted to shake hands with him, but he was too busy picking his teeth. It seemed strange to me that a man who had tamed this throbbing monster should have trouble with his teeth just like ordinary people. I was bewildered; I wanted to be alone with my thoughts. My sleep that night was disturbed by visions of fire-engines, as long as trains, chasing little red cars up and down interminable staircases.

Next day I took fifteen grains of potassium bromide and went to the "movies" with the second engineer. The pictures were so dry it was only natural that we should look around afterwards for an antidote, and we found the Café Bohème.

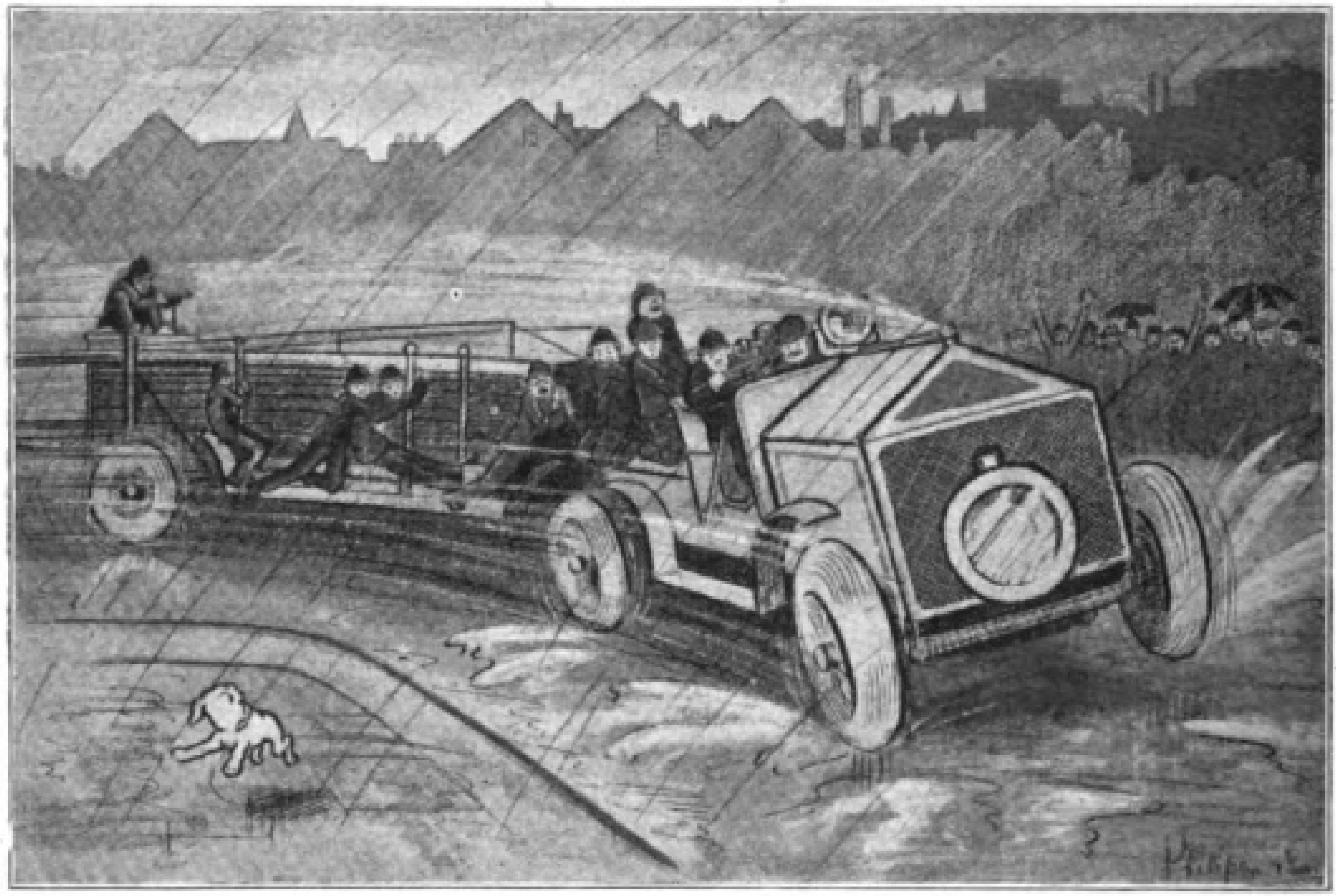
A gentleman of doubtful ancestry took our hats and coats and asked what we desired. I wanted one of those long chromatic drinks with straws stuck into it, but when I gave my order the gentleman of doubtful ancestry handed me back my hat and coat, saying with superb dignity, "This, sir, is a cabaret, not a Y.M.C.A." I begged his pardon and said I'd take anything wet, leaving the choice of label to his discretion. I was fortunate in my reply, for he took his calling very seriously, and, after a moment's deliberation—during which he held his chin in his left hand and said, "Let me see; let me see, now"—he strutted off with the air of a man whose mind is made up. I now felt at liberty to look around—a proceeding quite out of the question in his presence. We were in a huge square hall, below the level of the street. The marble steps from the vestibule to the main floor might have graced a cathedral and the floor itself was a masterpiece of mosaic. Dozens of tables, richly set, arranged themselves into a great horseshoe around a miniature stage and an orchestra sat entrenched behind a grand piano. Each table had its complement of vivacious humanity, disciples of Omar Khayyám intent on the worship of Bacchus.

"We're in for it now, Marconi," said the second. "Guess that's so," I replied in my best American. Further discourse was prevented by the return of our gentleman with a tray bearing two bottles of Pilsener, two conical glasses and a box of cigars. Well do I remember those cigars—Mexican Planters they were, and I have since sought for them in vain from Singapore to Edinburgh, from Vancouver to Kowloon. He relieved us of a sum so trifling that I felt half ashamed to offer it, kept the change with the *sang froid* of a perfect waiter, and then became enveloped by the throng.

I sat me down to philosophise, watching the bubbles in the glass with that pleasurable anticipation that children of all ages delight to inflict upon themselves, and my thoughts were rudely disturbed by the opening chords of some musical contortions

THE PERSISTENT REPORTER IN SEARCH OF "COPY."

played on the piano by a German Jew whose long hair had St. Vitus's dance and who seemed to be in great physical pain, judging by the writhings of his body. I had never before seen a full-grown man playing hop-scotch on a grand piano when by all the signs and portents he should have been in the hospital under treatment for ague. He played with vigour, swayed with and pedalled with vigour. Vigour marked every movement and quivered from every limb. Fortissimo was his motto and energy his stock-in-trade. With so great an expenditure of muscular tissue it was only natural that his contribution to our entertainment should have been short. He fell exhausted into a chair at a near-by table and I saw the gentleman of doubtful ancestry pass him a glass of something—evidently medicine. He rallied a little, but during convalescence his place was taken by an æsthetic-looking consumptive whose overgrown locks had evidently absorbed all the vitality of his system.



"HERE COMES THE DOGGONED SIX-WHEELER!"

He seemed to be a musician of quite a different school. He dallied with the piano, poising his hands above the notes as though reluctant to play them. He, too, possessed animated hair and St. Vitus's dance, but I didn't have much time to devote to him, for his music had drawn from some secluded nook a feminine atrocity in a cerise muslin sheath on "hobble-skirt" lines. "Mutton 'dressed' as lamb," whispered my companion.

It must have been a competition of some sort, for she sang against the pianist, and the first bout was a draw. On the second round she had the advantage, but at the end of the third round the pianist was quite five bars behind, but nobody seemed to mind, for was not the beer good and were not the ladies charming?

After a brief spell of the familiar discord with which a string band always preludes its performance, and which the Shah of Persia considered the cream of Western music, we were treated to some musical selections. There was no programme, but anyone with a little imagination and a musical soul could put one together for himself.

Having both it was not difficult for me to make out the titles. From what I remember of them they were as follows :—

DESCRIPTIVE : " Revolution Français "	... ...	*Sousa*
SELECTION : " Derby Day " ...	... ...	*Tschaikowski*
REVERIE : " Phantasmagoria "	... ...	*Keulah*
DESCRIPTIVE : " Mile End Road on a Saturday Night "	...	*Wagner*

Now there were about eight of those musicians and every one of them stark, staring mad. They played *on* their instruments and they played *with* their instruments. They made grimaces at their instruments one moment and fondled and caressed them the next. The instruments themselves seemed to enter into the spirit of the thing, for never in my life have I heard such a carnival of din. They would start with a slow, mournful movement, melancholy yet harmonious, and they would wander off, each on his own, as it were, quickening the time and swelling out to a climax of discordant fury. Then they would amble back, one by one dropping into the main theme, and would come to an abrupt finale with a triumphant chord. My ! they were the greatest musicians that ever disturbed the air within the range of Tympanum. That experience cost me just twenty-five cents, about a shilling, for which sum I had a cigar fit for the gods, two glasses of beer, selections by the bewitched orchestra, and I'd seen Life. After which I returned to my virtuous couch, marvelling greatly.

SELECTIONS BY THE BEWITCHED ORCHESTRA.

PERSONALITIES IN THE WIRELESS WORLD

MONS. ANDRÉ EUGÈNE BLONDEL

EARLY in 1863, André Eugène Blondel was born at Chaumont on the Marne. After being educated at the Lycée of Dijon, Mr. Blondel graduated at the Polytechnic School of Paris (1883), at the Universities of Paris (1885) and Dijon (1889), and at the National School for Bridges and Ways, where he obtained the first rank (1888) and the title of State Engineer of Bridges and Ways.

Having been appointed Engineer, and afterwards Engineer-in-Chief, to the Central Service of Lighthouses, Mr. Blondel turned his attention and energies towards the scientific subjects with which this service was concerned, such as Optics and Photometry, the Electric Arc, Electrical Machinery, Radiotelegraphy, Aerial and Submarine Signals. Selected in 1893 as the first occupant of the new Chair of Applied Electricity of the National School for Bridges and Ways, he made a large number of contributions to the publications of learned Societies, in addition to which he published in technical journals, etc., numerous monographs covering a wide range of subjects.

Besides his work on the Blondel Oscillograph and the theory of alternators, he paid particular attention to Radiotelegraphy, and published numerous articles on the research work carried out by him in connection with oscillating arcs, resonance transformers, directional radiotelegraphy and many other problems.

Mr. Blondel's achievements have been recognised by the French Government, who appointed him President of the Technical Commission of Military Applications of Electricity (1914). In 1913 he had been elected President of Comité Française de T.S.F. Scientifique, and a member of the Comité Technique des Postes et Télégraphes, in whose hands is vested the supreme direction of State radiotelegraphy in the Republic.

He was elected an Honorary Member of the American Institute of Electrical Engineers in 1912 for having "rendered service of the "highest value in the advancement of the electrical science and "arts, and notably by his work with relation to alternating-current "wave-recorders, the composite-electrode arc lamp, the distribution "and measurement of light and illumination, the theory and design "of alternating-current apparatus and the theory and calculation "of transmission and distributing systems." He is a member of the Académie des Sciences of Paris, and an Honorary President of the Société Française des Electriciens, Vice-President and Honorary Member of the Illuminating Engineering Society, etc. He was elected also, in 1917, a Fellow of the American Institute of Radio Engineers.

The Power Factor in the Resonance Transformer Circuit

By P. BAILLIE, L.Sc.

It may seem somewhat paradoxical to speak of power factor when dealing with a circuit whose electrical constants are so chosen that the circuit is tuned to the frequency of the alternator. However, considering the case of the feeding circuit of any modern transmitting plant will show that though the current is in step with the voltage, the power is not equal to the product of the R.M.S. current and voltage, as read off the ammeter and voltmeter. The effective power is always smaller than this product. We may therefore define an angle φ by the equation :

$$\cos\varphi = \frac{\text{Power (watts)}}{\underset{\text{R.M.S.}}{I\text{ (amperes)}} \,.\, \underset{\text{R.M.S.}}{V\text{ (volts)}}}$$

The factor $\cos\varphi$ is the power factor.

The angle φ is not a phase difference between the amperes and volts.

It is known—Wireless World, August 1917—that the instantaneous current i and voltage v across the transformer primary—the circuit being tuned to the alternator frequency—are :

$$i = -\frac{E_0}{R}\,(1 - e^{-\alpha t}) \,.\, \sin\Omega t$$

$$v = E_0 \,.\, S\,(1 - e^{-\alpha t}) \,.\, \cos\Omega t$$

with the following notations :

E_0 = maximum E.M.F. of the alternator.

R = total ohmic resistance of the circuit, including the resistance equivalent to magnetising current and resistance of secondary winding.

S = surtension $= \frac{L\,\Omega}{R}$

K = number of semi periods between two consecutive sparks $= \frac{\Omega}{\pi N}$

N = number of sparks per second.

α = damping factor $= \frac{R}{2L} = \frac{\Omega}{2S}$

The flow of electricity through the circuit is a succession of transient states of $\frac{1}{N}$ second duration. A spark occurs long before any sine current—or voltage—of constant amplitude has had time to establish. In other words, the exponential factors which take place in the expres-

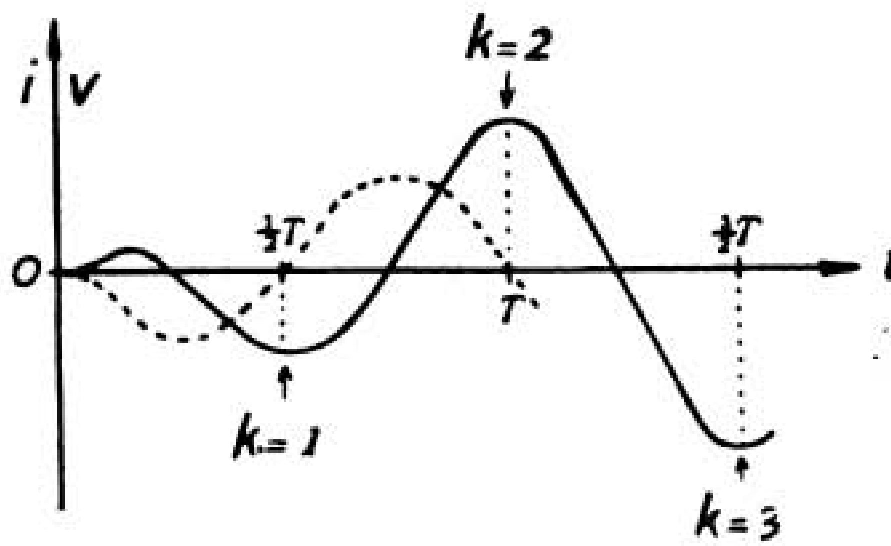


FIG. 1.

sions of i and v have too large values, when the spark occurs, to be neglected and to permit of considering the current as a sine function of time. This is obvious from Fig. 1. The exponential factor increases with the surtension S and number of sparks N. Therefore, the larger S and the smaller K, the smaller the power factor.

The value of the power factor may be deduced from the power, and the R.M.S. current and voltage.

The power generated by the alternator is—WIRELESS WORLD, June 1918:

$$P_a = \frac{N \cdot E_0^2}{R} \left[\frac{K\pi}{2\,\Omega} - \frac{S}{\Omega}\left(1 - e^{-\frac{K\pi}{2S}}\right)\right]$$

and power at the spark gap:

$$P_{o.c.} = \frac{1}{2} N c a^2 E_0^2 S^2 \left(1 - e^{-\frac{K\pi}{2S}}\right)^2$$

The efficiency ρ is therefore:

$$\rho = \frac{P_{o.c.}}{P_a} = \frac{S\left(1 - e^{-\frac{K\pi}{2S}}\right)^2}{K\pi - 2S\left(1 - e^{-\frac{K\pi}{2S}}\right)}$$

Values of ρ have been given in the quoted article.

A power $(1 - \rho) \cdot P_a$ is expanded into heat and the R.M.S. current is:

$$\underset{\text{R.M.S.}}{i}\ (\text{amperes}) = \frac{(1-\rho) \cdot P_a}{R}$$

hence:

$$\frac{\underset{\text{R.M.S.}}{i}\ (\text{amperes})}{\frac{E_0}{\sqrt{2}} \cdot \frac{1}{R}} = \sqrt{(1-\rho) \cdot \left[1 - \frac{2S}{K\pi}\left(1 - e^{-\frac{K\pi}{2S}}\right)\right]}$$

It may be noted that $\frac{E_0}{\sqrt{2}} \cdot \frac{1}{R}$ is the R.M.S. current when the key is depressed and the sparking distance so large that no spark can jump across.

The R.M.S. voltage cannot be calculated in the same way. We have:

$$V^2_{\text{R.M.S.}} = \frac{\Omega}{K\pi} \int_{t=0}^{t=\frac{K\pi}{\Omega}} v^2 \cdot dt = \frac{\Omega}{K\pi} \cdot \frac{E_0^2 S^2}{2} \int (1 + e^{-2\alpha t} - 2\,e^{-\alpha t}) \cdot (1 + \cos 2\,\Omega t) \cdot dt$$

The general integral is:

$$t + \frac{\sin 2\,\Omega t}{2\,\Omega} - \frac{e^{-2\alpha t}}{2\alpha} + e^{-2\alpha t}\,\frac{2\,\Omega \sin 2\,\Omega t - 2\,\alpha \cos 2\,\Omega t}{4\,(\alpha^2 + \Omega^2)} + \frac{2\,e^{-\alpha t}}{\alpha}$$

$$- 2\,e^{-\alpha t}\,\frac{2\,\Omega \sin 2\,\Omega t - \alpha \cos 2\,\Omega t}{\alpha^2 + 4\,\Omega^2}$$

The same assumptions that were made to calculate the power may be made here. Therefore we have to neglect $\frac{1}{4\,S^2}$ and *a fortiori* $\frac{1}{16\,S^2}$ before unity. In other words, α^2 and $4\,\alpha^2$ may be neglected compared with $4\,\Omega^2$. Putting:

$$tg\,p = \frac{\alpha}{\Omega} = \frac{1}{2\,S} \quad tg\,q = \frac{\alpha}{2\,\Omega} = \frac{1}{4\,S}$$

the general integral is :

$$t+\frac{\sin 2\Omega t}{2\Omega}+e^{-2\alpha t}\left[\frac{\sin(2\Omega t-p)}{2\Omega}-\frac{1}{2\alpha}\right]$$
$$+e^{-\alpha t}\left[\frac{2}{\alpha}-\frac{2\sin(2\Omega t-q)}{\Omega}\right]$$

and the definite integral :

$$\frac{K\pi}{\Omega}+\left(\frac{1}{2\alpha}+\frac{\sin p}{2\Omega}\right).\left(1-e^{-\frac{2\alpha K\pi}{\Omega}}\right)-\left(\frac{2}{\alpha}+\frac{2\sin q}{\Omega}\right).\left(1-e^{-\frac{\alpha K\pi}{\Omega}}\right)$$

Accounting for the following equations :

$$\frac{\alpha k\pi}{\Omega}=\frac{K\pi}{2S};\ \sin p=\frac{\frac{1}{2S}}{\sqrt{1+\frac{1}{4S^2}}}\# \frac{1}{2S}$$

$$\sin q=\frac{\frac{1}{4S}}{\sqrt{1+\frac{1}{16S^2}}}\# \frac{1}{4S}$$

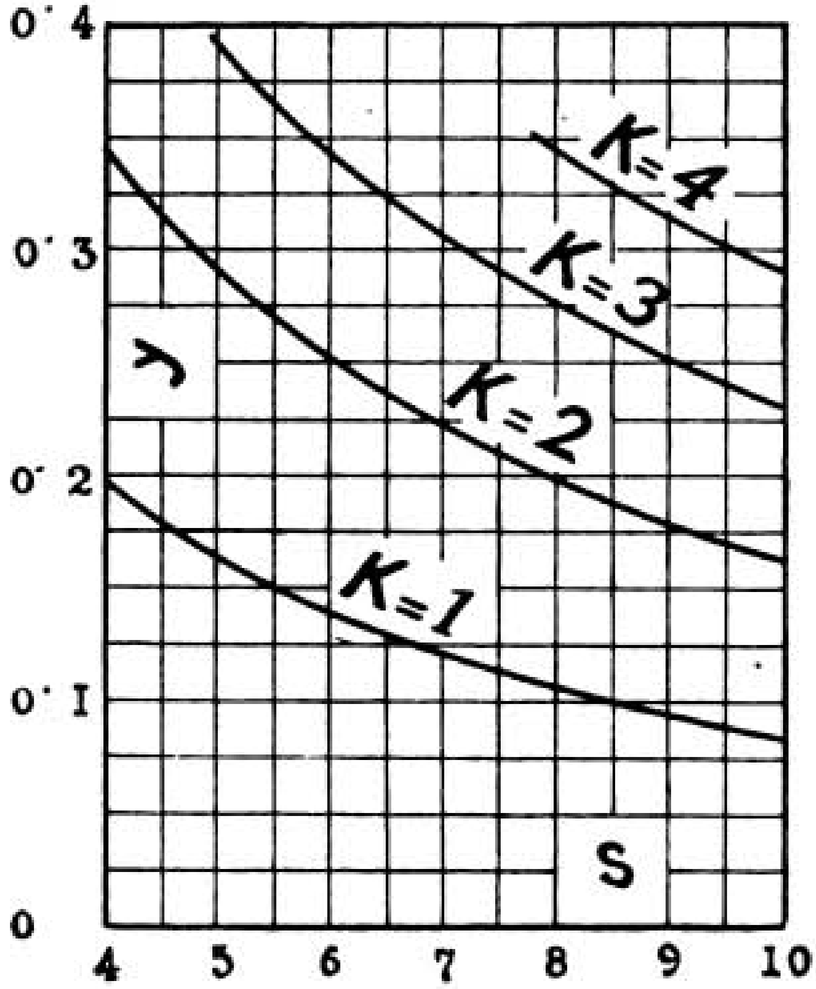


FIG. 2.

and multiplying by $\frac{\Omega}{K\pi}.\frac{E^2S^2}{2}$ we obtain the square of the R.M.S. voltage

Hence :

$$\frac{V_{R.M.S}}{\frac{E}{\sqrt{2}}S}=\sqrt{1+\frac{S}{K\pi}\left(1-e^{-\frac{K\pi}{S}}\right)-2.\frac{2S}{K\pi}\left(1-e^{-\frac{K\pi}{2S}}\right)}$$

From this we deduce the power factor:

$$\cos\varphi = \frac{\left(1 - e^{-\frac{K\pi}{2S}}\right)^2}{\sqrt{\left[(1-\rho)\cdot 1 - \frac{2S}{K\pi}\left(1 - e^{-\frac{K\pi}{2S}}\right)\right]\cdot\left[1 + \frac{S}{K\pi}\left(1 - e^{-\frac{K\pi}{S}}\right) - 2\cdot\frac{2S}{K\pi}\left(1 - e^{-\frac{K\pi}{2S}}\right)\right]}}$$

Numerical calculations show that for not too small values of $(S - S > 5)$ and not too large values of $(K - K < 3)$, that is, more than one spark every three semi-periods—the ratios

$$\frac{I_{R.M.S.}}{\frac{E_0}{\sqrt{2}}\,\frac{1}{R}} \quad\text{and}\quad \frac{V_{R.M.S.}}{\frac{E_0}{\sqrt{2}}\,S}$$

have practically the same value—error < 1 per cent.

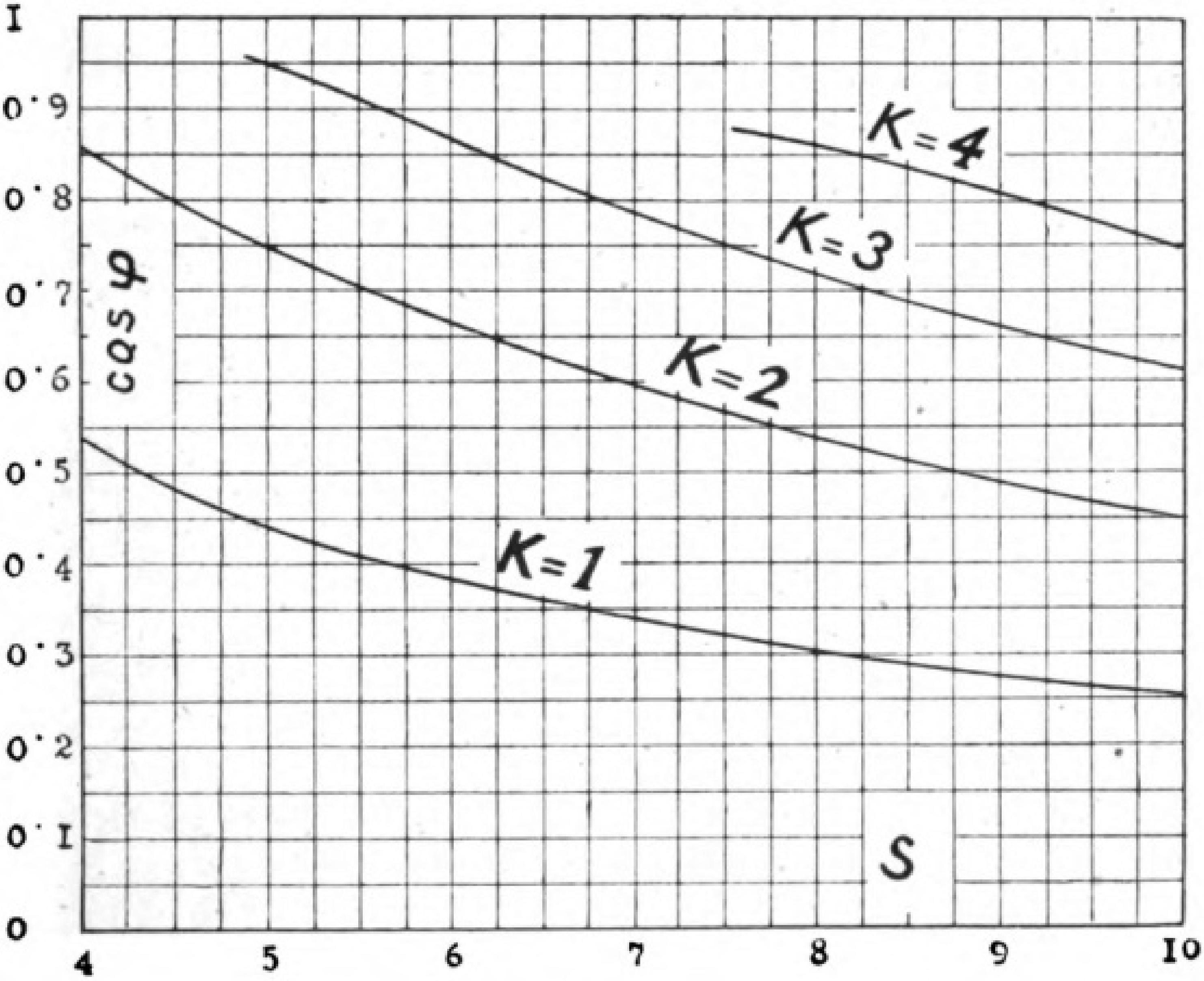


FIG. 3.

With these results, curves Figs. 2 and 3 have been plotted.

As expected, the power factor approaches unity for S small and K large.

The calculations are valid so long as $\frac{1}{4S^2}$ may be neglected. Therefore the power factor has not been calculated for values of S less than 4.

Table I. gives the common value y of these ratios in terms of K and S, and the power factor (number in heavy type).

TABLE I.—(POWER FACTOR IN HEAVY TYPE).

K	Surtensions S:						
	4.	5.	6.	7.	8.	9.	10.
1	0·196 **0·540**	0·162 **0·443**	0·138 **0·383**	0·120 **0·336**	0·105 **0·301**	0·093 **0·275**	0·083 **0·253**
2	0·345 **0·857**	0·291 **0·745**	0·251 **0·661**	0·221 **0·592**	0·197 **0·538**	0·178 **0·487**	0·162 **0·450**
3		0·392 **0·949**	0·342 **0·865**	0·307 **0·781**	0·276 **0·717**	0·251 **0·661**	0·230 **0·613**
4					0·344 **0·880**	0·314 **0·805**	0·290 **0·748**

A source of error is to be found in the fact that however perfectly constructed the transformer is, magnetic leakage is unavoidable. Therefore, the assumption that all the inductance of the circuit is external to the transformer is not quite correct. A small part—of the order 2 to 4 per cent.—of this inductance, equivalent to leakage, is located between the points where the voltmeter is connected. The measured effective voltage is therefore a little smaller than the calculated value.

Nevertheless, this is a means of quickly estimating, within a few per cent., the power supplied to the condenser of a transmitting plant, when no wattmeter is available.

It may be pointed out that the surtension S is equal to the R.M.S. voltage across transformer primary, when the key is depressed and the discharger disconnected, divided by the R.M.S. electromotive force of the alternator.

Wireless Time Signals

Establishment of New Radiating Station at Balboa (Panama)

MASTERS and seamen of vessels voyaging in the vicinity of the Pacific Coast and Panama Canal will be interested in the particulars of a new wireless station erected at Balboa, situated at the entrance to the Canal. The details are conveyed in an Admiralty Notice to Mariners (No. 962 of 1918), dated August 12th, 1918. The new station is situated in latitude 8° 56½′ N., longitude 79° 33¼′ W.

Wireless time-signals are sent out as follows :—A *dot* at every second from 0h. 55m. 00s. and 16h. 55m. 00s. to 0h. 59m. 49s. and 16h. 59m. 49s. Standard time, except at the 29th second of each minute, and from the 55th to the 59th second of each minute. A *dash* at 1h. 00m. 00s. and 17h. 00m. 00s. Standard time corresponding to 6h. 00m. 00s. and 22h. 00m. 00s. G.M.T., the beginning of the dash being the time-signal.

Digest of Wireless Literature

STANDARDS FOR RADIO COMMUNICATION.

THE following Sections 1,000 to 1,028 have been abstracted from the report of the Standardization Committee of the Institute of Radio Engineers.

1,000, *Acoustic Resonance Device*.—One which utilises in its operation resonance to the audio frequency of the received signals.

1,001, *Antenna*.—A system of conductors designed for radiating or absorbing the energy of electromagnetic waves.

1,002, *Atmospheric Absorption*.—That portion of the total loss of radiated energy due to atmospheric conductivity.

1,003, *Audio Frequencies*.—The frequencies corresponding to the normally audible vibrations. These are assumed to lie below 10,000 cycles per second.

1,004, *Capacitative Coupler*.—An apparatus which by electric fields joins portions of two radio-frequency circuits, and which is used to transfer electrical energy between these circuits through the action of electric forces.

1,005, *Coefficient of Coupling* (*Inductive*).—The ratio of the effective mutual inductance of two circuits to the square root of the product of the effective self-inductances of each of these circuits.

1,006, *Direct Coupler*.—A coupler which magnetically joins two circuits having a common conductive portion.

1,007, *Counterpoise*.—A system of electrical conductors forming one portion of a radiating oscillator, the other portion of which is the antenna. In land stations a counterpoise forms a capacitative connection to ground.

1,008, *A Damped Alternating Current* is an alternating current whose amplitude progressively diminishes.

1,009, *The Damping Factor* of an exponentially damped alternating current is the product of the logarithmic decrement and the frequency.

Let I_0=initial amplitude.
I_t=amplitude at the time t.
e=base of Napierian logarithms.
a=damping factor.
Then $I_t = I_0 e^{-at}$.

1,010, *Detector*.—That portion of the receiving apparatus which, connected to a circuit carrying currents of radio frequency and in conjunction with a self-contained or separate indicator, translates the radio frequency energy into a form suitable for operation of the indicator. This translation may be effected either by the conversion of the radio frequency energy or by means of the control of local energy by the energy received.

1,011, *Electromagnetic Wave*.—A periodic electromagnetic disturbance progressing through space.

1,012, *Forced Alternating Current*.—A current the frequency and damping of which are equal to the frequency and damping of the exciting electromotive force.

1,013, *Free Alternating Current*.—The current following any electromagnetic disturbance in a circuit having capacity inductance, and *less* than the critical resistance.

1,014, *Critical Resistance of a Circuit.*—That resistance which determines the limiting condition at which the oscillatory discharge of a circuit passes into an aperiodic discharge.

1,015, *Group Frequency.*—The number per second of periodic changes in amplitude or frequency of an alternating current.

NOTE 1.—Where there is more than one periodically recurrent change of amplitude or frequency there is more than one group frequency present.

NOTE 2.—The term "group frequency" replaces the term "spark frequency."

1,016, *Inductive Coupler.*—An apparatus which by magnetic forces joins portions of two radio frequency circuits, and is used to transfer electrical energy between these circuits through the action of these magnetic forces.

1,017, *Linear Decrement of a Linearly Damped Alternating Current* is the difference of successive current amplitudes in the same direction, divided by the larger of these amplitudes.

Let : I_n and I_n+I be successive current amplitudes in the same direction, of a linearly damped alternating current.

Then : The linear decrement, $b=\frac{I_n=I_n+I}{I_n}$

Also $I_t=I_n\,(I-bft)$.

Where I_o=initial current amplitude.

I_t=current amplitude at time t.

f=frequency of alternating current.

1,018, *Logarithmic Decrement* of an exponentially damped alternating current is the logarithm of the ratio of successive current amplitudes in the same direction.

NOTE.—Logarithmic decrements are standard for a complete period or cycle.

Let : I_n and I_n+I be successive current amplitudes in the same direction.

d=logarithmic decrement.

Then : $D=\log.\ \frac{I_n}{I_n+I}$

1,019, *Radio Frequencies.*—The frequencies higher than those corresponding to the normally audible vibrations, which are generally taken as 10,000 cycles per second. See also Audio Frequencies.

NOTE.—It is not implied that radiation cannot be secured at lower frequencies, and the distinction from audio frequencies is merely one of definition based on convenience.

1,020, *Resonance* of a circuit to a given exciting alternating e.m.f. is that condition due to variation of the inductance or capacity in which the resulting effective current (or voltage) in that circuit is a maximum.

1,024, *A Standard Resonance Curve* is a curve the ordinates of which are the ratios of the square of the current at any frequency to the square of the resonant current, and the abscissas are the ratios of the corresponding wave-length to the resonant wave-length ; the abscissas and ordinates having the same scale.

1,026, *Sustained Radiation* consists of waves radiated from a conductor in which an alternating current flows.

1,027, *Tuning.*—The process of securing the maximum indication by adjusting the time period of a driven element (see Resonance).

1,028, *A Wave Meter* is a radio frequency measuring instrument, calibrated to read wave-lengths.

1,030, *Decremeter.*—An instrument for measuring the logarithmic decrement of a circuit or of a train of electromagnetic waves.

1,031, *Attenuation, Radio.*—The decrease with distance from the radiating source of the amplitude of the electric and magnetic forces accompanying (and constituting) an electromagnetic wave.

1,032, *Attenuation, Coefficient of (Radio).*—The coefficient which, when multiplied by the distance of transmission through a uniform medium, gives the natural logarithm of the ratio of the amplitude of the electric or magnetic forces at that distance to the initial value of the corresponding quantities.

1,033, *Coupler.*—An apparatus which is used to transfer radio-frequency energy from one circuit to another by associating portions of these circuits.

The Design and Use of the Wavemeter.

The writer, in a recent issue of the *Electrical Experimenter*, mentions an interesting fact concerning a new type wavemeter (No. 28) recently brought out by the American Marconi Company. He states that there is a correcting wavemeter consisting of fixed inductance and capacities which may be excited by means of a buzzer and picked up on the main wavemeter. By this means it can be seen if the calibration has changed, and if so it can be corrected by adding or subtracting capacity on a correcting condenser, which is permanently connected around the main condenser. It is, of course, understood that the main wavemeter was calibrated with this correcting condenser half in, thus allowing an addition or subtraction of capacity to correct the calibration. The correcting condenser had a capacity of one-tenth of that of the main condenser.

Analysis of Alternating Current Wave Forms.

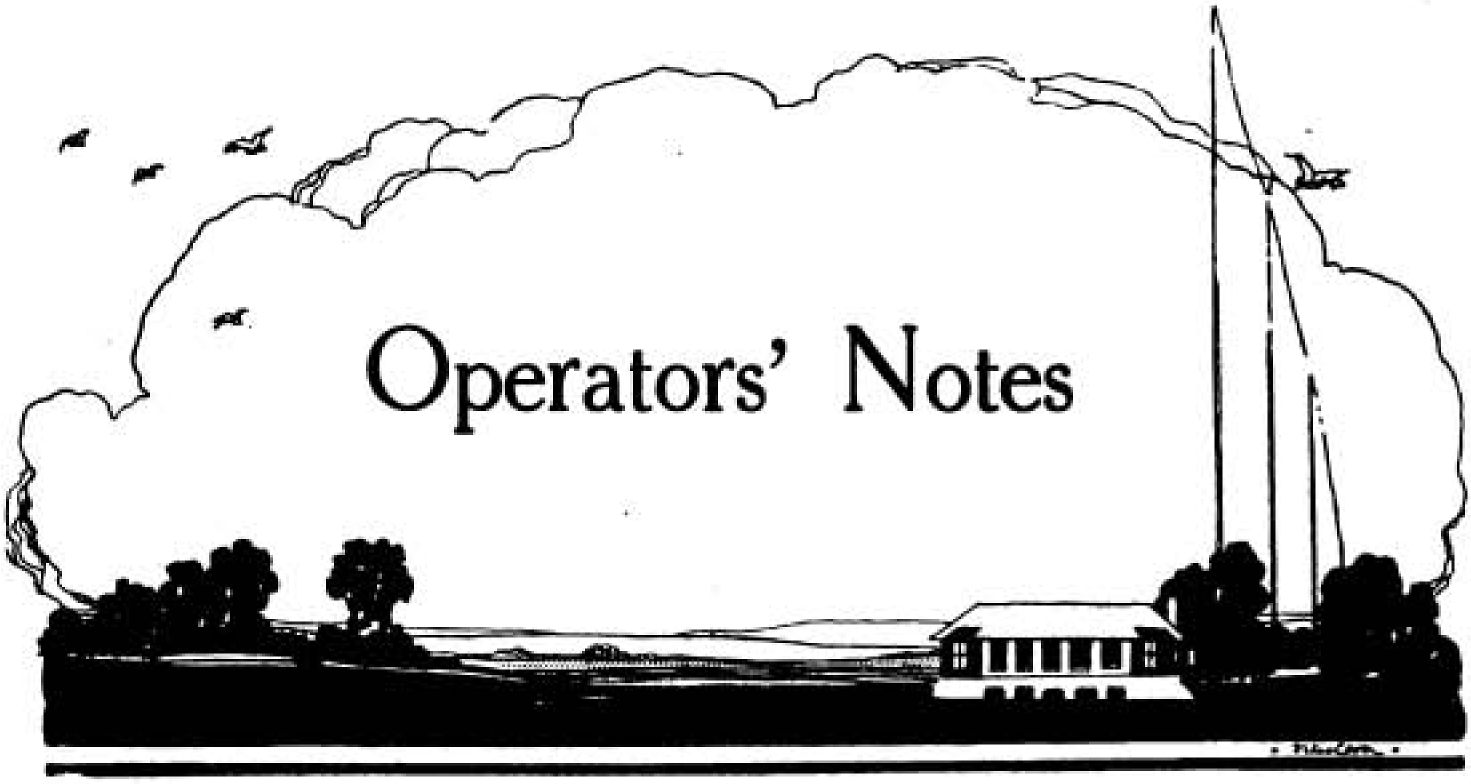
An interesting article appears in the *Electrical Experimenter* from the pen of Prof. F. E. Austin concerning the analysis of irregular wave-shaped alternating curves, leading up to a discussion on harmonics, which is an important problem in wireless telegraphy. The writer instances Fourier's discovery that any periodic or regularly recurring wave of any shape whatever can be shown to be made up of a number of sine waves, one of which has the same frequency as the original or resultant curve. In order to make this point clear it is suggested that a number of sine curves having different frequencies shall be drawn and added together algebraically, the resultant curve being obtained by joining up points resulting from this operation.

In order to add two or more sine curves together algebraically it is necessary to add positive values together and subtract any negative values which may occur at the points selected. If the result is positive the value thus obtained must be plotted above the line. If, on the other hand, the value is negative it must be plotted below the line.

Discussing the causes of irregularly shaped waves, it is pointed out that these may be due to irregularities in speed or non-uniform magnetic fields. These conditions may also be brought about by the nature of the load.

Some excellent guides are given for the purpose of aiding the investigator in making an analysis of an irregularly shaped wave, and it is shown that if the waves are symmetrical both above and below the line the frequencies of the component waves must be an odd multiple of the resultant. But if the curve is non-symmetrical the frequencies of the component waves are even multiples of the original. These component waves of frequencies higher than the fundamental are harmonics, and the case is considered where the notes of two wireless stations are similar in pitch but distinguishable by means of " quality." This phenomenon is brought about by the fact that although the wave representing the note is the same in each case as regards frequency, yet the arrangement of the component waves may be entirely different. The analogy is supplied by the sounding of a given note on the piano and violin. In each case the sound waves have the same frequency, but the component waves which form the resultant wave—*i.e.*, the harmonics—may have an entirely different arrangement.

Sine waves met with in wireless telegraphy are symmetrical, and it is evident that their harmonics must be odd multiples of the fundamental frequency.



Operators' Notes

The Operator at Sea (III.)

By F. B. RUSHWORTH

As regards telegraphy pure and simple, the art of the telegraphist may be divided under three chief headings: Reception, transmission and common sense.

When the ability of a telegraphist is to be decided upon, his skill is noted in, firstly, reception—the ability to record in clear and distinct writing the signals received by the ear and transmitted to the brain; secondly, transmission—to send well-formed characters and properly spaced words; thirdly, common sense and intelligence in the transcription of messages, particularly when such are in plain language, the elimination of obvious errors, by query, and the request for repetition of doubtful words and figures.

The writer is well aware of the conditions at present obtaining in connection with radiotelegraphy at sea, and that, for obvious reasons, the key is never used in these days of war, save by the express order of the Commander. But we shall not have war with us always, and when normal conditions are restored in peace time it is hoped that these notes may prove of some value to the " new man."

Messages in which errors occur are worse than no messages at all. They are a source of irritation, annoyance, and, maybe, loss of money to the sender or addressee, or both, and undoubtedly tend to throw discredit on the service. There is really no reason why an error should ever be passed. An old and true saying is, that *anyone* can learn the code, and be able to " send " Morse characters, but a *telegraphist* is required to interpret badly formed characters and write them down correctly.

A fact not to be lost sight of is that the only useful work done in actual operating is the sending and receiving of traffic correctly, with the minimum of queries and repetitions. All else is wasted energy. In all cases when doubtful words or figures have been queried and repeated, it is the custom to mark such by placing " x " immediately underneath such words to denote that the receiving telegraphist has had the word or figure repeated and confirmed as written. A good plan also is to record the nature of any query made on the telegraph form, turning up the left lower corner for this purpose. By so doing, in the event of subsequent inquiry arising, the form will itself bear evidence of such having been made. In the case of a message in duplicate or for delivery, the notation would, of course, appear only on the top or office copy.

The speed of the sending telegraphist must of necessity be controlled by the capacity of the receiving telegraphist. It is worse than useless to rush a message through in fast bad sending, and have to repeat it several times before an acknowledgment can be obtained for it. A steady rate of sending, with good formation and spacing, will save much time, temper and stationery. The most expert telegraphists have at one time been learners and have gradually excelled through practice.

The junior making his first trip will find a great difference between receiving the buzzer signals he has been accustomed to at school and those heard when first listening to actual ship signals at sea. Doubtless, when putting on the 'phones for the first time on board ship he will be somewhat bewildered, and perhaps a little nervous, at the jumble of signals caused by several stations working at one time. After a little manipulation of both aerial tuning condenser and the inductance he will be able to identify particular calls, gradually losing his nervousness, which will be replaced by a sense of certainty in the reception of signals. He will, so to speak, become *quickened* to the signals, and each watch will find him more receptive.

Always write down what is *actually received*. It is most important that everything received should be copied directly on to the proper form, or recorded in the *procès-verbal* or logbook, as the case may demand.

The latter should be most accurately and carefully kept, as its production may at any time be necessary, not only to verify or confirm the entries made in the wireless logs of other ships, but as evidence in a court of law. When the watch is turned over, the exact time, and the signatures of both operators, must be recorded.

A noticeable common fault of the " first tripper " is failure sufficiently to vary the aerial tuning condenser and aerial tuning inductance. When listening-in it is of vital importance that the condenser should be frequently kept on the move, and that the coupling should not be too loose.

The slightest touch of a condenser will sometimes bring in a sharply tuned station, which may possibly have an important warning to broadcast.

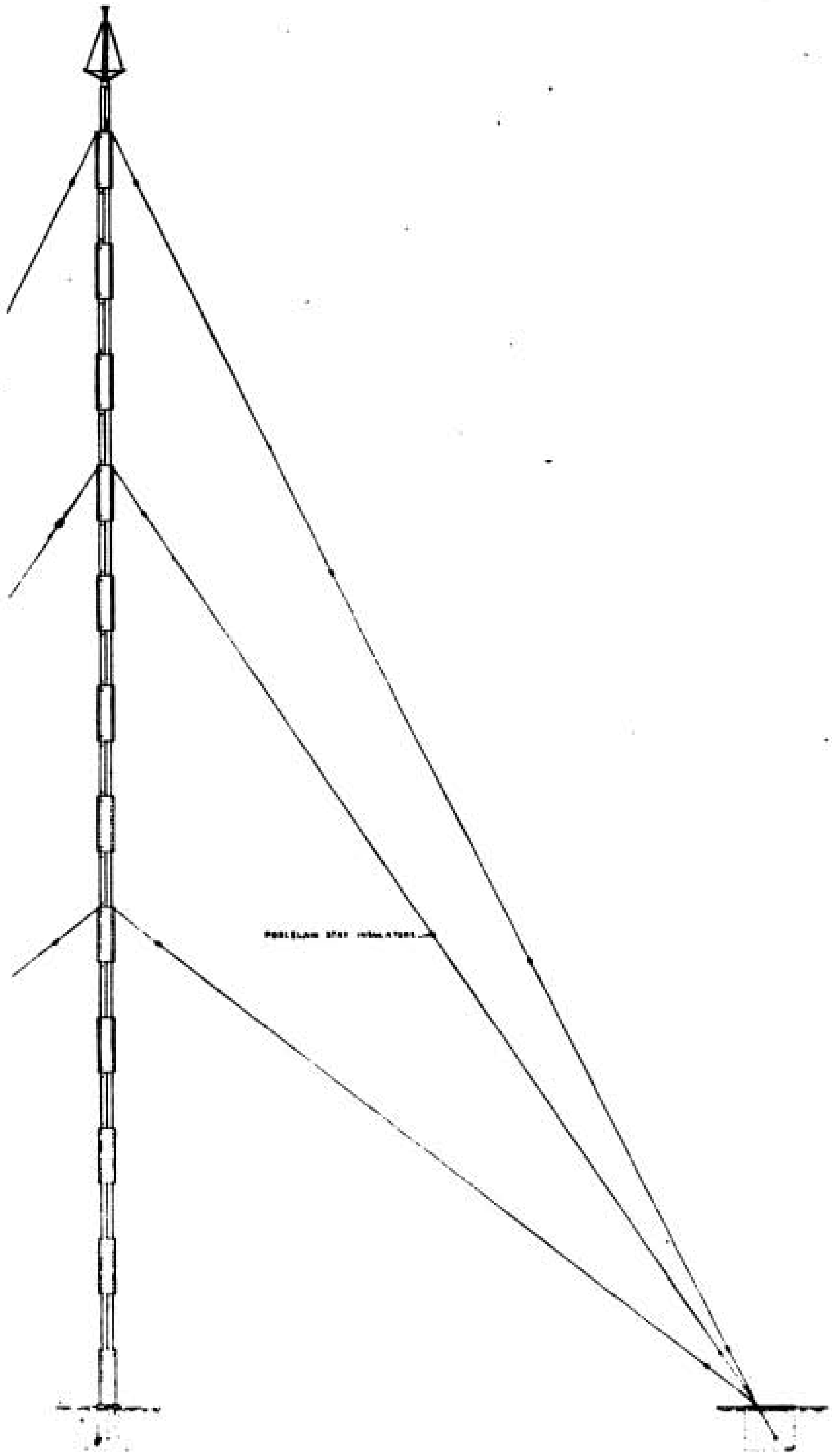
Reading on watch, in these times, is to be deprecated. It is impossible to concentrate one's attention on an absorbing book or magazine and at the same time to be properly on the alert for incoming signals.

The learner is, as a rule, more backward in the art of reception than that of sending. Whilst individual painstaking practice can alone make perfect on the key, very valuable aids to reception have been rendered possible by the invention of the gramophone. Records of telegraphic signals and messages are obtainable, faithfully reproducing almost all conceivable wireless conditions met with at sea. The user can set the speed of the records to suit his present rate and increase it as he improves in reception. Those who have not obtained the proficiency required for the first-class P.M.G. Certificate should bear in mind that there are aids such as these and make profitable use of their spare time on shore.

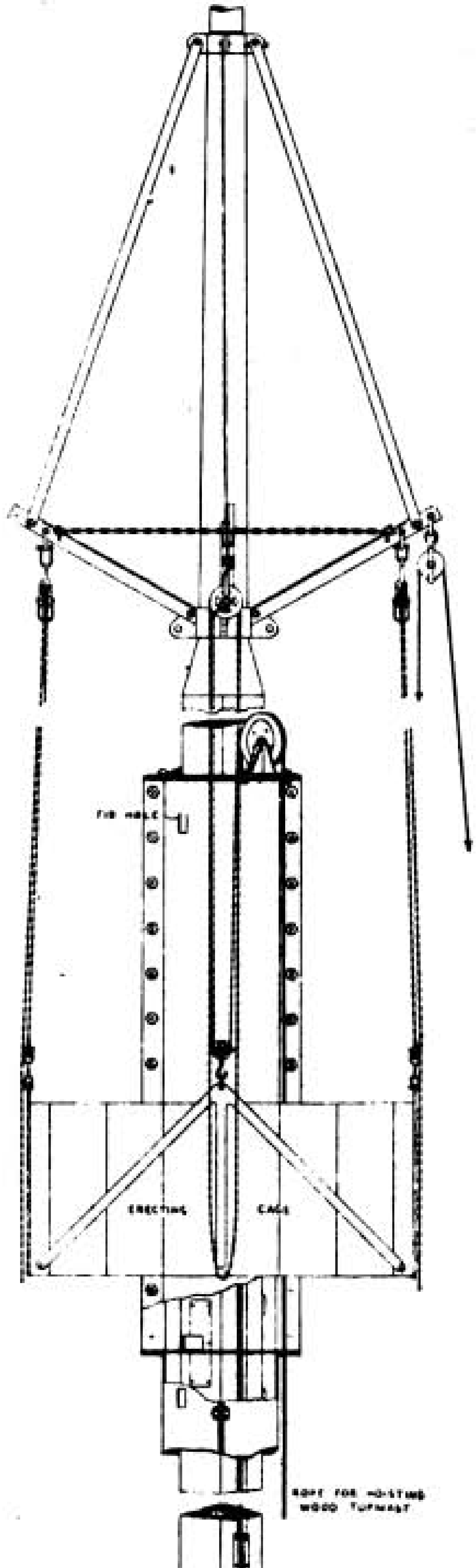
Indifferent handwriting should also receive attention. Nothing looks worse than bad or ambiguous writing on a telegraph form. Like sending, improvement in this art can only be effected by one's own endeavour. Legibility is of primary importance.

An easy, fluent style of caligraphy can be cultivated by holding the pencil in a comfortable position, the hand turned slightly inward, or to the left, with the wrist raised and supported by the third and little finger. With a little practice it will be apparent that good rapid writing, which is half the battle of good reception, can thus, with perseverance, be acquired. Otherwise, if the wrist be not supported in this manner, the writing will be slow and laboured, and the penman will become easily tired. The disease known as " writer's cramp " is caused, nine times out of ten, through ignorance of how to write properly, the result, usually, of lack of sound training in early life.

Sectional Steel Mast.



Elevation



Method of Erection

Avanti !

Italy Promulgates a New Wireless Magazine

UNDER the title of *Le Vie Del Mare e Dell'Aria*, there appeared in the course of July last the first issue of a new Italian wireless magazine, to which we accord a most cordial welcome.

The editor tells us his conception of the task he sets before himself and the objects of the magazine in his opening article headed "The New Struggle." He claims that, in naming his journalistic venture "The Way of Sea and Air," he is doing more than giving a name; he is putting forth an act of faith. He enlarges upon the immense scope for energies, to a large measure latent to-day, which will be given free play on the coming of peace: this magazine purposes to stimulate those energies and to record their achievements. It makes its appeal, says he, in his eloquent Italian manner, to men of good faith, to those who can look across the present booming of cannons and vortex of war, to the wide spaces beyond.

A new photograph of Senatore Marconi, in his naval uniform, fitly occupies the place of honour, faced by an autograph letter signed by the great Italian and reproduced in facsimile. The text thereof—translated from the original Italian—runs as follows :—

> In the summer of 1895, from the lofty mountain of Oropa, whilst contemplating the countryside around Biella, I dreamed of how men might find in space new energies, new resources, and new means of communication.
>
> The free way of Space, open for the transmission of human thought, has ever since exercised an intense fascination for my mind. Therein exist inexhaustible sources of inspiration for labours, always new, which may tend to benefit humanity.
>
> I trust that the sons of Italy, who—in emulation with those of other nations—have at all times displayed exceptional capacities for advancing the progress of civilisation, will rise to new and still more lofty heights in the conquest of the Free Ways of Sea and Air.

The magazine runs to ninety-six pages, of which the first thirty-two are devoted to subjects of general interest, whilst twenty-eight concern themselves with technical articles and fifteen treat of miscellaneous subject-matter. The rest of the pages are filled by current announcements together with personal and literary notes.

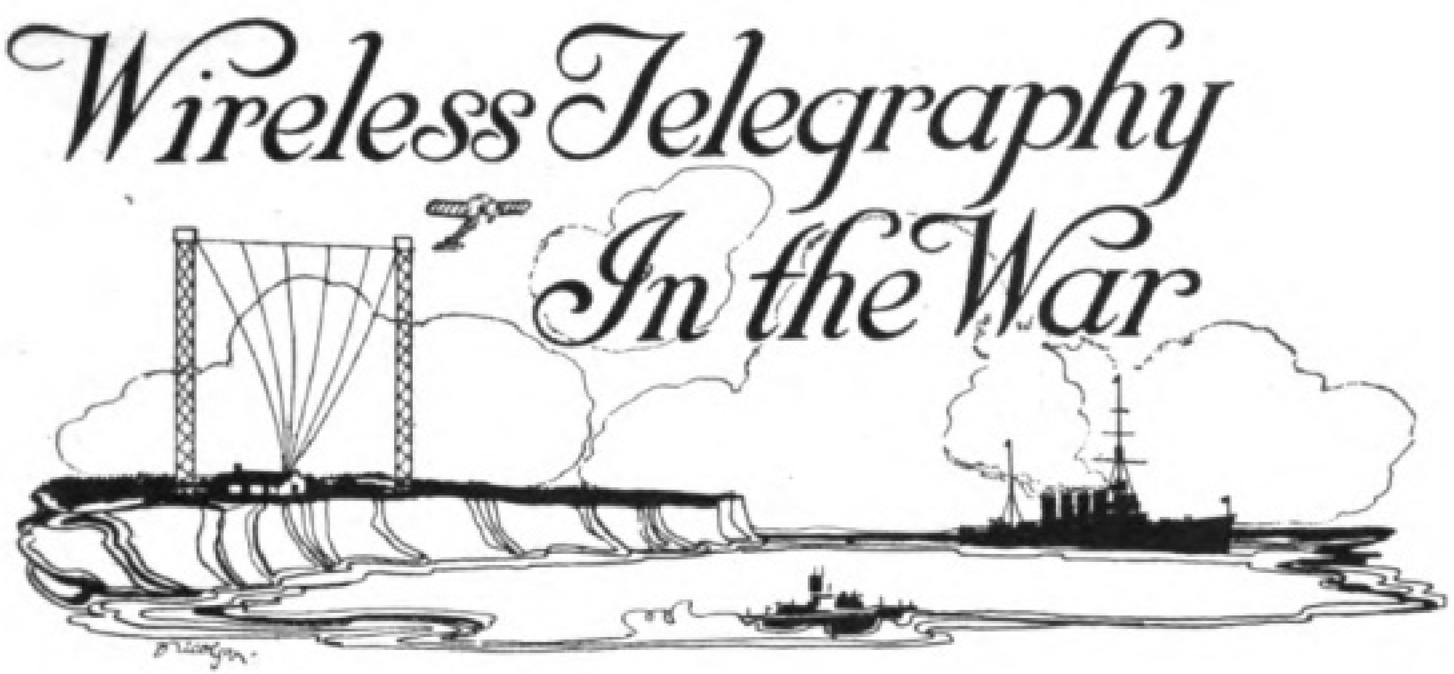
An editorial note at the end of this issue states that answers to correspondents, whose communications are invited, will be dealt with in subsequent issues.

It would be difficult to attempt a detailed critique in the space which we have available. But it is impossible to pass over, without mention, such exceptionally interesting matter as is contained in the article on "Long Distance Radiotelegraphy, wherein the Marquis Luigi Solari records a number of outstanding incidents in the history of this fascinating feature of wireless development.

He deals with the invention of the magnetic detector, and gives an illustration of the first instrument constructed by Marconi. Incidents connected with the reception of long-distance wireless by the Italian admiral, Mirabello, on the *Carlo Alberto* follow; and the illustrations include a reproduction of a radiogram in the handwriting of the admiral himself. We are especially glad to note that there are more of these reminiscences to follow.

Amongst the various contributions included in the technical section, we find Signor A. Guidoni's freely illustrated article on "American Efforts in the Development of Aviation," with a chart showing the distances and probable routes of commercial flying after the war; "Telephony in the Old and New World," by C. J. Giannini, and "Radiotelegraphy at Sea," by G. Lovisetto.

Wireless Telegraphy In the War



Diplomacy by Wireless.

We have recently seen in the daily Press paragraphs containing the text of official communications from the Governments of France and Great Britain addressed to the *de facto* rulers of Russia. This is nothing less than diplomacy by wireless, and marks an altogether new departure in the history of international relations. One of our morning contemporaries points out that, owing to the fact that the cable lines are at present in enemy hands, telegraphic communication with Russia is only possible through the means of wireless. As a matter of fact, ever since the introduction of radiotelegraphy into general use, diplomatic messages, in common with news items and trade communications, have been transmitted through the agency of this modern innovation. Under former conditions, however, such messages have followed the usual channels of diplomatic intercourse, and have been addressed to the foreign representatives of the countries whence the communications come. What constitutes the real novelty is that, under present circumstances, wireless is conveying messages direct from one Government to another. True this new situation is due to the concatenation of a number of circumstances over and above the one above referred to. One important item of causation consists of the fact that the Allied Governments, obliged by their own national interests to refuse official recognition to the Bolshevik authorities, find themselves without not merely the regularly accredited diplomatic representatives but also without the ordinary substitutes for it, who are having their full share of the troubles caused by the present chaotic condition of Russian internal affairs. Nevertheless, whatever the reason, the introduction into diplomacy of this novel procedure remains as an established fact; and the development is not without notable significance, especially when we come to review the line taken up by the Bolsheviks themselves from the moment of their first entry into power.

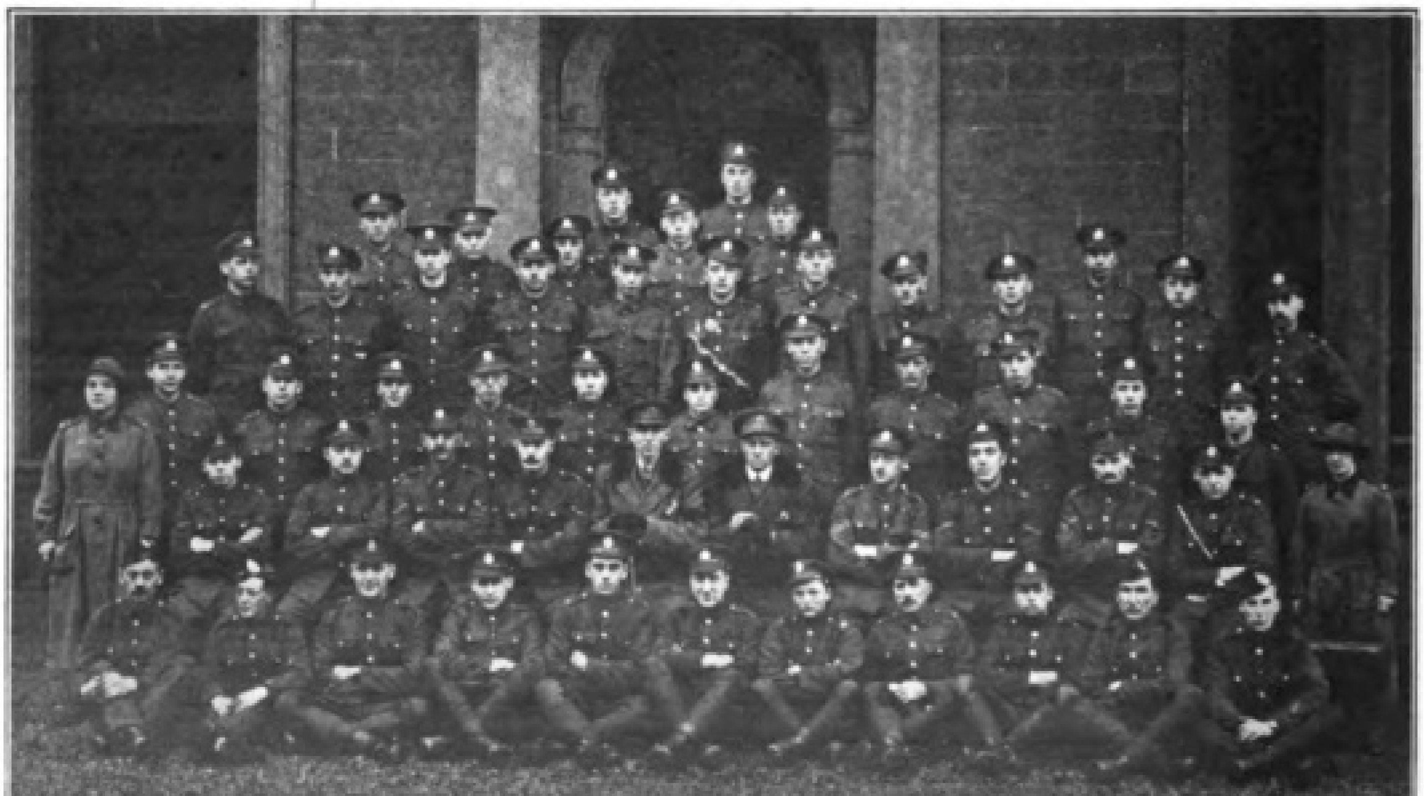
Bolshevik Wireless Policy.

It will be remembered that the original Russian revolutionists initiated their movement for the overthrow of the Czar by capturing the allegiance of the telegraphic services, both wired and wireless, and thus rendering it impossible for supporters of the *ancien régime* to take concerted action. In this case, however, wireless merely shared in a general policy affecting all classes of communication. But the Bolsheviks have gone much further in their attitude towards radiotelegraphy. As soon as they succeeded in seizing the reins of power they deliberately selected this medium for making the first announcement thereof, and our readers will doubtless recall the fact that in November, 1917, they radiated what they were pleased to call "a Formal Offer of Armistice to all Nations involved in the War—to the Allies and also to the Nations at War with us."

They have consistently followed the same procedure ever since. When they desired to change the commander-in-chief of the Russian Army they issued a wireless message "To all Committees of Regiments, Divisions, Corps, Armies; to all the Soldiers of the Revolutionary Army, and to all the Sailors of the Revolutionary Navy," announcing the steps they had taken, the new commander they had appointed, and the reasons for their action. What constituted to all intents and purposes a protest addressed to the Allied Governments for their diplomatic note in relation to the Pact of London was issued in the form of a proclamation radiated from their wireless stations. A similar course has been pursued by them all along: when they desired to indicate their food policy, to convene at Petrograd a general congress of the Russian forces, when they had decided upon a definite date for their armistice, and in fact at every step of any importance which they took. The leaders of the movement professed in set terms to have a horror of "Secret Diplomacy," and Trotzky, who styles himself "People's Commissionary for Foreign Affairs," made a virtue of conducting by wireless telegraphy in plain language every communication that passed between himself and his coadjutors all through his long-spun negotiations with the German representatives. He claimed that thus he was carrying out Bolshevik principles in practice, and conducting negotiations with an "Open Door." It is true that sceptics have pointed to the fact that a large number of the crucial passages in such communications were transmitted in such a way as to be unreadable or incomprehensible; but, whether we grant the sincerity of his attempts or not, the carrying out of diplomacy by wireless still remains a definite and declared policy of the Bolshevik authorities.

RECIPROCITY AND A SUGGESTION.

Such action on the part of the people in power in Russia was not likely to remain long an isolated phenomenon. We accordingly find, early in December, 1917, that Count Czernin, then the Austro-Hungarian Minister for Foreign Affairs,



A WIRELESS SECTION "SOMEWHERE IN ENGLAND."

answered the Bolsheviks' official radiogram by a diplomatic message from his own Government transmitted through the same medium. We now find Mons. Pichon, the French Minister for Foreign Affairs, protesting by wireless against the conduct of the Bolsheviks in imprisoning Allied Consuls, and demanding their immediate release, as well as facilities for enabling them to quit the country. Great Britain, when faced with the murder of Captain Cromie, the British Naval Attaché at Petrograd, resorted to the same medium for conveying their own demand for reparation and threats of reprisals. Circumstances have therefore forced wireless into the position of a regularly accredited medium for diplomatic intercourse, and it is assuredly a significant sign that this should occur simultaneously with openly expressed feelings of repugnance on the part of democratic peoples against the secret agreements at whose doors it is the fashion of the day to place responsibility for many past calamities.

Incidentally it may be remarked that—in view of the increasing reliance upon radiotelegraphy for official as well as other information—it might be not inadvisable for our own Government to institute more active steps in its extension. Take, for instance, the present situation with regard to Russia. To a large extent we are, under present circumstances, precluded, both officially and generally, from letting the Russian people know what we ourselves are doing, and from learning what is actually going on in those vast territories. Now that a British expedition, despatched in aid of Russian patriots, has actually established itself on the Murman coast, it would be quite possible to erect an important station in that friendly territory capable of transmitting and receiving messages from the different centres in Russia and in constant touch with our own authorities in London. The advantages of such an institution are obvious, and we are not aware that the execution thereof presents any insuperable obstacles.

More About Spies and Wireless.

During the course of the debate in the Upper House, when their lordships were discussing the British Nationality and Status of Aliens Bill, the Earl of Meath made what one of our contemporaries characterised as a "sensational statement," when he mentioned that "there had been Germans in our Navy actually working the "wireless on warships during the war until they were discovered."

We cannot help feeling some cynical amusement at such a statement forming any subject of surprise or "thrill." We have to deal with an enemy who prepared, through long years of peace, for a war which he intended to make inevitable. Spy organisation would naturally form part of such preparation—we usually call it "Secret Service," by the way, when we mention our own arrangements. Naturally such an important item as the British Navy would not escape the attention of the foe, and the wireless section thereof must inevitably be one which would (to employ a pregnant gallicism) "jump to the eyes."

Diligent search for such activities would constitute an important item at the start of active operations, and a certain time must necessarily have elapsed before all could be completely eliminated.

The same remark holds good with regard to every form of illicit enemy endeavours to secure information, and we observe in one of our American contemporaries a note concerning the recent discovery of two suspected spying wireless stations recently raided in Chicago. One of these is described as a "powerful affair for "sending, located on top of a large office building inside the Chicago Loop district"; the other appears to have been an installation designed for receiving only, and located on the north side of the city.

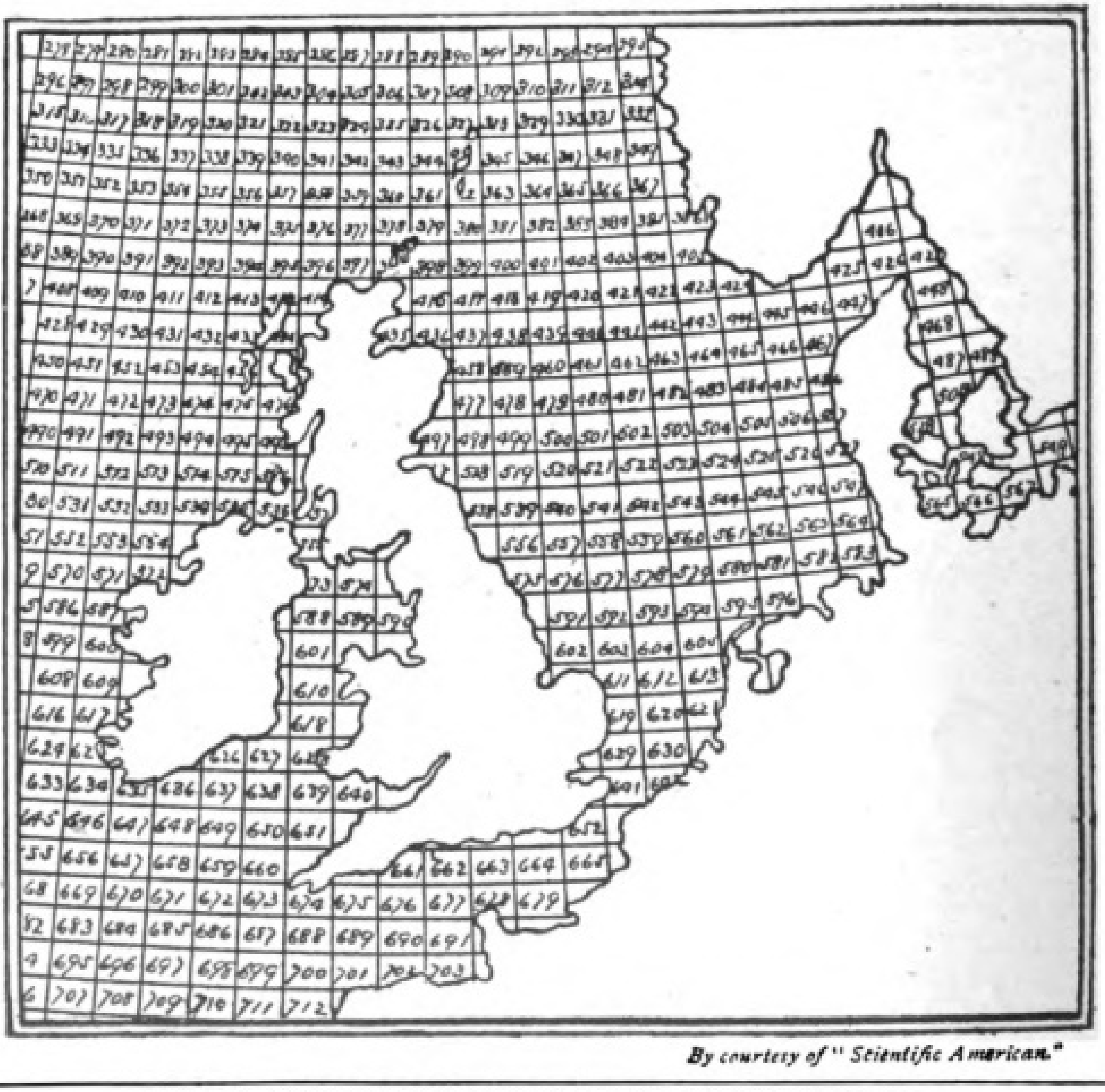
The accompanying map with its numbered squares is a reproduction of part of a German map discovered in Norway, and, lately released for publication by the

French censor, shows how the German navy plotted the North Sea and English Channel for the use of its submarines.*

By the use of a special code, the departure of every vessel, its tonnage, speed, route and whether it was a ship of commerce or of war, was wirelessed to the submarine by spies in certain coast towns of the adjacent waters. Mr. Henry Barby, writing in *L'Illustration*, gives the following translation of this code, and, as will be seen, it is so designed that every message shall seem to refer to some innocent commercial transaction.

The nationality of the vessel is indicated by first, second, third, or fourth quality, meaning in that order, British, German, French, or Russian, while neutral shipping is designated by colours, such as Norwegian, painted black; Swedish, painted blue; Danish, painted red.

The description of the vessels is designated in the following way: Wooden Box, Series 1, means a warship with one smokestack. Series 2, two smokestacks, and so on. Packing case, Series 3, means armoured cruiser, three smokestacks. Metal box, Series 2, 3, or 4, means light cruiser, two, three or four smokestacks. Barrel, Series 2, 3, or 4, means destroyer, two, three, or four smokestacks. Barrel, Series 1, means a torpedo boat, while the submarines are designated as "samples" and mines as "packages." The position of the boat is indicated by the number of the square on the map, thus a wireless reading "First quality packing case, Series 4, "No. 432," translated, is "British armoured cruiser, four smokestacks, in square 432."



By courtesy of "Scientific American."

* We are indebted to ***Flying*** for permission to reproduce this here.

Wireless in Turkey

An Amateur's Experiences

By W. GORDON CAMPBELL

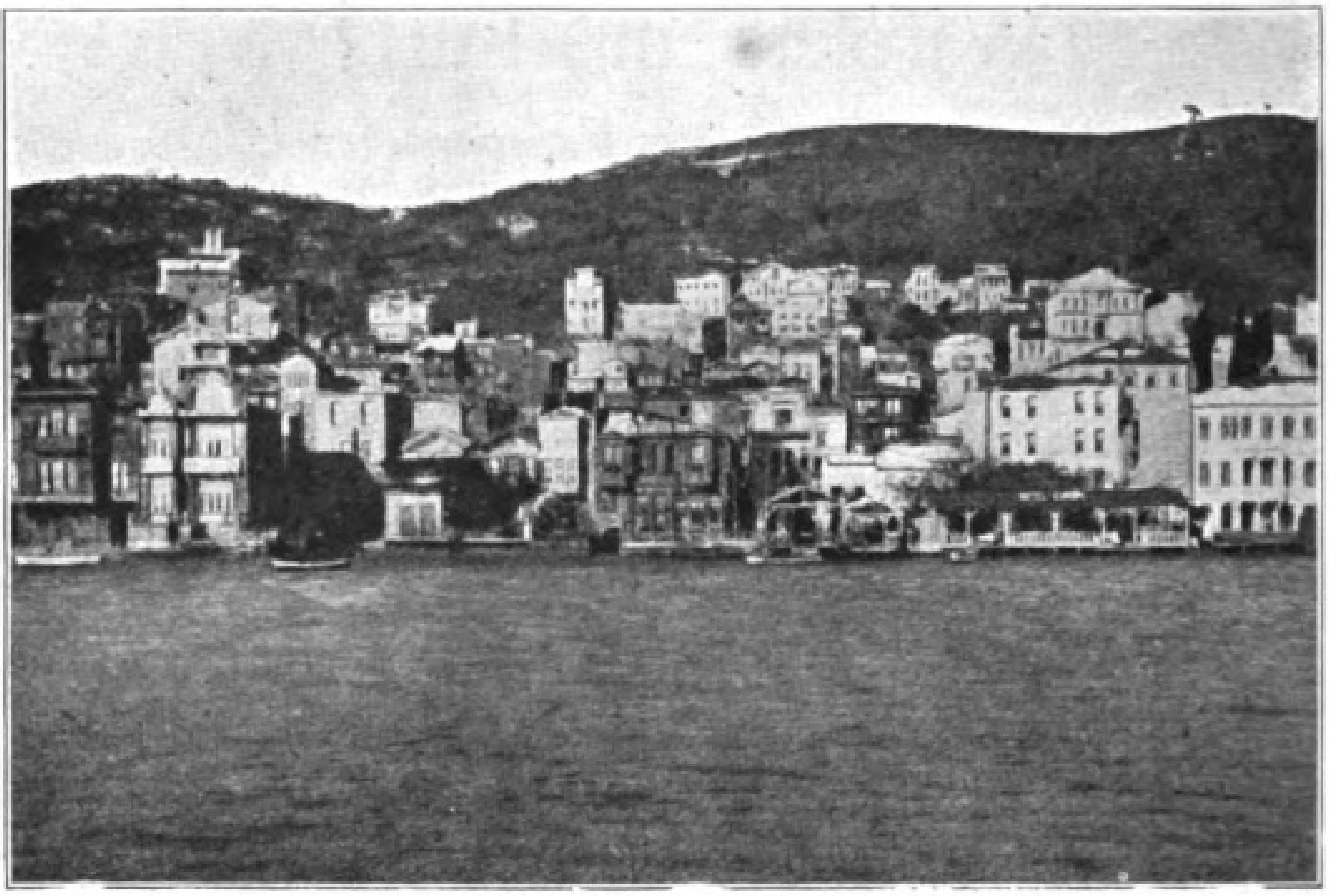
(Continued from page 309 of our September Number.)

WHILE the foreign warships lay at the mouth of the Bosphorus, close to the Sultan's palace of Dolma Baghcheh, they formed an imposing spectacle which greatly impressed the Turks. It was the first occasion since the Russo-Turkish war, when Disraeli sent a British squadron up to protect Constantinople, that the people had an opportunity of seeing such a fleet of powerful modern warships, and the effect upon them was most salutary. They realised that the guns of these ships could soon lay their city in ruins, if thought necessary, and that in the event of any trouble arising the available army of many thousand bluejackets would make short work of any resistance the Turks could then offer. Therefore, in spite of the threats of the fanatical section of the Mohammedans, no attempt was made to molest the Christians.

The warships were open to visitors on certain days, and thousands of the population, even including some Turks, availed themselves of the opportunity of inspecting them. I myself was specially interested in the wireless installations on these ships, and was fortunate enough to obtain permission to see the apparatus on the French, Italian, and Russian warships, as well as on the small American gunboat *Scorpion*. No one is allowed to enter the wireless room on a British warship without special authority, which is rarely given. The reason, I believe, is that in the British Navy they use special apparatus which they desire to keep secret. But on one of the British ships I was given many useful hints by the officer in charge of the wireless, and two British operators afterwards came to see my installation. The news transmitted nightly from Poldhu was regularly taken down and posted up on the ship's notice board early in the morning. The distance between Poldhu and Constantinople is about 2,000 miles in an easterly direction, so that the difference in time is about 2½ hours. The signals sent out from the Cornwall station about midnight were

THERAPIA, A FAMOUS SUMMER RESORT NEAR THE ENTRANCE TO THE BLACK SEA.

C



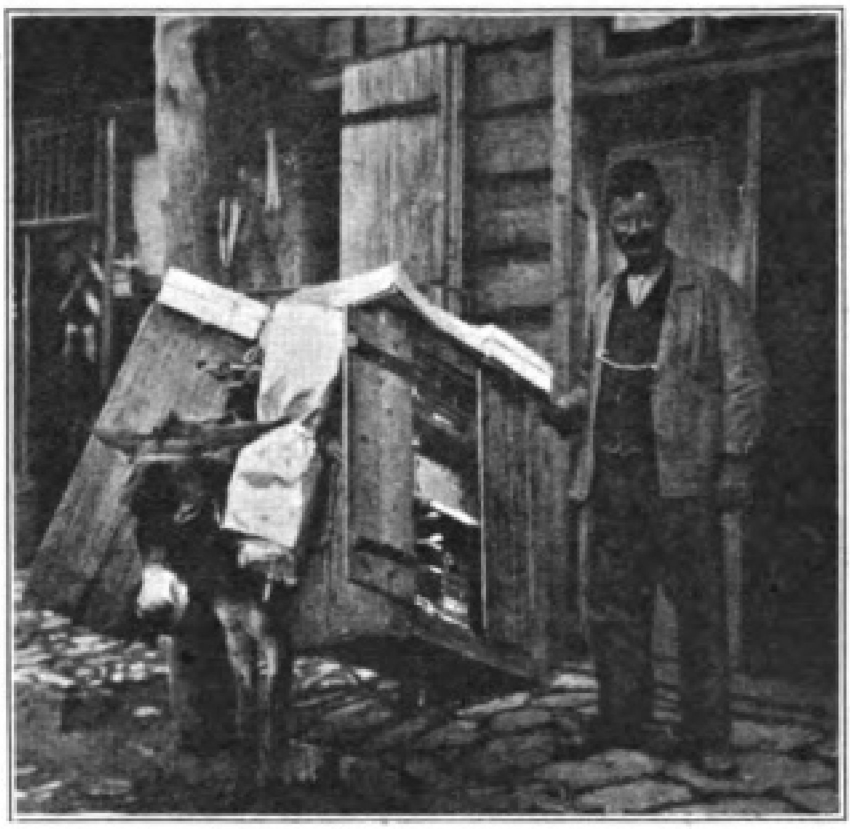
BUYUK-DEREH (*Great Valley*), A CLEFT IN THE HILLS ON THE EUROPEAN SIDE OF THE BOSPHORUS NEAR THERAPIA.

therefore received about 2 a.m. according to local time. The operators informed me that they had no difficulty in hearing the signals over that long distance. On the French *Jules Ferry* I was told, after some hesitation, that I might go into the wireless room for five minutes only; but once there we had a most interesting conversation, and I was pressed to remain as long as I pleased. On this ship they relied mainly on the electrolytic detector, but also used galena. They showed me a large block of this mineral in which they could not find a single sensitive spot. I gave the operator a piece which I happened to have in my pocket, and which, on testing, he found excellent. In return he presented me with one of the platinum "points" or thin glass tubes used in the electrolytic detector, which they themselves had prepared; and I used this with satisfaction for many a day. On the Italian ship *San Marco* the detectors in use were the Marconi "magnetic" and carborundum. The officer in charge here started the transmitting gear for my benefit and sent a few signals. One evening this officer visited my rooms in Pera and examined my installation. On returning to his ship he was good enough to transmit to me a short message. The installation on the Russian ship *Rosdislav* was a very poor one. The spark-gap was fitted over a huge Leyden jar contained in a tall wooden case like a grandfather's clock, and the headgear consisted of only one telephone receiver. On the American gunboat the apparatus was of the Fessenden type.

The harbour of Constantinople is one of the finest in the world, and the first view of the city, as the visitor approaches from the Sea of Marmora, is particularly charming. To the left lies the native quarter of Stambul, with its multitude of picturesque mosques and their delicate minarets. Then directly in front, on the other side of the Golden Horn, lies Galata, the commercial quarter, which is connected with Stambul by a pontoon bridge, as the water is here over 20 fathoms deep, and no other kind of bridge could very well be erected there. Over this bridge there passes a continual stream of people of almost all nationalities, in all kinds of picturesque garb, and if the curious visitor were to stand on this famous bridge for half an hour and listen to the passers-by he might hear between twenty and thirty different languages. Behind Galata the ground rises steeply towards Pera, the European quarter, and is dominated by the old Genoese tower known as the Tower of Galata, from which a magnificent view of the whole city can be obtained. Here men are on watch day and night for outbreaks of fire, which are so destructive where the houses are mainly built of wood. When a fire is observed signals are hoisted on the tower and the "bekjis" or night watchmen go through the main streets as well as the outlying villages shouting, "Yangin var" ("There is a fire"), with particulars of the locality. Farther to the right lies the entrance to the Bosphorus, a deep channel about fifteen miles long and from three-quarters of a mile to two miles wide leading northwards to the Black Sea. The ground rises abruptly on either side, and the succession of marble palaces and other picturesque buildings, some of which overhang the water, that meet the eye at every turn help to create a veritable fairyland of which the eye never tires. The water is so deep close up to the very edge that great steamers may pass within a few yards of the shore; indeed, on one occasion a passing vessel, on which the steering-gear went suddenly wrong, pushed her nose right into a Turkish harem before the engines could be stopped. What a fright the ladies must have got! The declaration of one of the sailors that when the vessel backed out they found a fair odalisque sitting astride the bowsprit is believed to be untrue.

As everyone knows, there is very little tide in the Mediterranean. At Constantinople the water is always at the same level except when a strong south wind, driving it up from the Sea of Marmora, raises it by a foot or so. There is, however, a strong current which usually flows down from the Black Sea, and there is also an

A PRETTY BAY NEAR THERAPIA.



TRAVELLING HABERDASHER IN TURKEY.

undercurrent flowing in the opposite direction. A curious experiment was once carried out here by an English naval officer. He constructed two wooden boxes connected together by a rope, of which one floated on the surface, while the other was weighted so as to catch the undercurrent. On that day the lower current was the stronger, and the Turks were astounded to see the floating box sailing up merrily against the surface current without any visible cause. They decided that the devil must have had a hand in it.

About half-way up the Bosphorus, at its narrowest part, we see, on the European side, the old towers of Rumeli Hissar, built by Mohammed II., after crossing at this point, shortly before he captured Constantinople in 1453 and set up the Crescent in place of the Cross over the famous church of St. Sophia. There is at last a prospect that the Christian emblem may soon be restored. I lived for three years at Rumeli Hissar, high up on the hillside, from which there was a magnificent panorama of the Bosphorus and the continuous procession of ships that passed to and from the Black Sea. Not far from the Black Sea entrance lies Therapia, where most of the Ambassadors pass the summer months, and which is then the centre of fashionable European life. Adjoining Therapia, on the other side of a small inlet, is Buyuk-dereh, shown in the photograph, which is also a favourite summer resort. Across the Bosphorus, directly opposite Therapia, lies the Bay of Beicos, from which a winding and steep road leads up to the summit of Yusha Dagh, or Joshua's Mountain. Here the visitor is shown what purports to be the grave of the Prophet. It is over 30 ft. long, so that we must conclude that there really were giants in those days. This mountain commands the entrance to the Bosphorus from the Black Sea, and from the top a magnificent panorama of the Strait is obtained.

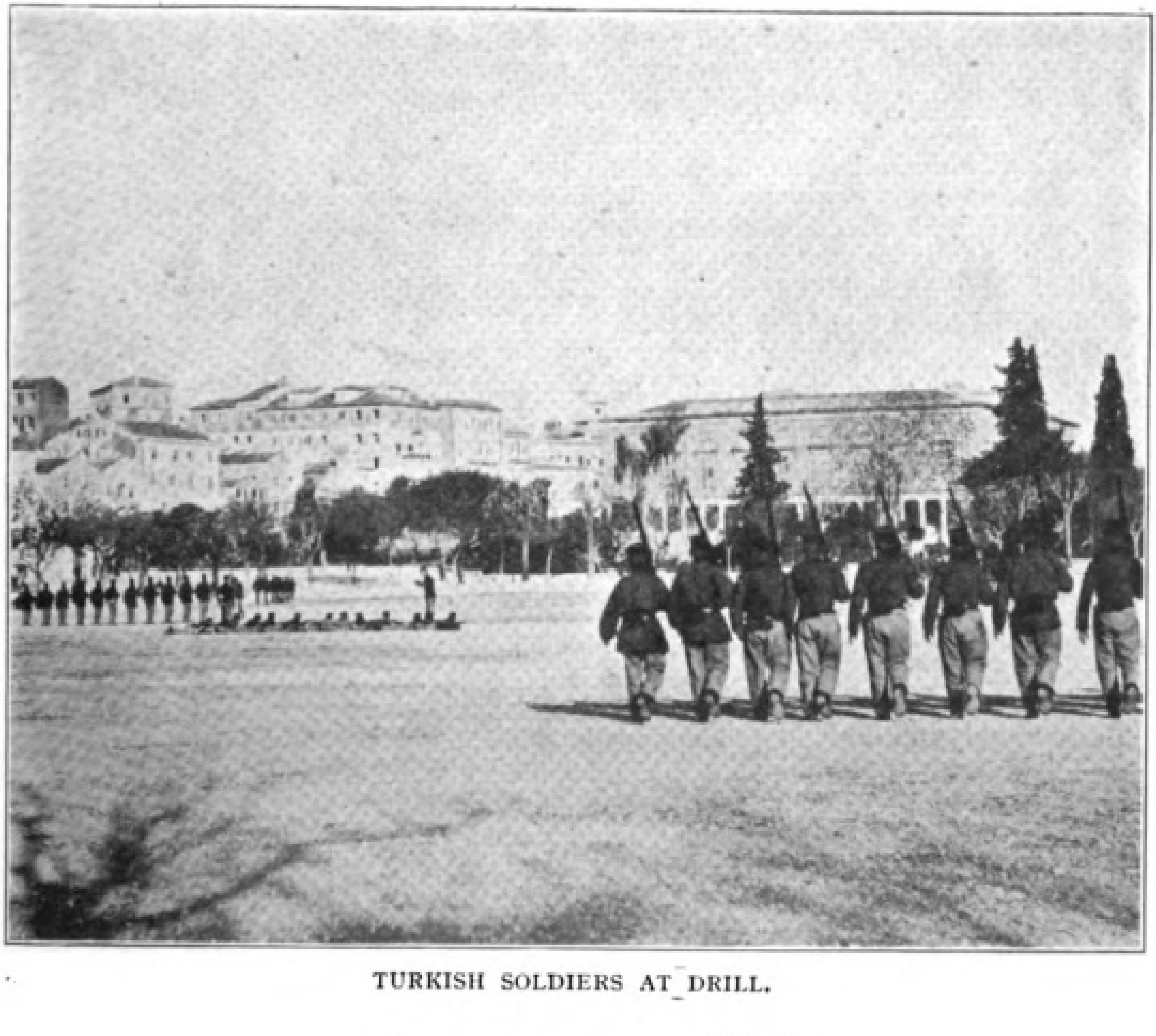
The tomb is surrounded by a railing, on which the devout hang up rags of clothing after repeating a prayer, as a sort of reminder to the Prophet that they seek his favour. A short distance south of Beicos the mother of the recently deposed Khedive used to live, and on the hill behind her residence he erected, a few years ago, a beautiful Kiosk or summer palace, which forms a prominent object on the Asiatic side of the water. During the Khedive's visits to Constantinople his yacht *Mahroussa* used to lie in Beicos Bay, and I often heard the operator speaking in English with Port Said.

When the visitor lands at Constantinople and wanders through the dirty, narrow, and ill-paved streets the charm of the place suffers a good deal. A few years ago one had to pick his way over sleeping dogs, which had a distinct preference for the pavement as a resting-place, but these are nearly all gone now. Their end was indeed sad. When the Turks decided to clear the streets of these animals they transported them to a small rocky island in the Sea of Marmora and arranged with certain men to provide them with food and water ; but these men, after pocketing the money given them, entirely neglected the dogs, which all died of starvation or disease to the number of about 15,000.

A great deal of the trade in fruit and all kinds of small goods is carried on by itinerant vendors, with and without the inevitable donkey, and their voices may be heard everywhere shouting or singing their strange cries in both Turkish and Greek.

It would require a volume, instead of a short magazine article, to give an adequate description of this wonderful city and its surroundings, and I have therefore only indicated a few of the most interesting features.

As soon as Turkey decided to join in the war a " law " was issued prohibiting the use of wireless, and my installation was at once dismantled. I was obliged to hand over my instruments to the police, but for some reason I was still suspected of having secret apparatus, and they made several unexpected visits to my rooms. Meantime several persons had been arrested on mere suspicion, or because a child in the house had some electrical toy. The police knew nothing about wireless, and assumed that any toy apparatus could be used to " communicate with the enemy " outside the Dardanelles. My own position having become decidedly dangerous, I resolved to leave Turkey if I could, as many British subjects had already done, and with some difficulty I was eventually able to cross the frontier into Bulgaria. I was, however, obliged to abandon most of my belongings. It was well that I did so, as I subsequently learned that a few hours after my departure the police had again visited my rooms; but on seeing my books and papers lying about as usual they little suspected that I was then *en route* for Dedeagatch, where I duly arrived with a crowd of other fugitives. From that port I proceeded a few days later to Piræus and Athens.



TURKISH SOLDIERS AT DRILL.

Maritime Wireless Telegraphy

Wireless Fighting the Submarine Menace.

To under-rate *any* enemy effort constitutes one of the most prolific sources of disaster in waging war. Our German foes have erred in this way many a time and oft; perhaps never more conspicuously than in the spring and summer campaign of the present year.

The anxious times through which the British authorities passed during the height of the U-boat menace arose very largely from the same cause. In its initial stages, German submarine warfare was treated as a side-show, troublesome at intervals, but not of paramount importance. So soon as the problem was tackled in earnest, British ingenuity and intrepidity speedily manifested its superiority. At the same time, it can never be too persistently emphasised that there is no panacea for the pest; the evil is being remedied solely by the consistent and ceaseless application of *all* the various means at our disposal. Wireless plays a prominent part amongst these antiseptic agencies, a fact which is well brought out by the following recently released story of aerial activities.

* * * * * * *

The commander of a British airship received orders to relieve a sister vessel watching over a "suspected area." So soon as he found himself in the air, he started attempting to locate his consort's position by means of wireless, and speedily effected his object, with the result that the earlier watcher returned to her base. After a period of uneventful watching, the look-out spotted a German craft lying "doggo" on the bed of the ocean. Wireless immediately came into action again; and, summoned by the ether waves, a lithe destroyer put in her appearance, bringing in her train four squat armed trawlers. The gun-crew of the destroyer, guided by wireless instructions, trained their guns in readiness to greet the foe should he rise.

In the meantime, the trawlers reached the scene and set to work in their own way. Organised in pairs they approached their prospective victim from opposite directions, steaming towards each other. Between each pair stretched a strong "sweep" allowed to hang in a huge loop so that it might traverse the sea bed. In due course each pair succeeded simultaneously in entangling the U-boat; one loop holding her forward and one aft. Thus she was, as it were, "rocked" in a gigantic "Cradle of the Deep"!

So far the German underwater craft had shown no signs of alarm; but now—immeshed in the tentacles of her foe—she writhed to and fro, making frantic but useless endeavours to escape. At length, realising her helplessness, she ceased to struggle. The watchers on the airship, observing her quiescence, duly wirelessed the fact to the destroyer below. The British commander paused for a few minutes to give the U-boat commander an opportunity of rising to the surface to surrender. This opportunity was not taken; and in response to a flagged signal from the destroyer, the starboard foremost trawler, and the port one aft, each attached a tin of high explosive to their respective "cradle wires," sliding the mine downwards until it rested on the pirate's hull. Again a signal from the airship, and the two firing keys were pressed. A greyish mound of water rose; and, when the troubled ocean calmed again, nothing of the submarine was to be seen save an extensive patch of oil floating upon the surface of the water.

* * * * * *

The same tale of wireless at every turn is told in all the yarns which concerned themselves with the hunting of German sharks, unless the narrator be so *blasé* to its services as simply to take them for granted. For instance, one British correspondent, describing his voyage on a French destroyer, carrying the Admiral in command of the local operations, has nothing to say about radiotelegraphy until a point in his story when he comes to describe how the French commander accounted for lack of luck by showing him a wireless message from a sister boat which claimed to have "put down" a German submarine thirty miles away. The Admiral's staff on the French destroyer remained a little sceptical of the claim, and the second-in-command made the following remark:—

"They often claim that they have done for the submarine; but it is our staff's "job to be healthily sceptical. That wireless about the German craft thirty miles "away came to us and to every other warship on this beat. Such radio messages "arrive very frequently, much more so probably than the German submarines "imagine. The methods of detection by wireless now in use are much improved "and very accurate."

A FRENCH WIRELESS OPERATOR AT THE DOOR OF HIS CABIN.

Notes of the Month

A Wireless Alibi.

Lovers of Dickens will recollect how Sam Weller's father advised Mr. Pickwick, when the latter was preparing his defence against Mrs. Bardell's action for breach of promise, to "Try 'em vith a halibi." This traditional method of defence was, according to the *Montreal Herald*, recently utilised with great effect in favour of a certain Mandal Moosa, a Hindu magnetic doctor, charged with a theft of jewellery. The defendant pleaded an alibi which Judge Leet considered important enough to warrant investigation by wireless. Messages were accordingly radiated to and from a vessel on the high seas which established to the judge's satisfaction that the ship's log registered Moosa's presence on board at the time when the complainant averred him to have been in her house. The alibi thus "made good" sufficed to give the accused the benefit of the doubt, and—for the first time in the Montreal Courts—a prisoner was set at liberty through the intervention of wireless.

Board of Trade Announcement.

No little satisfaction has been given by the following announcement recently issued from the Board of Trade :—

> The King has approved of a special medal being granted to Masters, Officers and seamen of the Mercantile Marine for services performed in the danger zone during the war. The medal will be issued at the end of the war, and clasps will be awarded where conspicuous service has been rendered.
>
> His Majesty has also approved a standard uniform for the Mercantile Marine, and an Order in Council on this subject will be issued shortly.

Particulars concerning the National Standard Uniform for the British Mercantile Marine are given in the *London Gazette*, dated September 6th, page 10,533, and we find Wireless Operators included amongst those specifically named as entitled to wear the insignia, which are forbidden to those not qualified.

The First Wireless Operator is entitled to a distinctive badge of two waved lines with a diamond ; the Second Operator to the same without a diamond, and the Third Operator to a single waved line. These lines may be in ¼-in. gold Russian braid or in plain black braid. The space between each row of lace, mohair, or braid, is to be ½ in. except in cases where there are two rows only, in which case the space between them is to be 1½ ins. The one diamond borne by First Wireless Operators is to be of ¼-in. gold Russian braid (or block braid) with open centre and an outside measurement (angle to angle) of 1½-ins. imposed on the distinction lace.

Dignity and Impudence.

Castilian dignity is proverbial, and the present writer has had many opportunities of admiring it. A series of curious contrasts has been afforded during the present war by the conduct of the German Government *vis-à-vis* with Spain. Only the other day one of the most prominent of German newspapers, the *Koelnische Zeitung*, was taking King Alphonso's Ministers to task for threatening to seize German ships, and characterised such an act as "one of gross violation of neutrality." Yet all the time Germany claims that she may sink Spanish ships with impunity ! For downright and unmitigated impudence, however, we think that the wireless message sent by the Teutons to the new Spanish Minister, Señor Lopez de Vega, when *en route* to take up his official duties in Athens, would be hard to beat. His Excellency received at dinner a wireless message announcing that Austro-German submarines would sink the vessel he was travelling by, but would take precautions for his personal safety !

On Valve Characteristic Curves and their Application in Radiotelegraphy

By J. SCOTT-TAGGART, R.E.

II.

NOTE.—*The first instalment of this article appeared in our September issue, p.312 et seq.*

FIG. 5 shows the original curve, and also a similarly placed but larger curve obtained by correctly balancing suitable values of filament current and high-tension voltage.

From the above we see that, by judicious adjustment of filament current and high-tension voltage, we can vary the nature of the characteristic curve and arrange to have it completely to the left of the zero ordinate, almost completely to the right, or at any intermediate position. We have also seen that once we have obtained the desired curve by means of these adjustments, no matter what its position or height, we can use the valve at any point on that curve by adjusting the normal grid voltage to the necessary value. Thus, if we desired to work the valve at saturation point, and we have 3½ volts across the filament and 6 volts on the plate, we would have to give the grid a normal positive potential of + 11 volts. If, on the other hand, we have 154 volts on the plate, we would require a negative potential of −7 volts on the grid to make the valve function near its saturation point.

Let us now examine the curves with a view to finding out what curve, and what point on it, is the most suitable when we desire to use the valve as an amplifier.

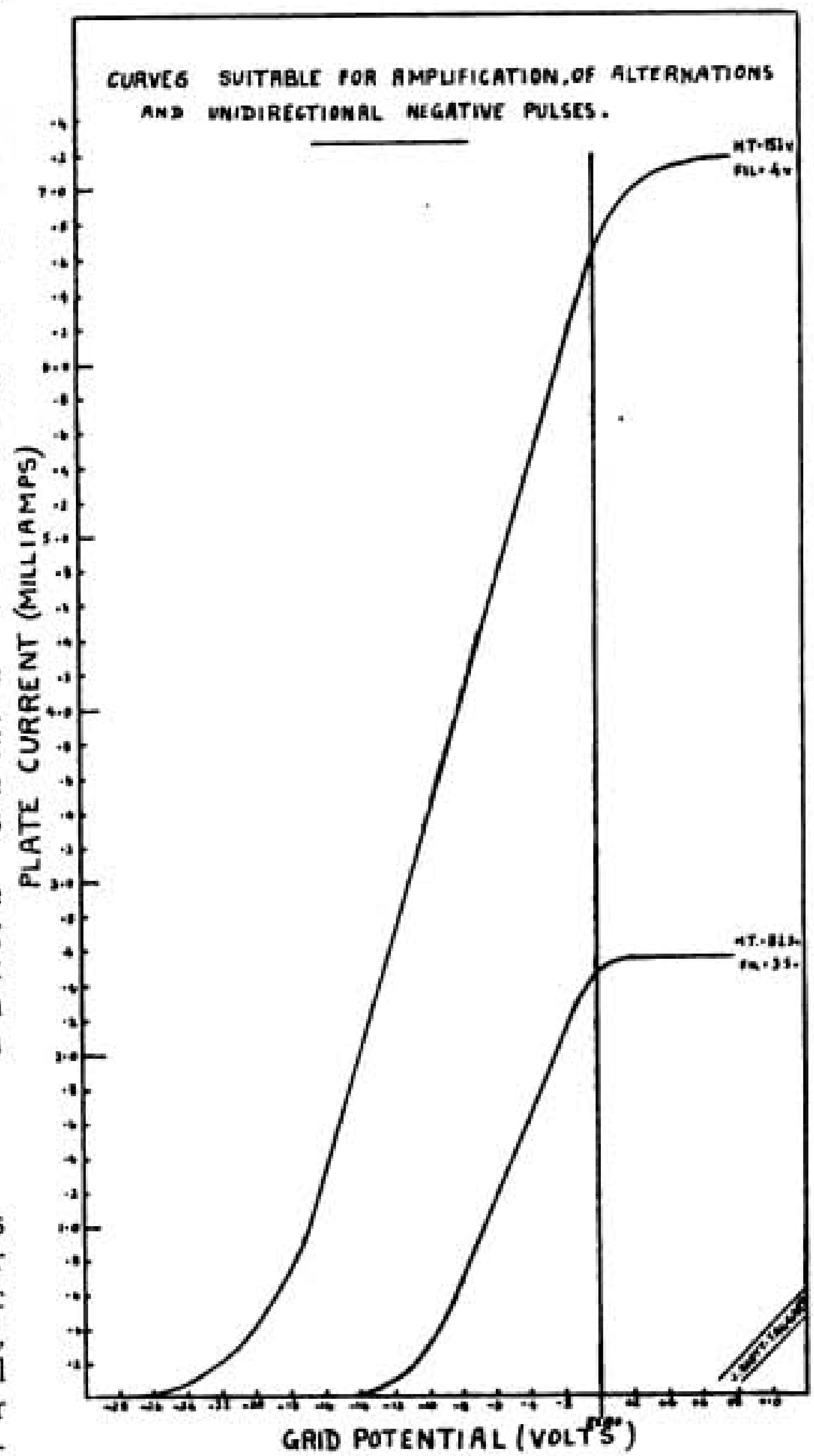


FIG. 5.

AMPLIFICATION.

The valve may be used as an amplifier of alternating or oscillating currents, microphonic currents produced by speech, or intermittent unidirectional pulses. The circuits used for these purposes have been described by the writer in previous papers ;* it is now proposed to look more closely into the question of amplification from a quantitative as well as qualitative standpoint.

Fig. 6 shows a suitable circuit for low-frequency amplification. The potentiometer *P* enables us to give the grid a normal potential on either side of zero. The voltage of the original alternating current is stepped up by means of the transformer *T* before influencing the grid, its final value, let us suppose, ranging from + 3 volts to − 3 volts.

FIG. 6.

Let us also suppose that we are using our valve under conditions that give a characteristic curve similar to the *E* curve of Fig. 3. This curve is obtained by placing 3½ volts across the filament and 33·5 volts on the plate.

If we keep the grid voltage zero, the negative half of each alternation will cause the grid voltage gradually to drop to − 3 volts, and then to return to its normal potential. As the positive voltage builds up on the grid—due to the positive half of each alternation—a grid current will be set up, since the grid is at a higher potential than a portion of the filament. This flow of negative electrons will tend to neutralise the positive charge that the positive half-cycle is trying to place the grid. In other words, the grid current prevents to a certain extent the rise of grid potential, just as the E.M.F. of a cell drops on completing the outer circuit. The result is that the positive half-cycle causes only a slight increase in the plate current, while the negative half produces a drop of about ·8 milliamp.

By using the grid at zero voltage we have produced alternations in the plate circuit of a different nature to the original alternations. We have, in fact, rectified the latter to a certain extent. Since we are trying to reproduce faithfully our original current variations, this rectification effect due to a grid current is a very decided disadvantage. Moreover, it will exist in all cases where there is a tendency towards the establishment of a grid current. If we use a higher value of high-tension voltage, the grid current for 3 volts on the grid is less than before, and the rectification effect is not so marked. It will always exist, however, whenever the grid potential tends to acquire a positive value.

In order, then, to avoid a grid current we must never allow the grid voltage to become positive. If, therefore, we give the grid an initial potential of − 4 volts by means of the potentiometer, the alternating current will vary the grid voltage between − 1 volt and − 7 volts. Although we now get no complications due to a grid current, by continuing to use the same curve we are still at an unsuitable point for amplification. We are using the bottom bend of the characteristic curve, and, therefore, the increase in the plate current due to the positive half of an alternation or oscillation will be greater than the decrease produced by the negative half. In our special case the increase will be ·45 milliamp, and the decrease ·1 milliamp. We, therefore, still have undesired rectification effects. If we increase the high-tension voltage to 100 volts we will be using a new curve, but this time the − 4 volts on the grid brings us to the *upper* bend of the curve, near saturation point. At this point the positive half-cycle produces practically no increase in the plate current, while the negative half-cycle causes a very considerable drop. This time the 3 volts bring the grid voltage to − 1 volt, but the plate current is only increased from 2·27 milliamps to 2·58 milliamps, while − 3 volts added to the existing − 4 volts on the grid cause the plate current to drop from 2·27 milliamps to 1·6 milliamp.

It is, therefore, important that we should avoid either of these bends. In fact,

* *Vide* WIRELESS WORLD, January, February March, 1918.

if we wish to reproduce current variations with absolute accuracy, it is essential to use straight portions of the characteristic curve. The *steep*, straight portion is obviously the part to use since we get big current variations in the plate circuit for small grid voltage changes. Even if the ordinate passing through the normal negative grid voltage cuts a bend in the characteristic curve, the valve will reproduce fairly accurately current variations *of very small voltage*, but the amplification obtained is small.

From the above it is apparent that, to avoid rectification effects and to obtain the maximum amplification, we must use the steep, straight portion of a curve. We could use the 82·5 volt curve and, by putting a normal voltage of −5 volts on the grid, use it approximately at its half-way point. Equal positive and negative voltages will now cause equal increases and decreases of plate current, and all current variations in the grid circuit will be reproduced on a larger scale without distortion in the plate circuit. Fig. 7 shows the effect of a complete cycle of alternating current of 3 volts amplitude in the grid circuit on the current in the plate circuit, which is shown by a dotted line. Fig. 8 shows us the same results in a different form.

It will be seen from a study of the 82·5 volt curve under discussion that if we use a stronger alternating current in the grid circuit than the one we have so far considered, not only will we be using both bends of the curve, and so produce distortion in our plate-circuit alternations, but we will not be getting the fullest amplification possible with the valve.

Let us suppose that the alternations in the grid circuit have an E.M.F. varying from −8 volts to +8 volts. By giving the grid a normal potential of −5 volts we will vary its voltage between −13 and just under +3 volts. The effects of this on the plate current is shown in Fig. 9, which shows us the distortion effects, and also shows that the amplified alternations are of not much greater amplitude than those produced by the 3 volt alternations.

From this we see that for a given characteristic curve, or, more simply, for a given value of filament current and high-tension voltage, the maximum amplification obtainable is limited, and is achieved when the varying grid vol-

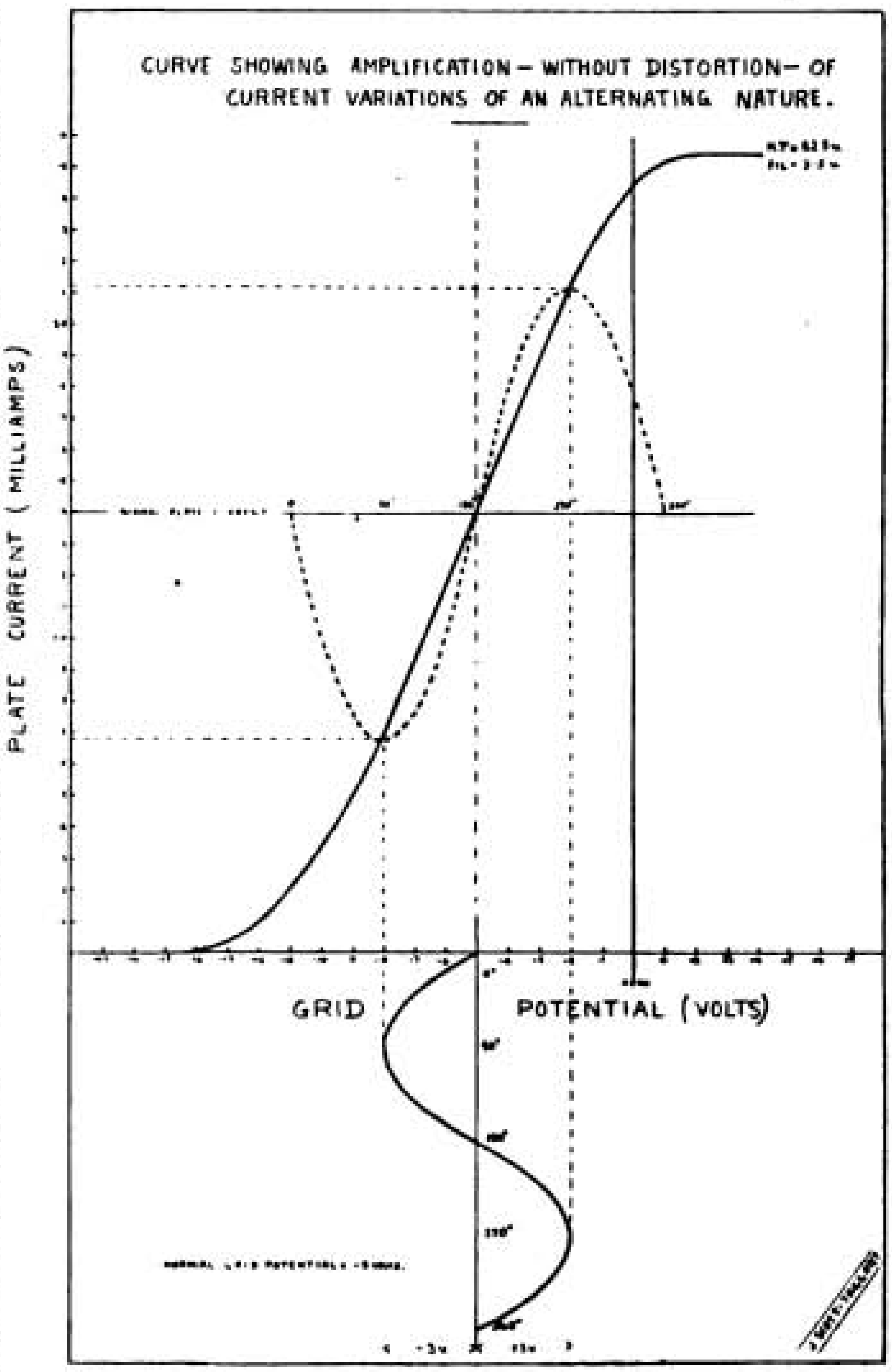


FIG. 7.

tage varies the plate current between zero and its saturation value.

For strong alternations or signals, it is, therefore, desirable to extend the curve vertically. This, we have shown, can be done by increasing the filament current and high-tension voltage. We still, of course, keep the whole of the straight portion of the curve to the left of the grid zero ordinate. Fig. 7 shows the original 82·5 volt curve—which was only suitable for alternations or oscillations not exceeding 3 volts amplitude, and also a higher curve suitable for amplifying stronger current variations. This curve will do justice to our 8 volt alternations, and no distortion effects will be produced. It will, however, be necessary to give the grid a normal voltage of −8 volts in order to use the curve at its half-way point.

Although it is not absolutely necessary to use the valve near the mid-way point along its curve, this is generally done when amplifying alternating, oscillating or microphonic currents. If the current variations are not too strong, we may use practically any point on the straight portion of the curve as our normal adjustment. The point *B* on the 82·5 volt curve (Fig. 3), obtained by using a normal grid voltage of −9 volts, would be quite suitable when amplifying currents which varied the grid potential 1 volt to either side of its normal value. On the other hand, it would be quite unsuitable for amplifying currents which would increase and decrease the grid voltage by 3 volts.

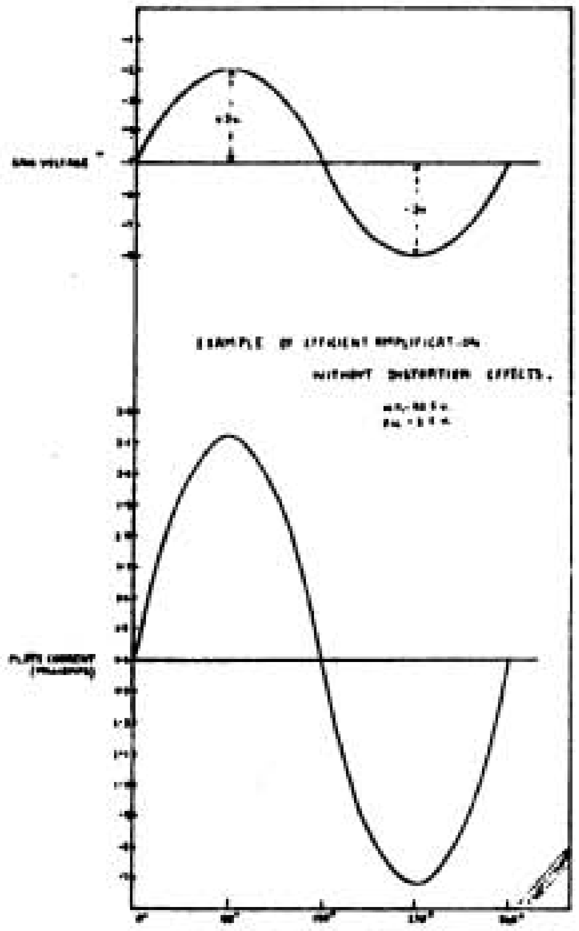


FIG. 8.

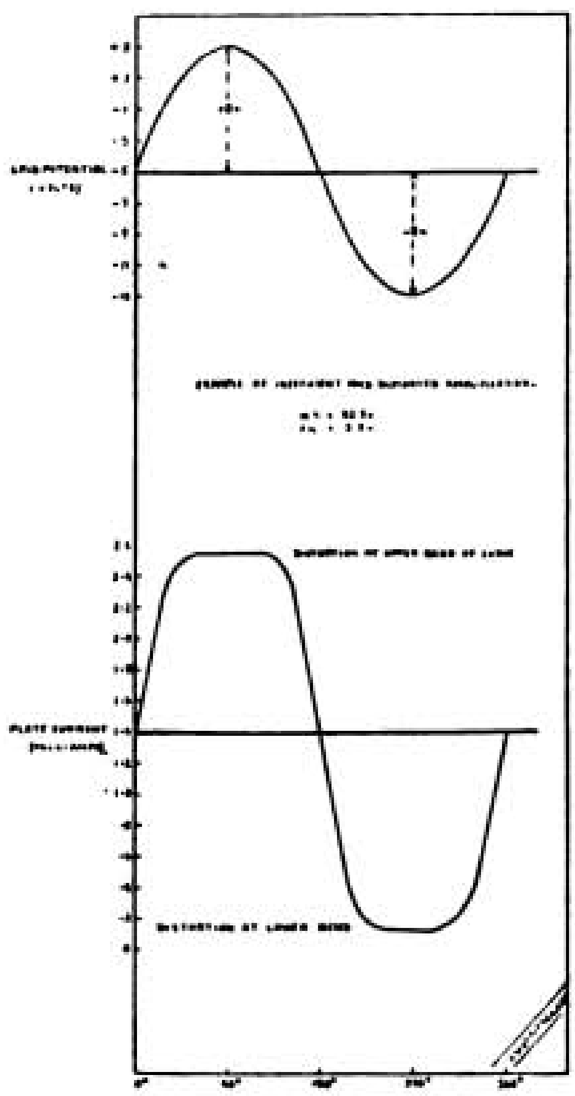


FIG. 9.

Thus we see that our choice of the most efficient curve and the most efficient point on that curve is dependent very largely on the *strength* of the alternations, oscillations or microphonic currents which are to influence the grid.

The amplification of unidirectional pulses, such as are obtained from a rectifying detector, is a much simpler matter. Since the current flow is always in the same direction we can arrange matters so that the grid always receives a negative charge at each pulse. Since there will never be a grid current, it is unnecessary to have an initial negative voltage on the grid; we can keep the grid at zero voltage and dispense with the potentiometer. As regards curves, we can use most of those given in Fig. 3, the choice depending upon the strength of the pulses on the grid. The 6 volt curve, however, is inefficient, partly because it would be unsuitable for any but very weak pulses, and partly because even then the current changes in the plate circuit would be very small, the curve gradient at this point not being steep.

The 33·5 volt curve is capable of dealing efficiently with stronger pulses which would cause the grid potential to drop to values as low as −3 volts. For still stronger pulses the 82·5 volt curve would be suitable. For pulses which would cause the potential of the grid to drop 12 volts but not more, the 100 volt curve could be used. Curves such as the 154 volt curve are practically useless for amplification, since it would take the first 12 volts on the grid to round the saturation bend and produce a drop in plate current of only 0·6 milliamp. None of the curves of Fig. 3 would, therefore, be suitable for amplifying very strong pulses. The large curve of Fig. 5, however, would be very suitable. This curve is obtained by 152 volts on the plate and 4 volts across the filament. This curve would be suitable for *any* grid voltages down to −18 volts, which value would produce a drop in plate current of about 6 milliamps.

If, by mistake, we connected the amplifying valve or valves so that the pulses gave the grid a positive value, we would have to adjust the high-tension voltage and the filament current so that a considerable portion of the curve would be to the right of the grid zero ordinate. The 12 volt curve of Fig. 3 would be suitable. Such an arrangement might be considered economical, since the plate current is normally very small when signals are not being received. However, the amplification obtained is not as great as that given by the reverse connections, for two reasons closely allied. In the first place, the "straight" portions of curves become less steep to the right of the grid zero ordinate, owing to a certain proportion of electrons passing to the grid; secondly, this grid current prevents the potential of the grid reaching its full positive value.

When connecting up an amplifying valve or multi-valve amplifier, the reverse connections to grid and filament should, therefore, also be tried, and the optimum signal strengths obtained in each case noted and compared.

It will have been noticed that when we are dealing with unidirectional pulses it is not necessary to make the valve function near its midway point.

In fact, if we do this, we will be using a curve twice as high as is necessary, and half the curve will never be used. This means that we are needlessly wasting current from the lighting accumulators, and perhaps from the high-tension battery. If the grid is connected so as always to receive pulses which give it a negative charge, a curve of half the height may be used, provided we use it at the upper end of its straight portion. Such a curve is the "D" curve of Fig. 4. This arrangement is almost as efficient and far more economical than using a higher curve like the "C" curve of Fig. 4. Similarly, when we arrange for the grid always to receive positive pulses, we should, for reasons of economy, use the bottom part of the steep, straight portion of the curve. The 12 volt curve of Fig. 3 would be suitable.

For a valve to be efficient as an amplifier of any type of current variations its characteristic curve should, along its straight portion, be as steep as possible. It is important to notice that for a given valve the portions of the curves *used*—namely, the steep, straight portions of curves lying mostly or altogether to the left of the grid zero ordinate—have all approximately the same gradient. The 100 volt curve of Fig. 3 is not quite as steep as the 54 volt curve, but the variations of gradient are never considerable. If anything, the higher curves obtained by large values of filament current and high-tension voltage are the steepest.

Different types of valves, however, vary considerably in the gradient of their curves, and, therefore, in their value as amplifiers. Fig. 10 shows a comparison of the curves of two types of valves, the one having a steeper curve than the other.

Before passing on to a consideration of valve rectification and transmission, let us summarise some of the points already dealt with above.

Different combinations of filament current and high-tension voltage give us curves of different sizes and positions. The position of the point of intersection

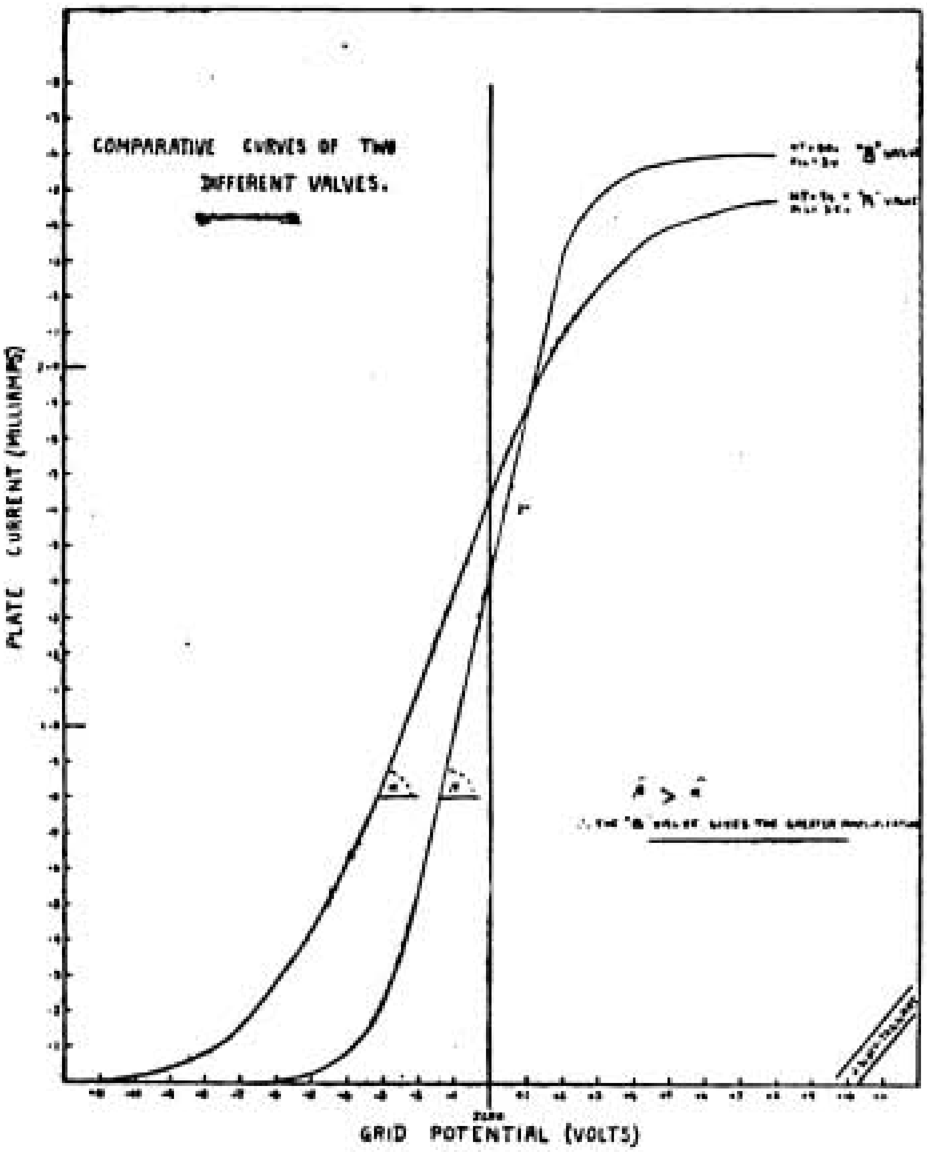


FIG. 10.

where the curve is cut by the vertical line passing through zero grid volts, and which has been termed the grid zero ordinate, is of the utmost importance. For general amplifier work this line should cut the curve just below the saturation bend. The workable portion—the straight part—is then entirely to the left of the vertical line, and no rectification effects are obtained through the establishment of a grid current.

Even more important than the curve's position relative to the zero ordinate is the point at which we work the valve—that is to say, the part of the curve cut by the vertical line passing through the normal potential of the grid, which may be given any value. To find the value of this normal grid voltage most suitable for amplifying currents of an alternating nature we have only to drop a perpendicular line from the midway point along the straight portion of our curve on to the grid voltage abscissa. This negative value may be given the grid by means of a potentiometer included in the grid circuit, no matter whether the grid circuit has in it the secondary of a step-up transformer or an inductance coil. Where a certain amount of distortion in the amplified current variations is not of consequence we can keep the grid at zero voltage by simply connecting it through the transformer or inductance coil to the negative end of the filament. In this case we would arrange the curve so that the grid zero ordinate would cut it at its half-way point. When speech, however, is to be amplified, it is of great importance that we should avoid the slightest distortion. In practice, we could use a couple of dry cells, instead of a potentiometer, to keep the grid at normal negative value, and arrange our curves accordingly.

The characteristic curve may be displaced to the left by increasing the high-tension voltage on the plate. This hardly affects the steepness of the straight portions of the curves, which remains more or less the same for different values. It will be noticed that the curves of Fig. 3 all have their straight portions almost parallel. At the same time, the maximum height of the curve is increased.

The extension of a characteristic curve is practically equivalent to moving the curve to the right. The effect is to make the grid zero ordinate cut through a relatively lower point of the curve. For low values of high-tension voltage the extension of the curve by increasing the voltage on the plate exceeds the actual displacement of the curve to the left. The resultant effect is that the grid zero ordinate cuts through a lower relative point on the curve. As we increase the high-tension voltage the extension produced becomes small compared to the displacement to the left, so that the resultant effect is that the point where the ordinate cuts the curve moves higher and higher until saturation point is reached. The above will be more clearly understood by a reference to Fig. 3.

The effect of increasing the filament current is simply to extend the curve without actually moving it sideways. This extension, however, is equivalent to moving the curve to the right, since it causes the zero ordinate to cut it at a lower point.

By increasing or decreasing the filament current and high-tension voltage together we can produce a series of curves all similarly placed with regard to the zero ordinate, but of different sizes, the larger curves being suitable for amplifying very strong current variations.

Before passing on it would be as well to point out that the results given here in graphical form have been obtained by giving the grid steady, *maintained* potentials. In actual practice, especially when amplifying high-frequency oscillations, the potentials given to the grid are only momentary, lasting perhaps for only a millionth of a second. Deductions from the curves must be made with this always in mind, particularly when considering those portions of curves which lie to the right of the grid zero ordinate. This point will be subsequently emphasised more strongly. Later, the writer intends to give details of results obtained by taking oscillographs of the magnified current variations taking place, under various conditions, in the plate circuit of a valve. The present paper is only intended as a broad consideration of some of the more elementary facts. It is hoped later to enter more deeply into the finer distinctions and phenomena in connection with valve characteristic curves.

(*Concluded.*)

London's Lord Mayor Greets Senatore Marconi in Rome

THE RIGHT HON. SIR CHARLES A. HANSON, WHO RECENTLY VISITED ITALY, HAD THE OPPORTUNITY OF GREETING THE DISTINGUISHED ITALIAN SCIENTIST IN HIS OWN CAPITAL CITY.

Among the Operators

It is our sad duty, month by month, to record the deaths of the brave operators who have lost their lives at sea by enemy action and other causes in the wireless service of their country. Owing to the necessity of preventing the leakage of information likely to assist our adversaries, the names of ships and localities of action cannot be published. With the exception of Messrs. Harold Whittaker, drowned whilst bathing at Civita Vecchia, and James Falconer McArthur, who died from natural causes, the lives of the operators mentioned this month have been sacrificed as the result of hostile activities or disaster at sea.

MR. JAMES DRUMMOND was born at Rutherglen, Scotland, on January 6th, 1894, and educated at MacDonald Public School, Rutherglen. His employment by the several firms of Messrs. Campbell Cameron & Co., Morton & Hume, and T. F. Firth & Co., all of Glasgow, gave him a good business experience, after which he underwent training at the North British Wireless Schools, Ltd., Glasgow. On gaining the P.M.G. Certificate he was appointed to the Marconi Company's staff in July, 1916.

Born at Tottenham, London, on May 27th, 1900, MR. EUGENE JOSEPH O'SULLIVAN was educated at St. Mark's School, Chicago, Ill., U.S.A., St. Ignatius College, Stamford Hill, N., and Clark's College, London. After a period of service in H.M. Paymaster-General's Office, he entered Marconi House School, where he qualified for, and received, the P.M.G. Certificate, and was given an appointment by the Marconi Company last June.

MR. WILLIAM MUNDIE was born at Peterhead on November 20th, 1900, and went to St. Fergus Public School for his education. His training in wireless telegraphy was received at the Marconi House School, and, after obtaining the P.M.G. Certificate, Mr. Mundie commenced his service with the Marconi Company in March last year.

In his eighteenth year, MR. LEONARD JAMES WILLIAMS was born at Plymouth, and received his education at Prince Rock Council School, Plymouth. Whilst employed as a boy messenger at the Plymouth Post Office he occupied his spare time in learning ordinary telegraphy at the Bedford Park Telegraph Training School, and during that period he also passed the examination for a Post Office clerkship. Mr. Williams was admitted to Marconi House School for wireless training, where he gained the P.M.G. Certificate, and was appointed to the seagoing staff of the Marconi Company last May.

MR. ROBERT HAWKER NASH was born at Barton-upon-Irwell on October 13th, 1893. He was educated at Hulme Grammar School, and trained at the Manchester Wireless Telegraph Training College, where he qualified for the P.M.G. Certificate. He was placed on the operating staff of the Marconi Company in January, 1913. Mr. Nash sailed on numerous ships in the course of his duty, and did good service when on board one of H.M. transports which was sunk by torpedo in 1917.

Uig, Ross-shire, was the birthplace of MR. NORMAN MACIVER twenty-one years ago. After receiving his education at Bernera, Stornoway, he assisted his father, a master fisherman, and when not at sea worked on his father's croft. His wireless training was received at the North British Wireless Schools, Glasgow, and, after passing the P.M.G. examination for his certificate, he joined the operating staff of the Marconi Company in June, 1917.

MR. CEDRIC RICHARD MARSHALL, born at Jarrow-on-Tyne on August 4th, 1899, was educated at the Birkenhead Institute, and commenced his career in an African produce broker's office. His wireless training was received at the Liverpool Wireless

ROLL OF HONOUR.

D

Telegraph Training College, and on receipt of the P.M.G. Certificate he proceeded to sea as a Marconi operator in November, 1917.

MR. SYDNEY HARSANT POPPY was born on April 30th, 1901, at South Leyton, and was a pupil at Brentwood High School. After completing the curriculum there, he decided to take up wireless as a career, and was trained in radiotelegraphy at Marconi House School. Mr. Poppy was given the P.M.G. Certificate in April last, and then entered the service of the Marconi Company.

Born at Carrigdangan, Co. Cork, on October 4th, 1894, MR. DANIEL HORGAN was educated at Kilhanna National School, and St. Ignatius College, Galway. He attended the Irish School of Telegraphy, Cork, and there qualified for the P.M.G. Certificate. After its award, Mr. Horgan joined the Marconi Company's service in August, 1916.

Formerly employed in the Town Clerk's office at Bolton, his native place, MR. WILLIAM DOUGLAS CRAWSHAW was born on April 29th, 1901, and educated at Clarence Street Council School, and the Church Institute, in that town. He took a course of training at the Manchester Wireless Telegraph Training College, and received the P.M.G. Certificate. Mr. Crawshaw entered the Marconi service in October, 1917.

Also a Lancashire lad, MR. HAROLD WHITTAKER was born at Royton on January 28th, 1900, and received his schooling at Hulme Grammar School and Elmfield College, York. He was employed for a time as clerk in the office of a cotton spinning company, after which he became a student at the City School of Wireless Telegraphy, Manchester. When possessed of the P.M.G. Certificate Mr. Whittaker was placed on the seagoing staff of the Marconi Company last July.

MR. JAMES FALCONER MCARTHUR was born at Crowhall, Elginshire, on September 28th, 1899, and attended Cullen Higher Grade School and Fordyce Academy for his education. His training in radiotelegraphy was received at the North British Wireless Schools, Edinburgh, and on gaining the P.M.G. Certificate Mr. McArthur was placed on the operating staff of the Marconi Company in January of this year.

Correspondence

An Interesting Optical Illusion

THE following letter drawing attention to a remarkable phenomenon in connection with the *Wireless Press* Armature Model will, we are sure, be read with interest by the many purchasers of that useful production :

THE EDITOR,

" Dear Sir,—May I be allowed space in your columns to point out an interesting " optical illusion which can be obtained from the *Wireless Press* armature model ?

" Take either of the circular end sections of the model in the hand, and move " the hand round and round in a horizontal plane. Two white sickle-shaped " brushes will then be seen to rotate over the windings, in the same direction of " rotation as that of your hand.

" I believe this phenomenon is similar to that obtained from a drawing which " can be made for the purpose of producing a circular diffraction grating on a " photographic film. The drawing consists of alternate black and white concentric " rings.

" Hoping this may interest some of your readers,

" Yours, etc.,

" S. L. MAINPRIZE, *Lieut.*"

Instructional Article

NEW SERIES (No. 7).

EDITORIAL NOTE.—Below we give the seventh of a new series of twelve Instructional Articles devoted to PHYSICS FOR WIRELESS STUDENTS. *Although at first sight the subject of physics would not seem to have a very intimate connection with wireless telegraphy, yet a sound knowledge of this subject will be found of the greatest use in understanding many of the phenomena met with in everyday radiotelegraphy. As in previous series, the articles are being prepared by a wireless man for wireless men, and will therefore be found of the greatest practical value.*

ELASTICITY (*continued*).

IN the last Article we said that a moving charge sets up magnetic flux and that in the case of two oppositely charged conductors separated by a strained dielectric the strain in the latter should have disappeared by the time all the potential energy stored in it had assumed the kinetic form. Having now armed ourselves with the idea of the lines which tend to shrink and which repel each other laterally, let us again attack our subject.

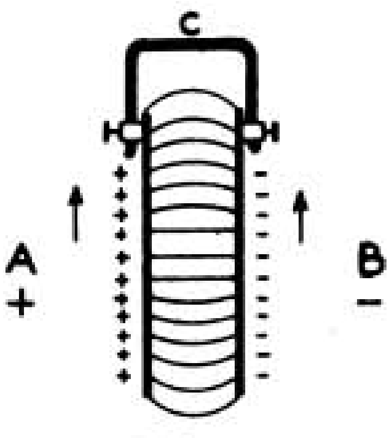


FIG. 29.

Refer to Fig. 29; this represents a condenser which in imagination we are going to discharge. In other words, we are going to make the charge move, or transform the electrostatic energy of the charge into electrokinetic energy, incidentally losing some, because, as was mentioned in the section on Energy, such loss is bound to occur in any energy transformation. When the plates *A* and *B* are joined by the *low resistance* wire *C*, the discharge is oscillatory and continues for a certain time which is determined by the resistance and the radiative property of the circuit. As soon as the plates are connected the energy begins to remove *from the dielectric to the circuit*, and this is equivalent to saying that there is a decrease of stress or a weaker field because the charge on the plates is decreasing; hence there must be a decrease of strain in the dielectric by virtue of its elasticity. Again, whilst the current in the circuit is growing there will be an *upward movement* of the charges on the plates—that is, *upward* in a case such as Fig. 29 depicts, or in general, a movement *towards* the connecting wire.

Now notice that the lines terminate in positive charges on the plate A and in negative charges on the plate *B*, and that as these charges move upward they are accompanied by the lines; one can conceive that they drag the ends of the lines with them. Thus at the end of the first $\frac{1}{4}$th cycle there exists a state of affairs something like that shown in Fig. 30; the + and − charges are moving towards each other along the wire and the lines are contracting lengthways, some having already disappeared. We can imagine these lines to have become so short that their ends have actually met. The figure also shows that there is a decrease of strain in the dielectric.

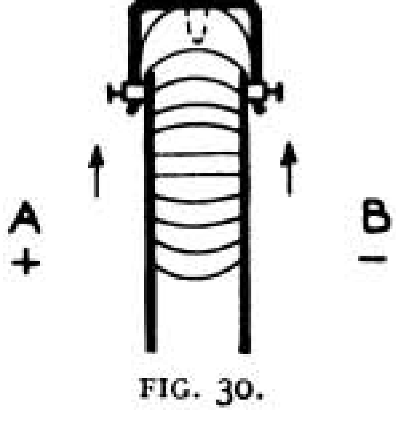


FIG. 30.

At the end of the first quarter-cycle all the energy is in the circuit, the strain in the dielectric has disappeared, and there is a field of magnetic force set up at right angles to the direction of the motion of the moving charges. (Fig. 31.) At this stage we have I_{max} in the circuit. (See section on Harmonic Motion.) The nature of the discharge being oscillatory there is no interval between the stage just described and the commencement of the recharging of the plates and the consequent return of strain in the dielectric.

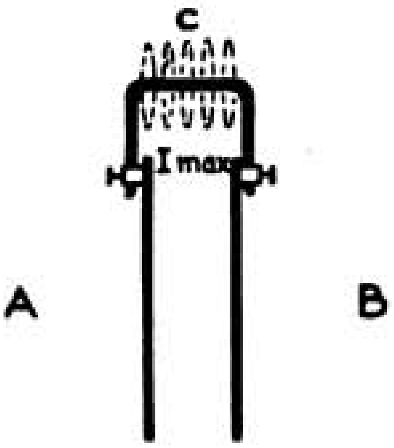


FIG. 31.

The production of electromagnetic waves involves the production of the two components, electric force and magnetic flux, the one diminishing as the other increases, then *vice versa*, and so on in a series, some of the energy originally stored in the dielectric being radiated and constituting together with the heat losses in the circuit the loss due to the transformation of energy. A full discussion of this process belongs to the textbooks of wireless telegraphy and the present article is intended to prepare the reader for further study of the subject by rendering him more familiar with the terms, often unexplained, which he may meet in such books.

ATOMS AND MOLECULES.

In regard to what follows concerning the constitution of matter it should be understood that we are dealing with this subject more from the standpoint of chemistry than from that of the latest conclusions of physics. Hence the fact that atoms are subdivided into "positive ions" and "electrons" has been ignored. Generally speaking, science at present owes far less to the electron theory than to the atomic theory on which it may be said the foundations of modern chemistry are laid. In these elementary articles we refer to the atom as a whole and the fact that it is no longer considered to be homogeneous will not conflict with such a treatment. When we say that a molecule of a certain substance is composed of a certain number of atoms, so many of one kind and so many of another, or when we speak of the weight of an atom or of its affinity for another, we are on safe ground. The atom is still the CHEMICAL *unit of matter, and if its name—which implies that it is indivisible—is now inapplicable it ought to be changed, though it is not worth while to do so until its retention is generally recognised as a serious imperfection of scientific nomenclature. When such a purifying process is undertaken there will be found greater causes of offence than the word atom as now applied. If an atom loses an electron it does not cease to be the chemical unit of matter even though it is then renamed a "positive ion"—another name for a positively charged atom—that is, an originally neutral atom which has lost an unit of negative electricity.*

Dalton's atomic theory satisfies the essential requirement of being in accordance with facts, but it was never represented as an ULTIMATE *doctrine.*

The problem of the structure of matter was solved for the time being by the conception and definition of atoms and molecules based on data derived from numerous experiments. The philosophical question as to whether matter is *infinitely* divisible served no practical purpose and science groped to discover whether it possesses some structural unit which may be regarded as bearing a relation to matter in bulk similar to that of a brick to a house—a more useful line of enquiry, because once a limit (even a theoretical limit) to the divisibility of matter is arrived at the ultimate particle is not only partially defined but serves as a definite starting-point for a system of physics.

It is supposed that all matter is made up of indivisible particles so small as to be quite undetectable by the most powerful microscope. Their shape is unknown and their size has been only approximately computed, but their relative weights, taking the oxygen particle as 16, have been determined with great accuracy. Some seventy-eight different kinds of these particles are known to exist and matter wholly composed of any one of these kinds is called an elementary substance or **element.**

These fundamental particles or atoms are not capable of separate existence. They have a perpetual tendency to form aggregations and even when combined will readily abandon one group for another. This interchange of atoms is **chemical action** and may be brought about by the mere contact of two substances or by heat, light, mechanical pressure, or electricity. The force which unites atoms is called **chemical attraction** and is believed to be electrical in nature.

A group of atoms held together by chemical attraction is termed a **molecule.** If the atoms are all of the same kind the group is an **elementary molecule**—e.g., a molecule of iron—and the substance itself, that is, an aggregation of such molecules, is an element. If there are two or more kinds of atoms present in the group this is known as a **compound molecule**—e.g., a molecule of water—and the substance is a compound.

(1) *An atom is the smallest particle of matter which can take part in a chemical change. It is indivisible and cannot exist separately.*

(2) *A molecule is a group of atoms forming the smallest particle of matter which can exist separately. It is not divisible by mechanical means but can be split up by chemical or electro-chemical means.*

As an apparent contradiction of what has been stated with regard to the plurality of atoms in the molecule it must be pointed out that there are certain substances—sodium and potassium, for example—the molecules of which are considered to consist of but a *single* atom. Clearly in the case of monatomic elementary molecules we must accept a merging of definitions (1) and (2) and look upon an atom of, say, sodium as being also a molecule of sodium. Such a molecule is, of course, indivisible, but were it possible to split it up we should find that in conformity with the behaviour of all other molecules similarly treated it would lose its original properties, for *in matter of any kind the molecule is the smallest particle in which the original properties of that matter are inherent.* Yet even these unusually independent atoms possess the fundamental tendency to combine and are very chemically active, readily forming a large number of compounds.

Chemical and Physical Changes.—Any change which does not destroy the original properties of a molecule is only a physical change, but if the original atomic structure is destroyed or even altered the change is both chemical and physical. Water can be changed to a solid by freezing it or to the invisible form of steam, but in each of its states, solid, liquid, and gaseous, its component molecules are physically alike and contain three atoms, so that a change from one state to another is purely physical; but if water is electrolysed its molecules are broken up and new molecules of hydrogen and of oxygen are formed, physically and chemically different from the original aqueous molecules.

Molecular Motion.—Molecules are never at rest. They are ceaselessly engaged in darting about at high velocities, colliding with each other and rebounding. Between any one collision and the next the molecule pursues a perfectly straight path, and although its *track* would, therefore, be "zigzag" it may in some cases have a more or less definite direction if considered as a whole during a given period. One difference between solids, liquids, and gases is that in any one of these forms the molecules have a *mean free path* different in length to that of those in the other two forms. This means, for instance, that in solids generally a molecule cannot move so far in a straight line without colliding with another as can a molecule of a liquid. Similarly the molecules of a gas at normal pressure have a greater mean free path than those of a liquid.

The kinetic energy of a molecule of a gas is heat energy and can be expressed by the equation $E = \frac{MV^2}{2}$. From this it can be seen that the smaller the *mass* of the molecule (or the smaller the weight of its atom) the greater is the molecular velocity, V, at a given temperature. If the temperature of the gas is raised the molecular energy and the molecular velocity increase, since the mass remains constant. Hence if we raise the temperature of a substance we impart to its molecules a tendency to acquire a greater mean free path, so that in the case of solids and liquids there is expansion in bulk and in the case of a gas enclosed in a vessel there is an increase in the pressure exerted by the gas on the walls of its container. From the above-mentioned equation it follows also that E can only be zero when V is zero, which means that there is a limit below which a substance cannot be cooled because only when a molecule attains absolute rest—i.e., zero V—can it be absolutely cold—i.e., zero E. But we know that a molecule never ceases to move.

Taking into account the collisions of the molecules of a gas not only with each other but with the walls of the vessel enclosing it, it should be clear that at a given moment the molecules will be moving at *various* velocities because the direction and sense of their velocities is constantly altering. Yet at a given temperature there is a *mean velocity* of

$$485 \sqrt{\frac{t}{273\,\rho}} \text{ metres per second.*}$$

t being the absolute temperature (in degrees Centigrade) of the gas and ρ the specific gravity of the gas compared with air.

This velocity is the square root of the arithmetical mean of the various values of v^2; the arithmetical mean of these velocities (v) is given by

$$447 \sqrt{\frac{t}{273\,\rho}} \text{ metres per second.}$$

Thus in air at normal temperature and pressure the mean velocity of a molecule of oxygen is roughly a third of a mile per second, and the length of its mean free path is of the order of 7·6 hundred-millionths of a metre ($7{\cdot}6 \times 10^{-8}$ metre).

If we reduce the molecular velocity of a gas it will first assume the liquid form and, finally, if the process continues, will become solid. Actually what is done is the reduction of the kinetic energy of the gas by lowering its temperature and subjecting it to great pressure; this reduces the velocity, because v^2 varies as t, and the mean free path becomes smaller. All this amounts to saying that as the intermolecular spaces are reduced the gas becomes denser and tends to assume eventually the general properties of a liquid and finally those of a solid.

Molecular Magnets.—With further reference to the kinetic energy of molecules it is worthy of note that when iron is rapidly magnetised and demagnetised it becomes hotter. According to the molecular theory of magnetisation iron subjected to such an alternating process would have its molecules set swinging, first into positions with the N pole of one aligned with the S pole of the next and so on, all of them forming orderly lines in the direction of the magnetising force, and then back again into stable groups forming closed magnetic circuits, that is, into their natural distribution. By virtue of these enforced movements the molecules apparently acquire extra kinetic energy which is added to the original heat energy.

Summarising, we can say that the chemist's view of matter is that it is an aggregation of molecules moving at various velocities, but always in straight paths, the direction of these paths continually changing as the result of molecular collisions and the lengths of the paths varying according to temperature or pressure; that for a given material at a given temperature and pressure these velocities and lengths can be expressed as *means*, and that within the molecule the constituent atoms, grouped by virtue of chemical attraction, are performing movements which may be likened, for lack of a more precise description, to the movements of the members of a solar system with regard to each other.

Mixtures.—With the preceding paragraphs fresh in our minds the difference between a true compound and a mixture is easy to understand. A **compound is**

* Clausius.

the result of chemical action, new molecules having been formed possessing properties peculiar to themselves and distinct from those of the substances from which the compound is formed.

Example.—SODIUM. *A soft white metal, easily cut with a knife or moulded in the fingers. Will not form crystals.*

CHLORINE. *A heavy, green, poisonous gas.*

CHLORIDE OF SODIUM (*Common salt*). *Molecules composed of one atom of sodium combined with one atom of chlorine. A white solid, pleasant to taste, odourless, an essential article of food. Crystallises in the form of cubes.*

A simple mixture is the result of mechanical action and its ingredients can be separated mechanically; no new molecules are formed and each component retains its original properties.

Example.—GUNPOWDER. *A mechanical mixture of carbon, sulphur, and potassium nitrate. The latter can be easily dissolved by water and from the residue the sulphur can be dissolved out by carbon bisulphide. Thus the three ingredients are mechanically separated.*

Chemical Attraction.—Oxygen, one of the principal components of the gaseous mixture known as air, has a very pronounced "affinity" for many other elements and readily combines with them. The rusting of iron and the tarnishing of copper and many other metals are due to the presence of free atmospheric oxygen. Yet, on the other hand, argon, another constituent of air, is so chemically inert that it will form no compound whatever, so far as is known. Why is this? Why do atoms display such varying degrees of chemical activity, and why do atoms which are active follow a rule of selectivity, combining readily with some kinds of atoms and remaining "cold" towards others? There are no satisfactory answers to these queries. We only know that given due opportunity certain atoms will abandon their connection with other kinds to form new molecules with a third kind. For want of a better word it is said that an atom has various *affinities* for atoms of other elements, meaning that, as between any one kind of atom and the other seventy-seven existing kinds, there are various degrees of chemical attraction.

The stability of a molecule, simple or compound, seems to depend largely upon its internal energy, but without going into the theory of molecular architecture we can draw from the preceding paragraph the conclusion that a molecule is unstable if the attraction between its atoms is very weak. An unstable simple molecule tends to change into a more stable form of the same element and an unstable compound molecule needs but a slight push to cause the decomposition of its atomic system. Under the heading of chemical action more will be said in regard to the stability of elemental forms of matter.

Examples.—STABILITY. *One atom of hydrogen combines with one atom of chlorine, forming the stable compound called hydrochloric acid, the two gases* UNITING, *when mixed,* BY MERE EXPOSURE TO THE SUN.

INSTABILITY. *One atom of nitrogen will combine with three atoms of chlorine, forming a thin oily liquid called nitrogen trichloride.* BY MERE EXPOSURE TO THE SUN *this unstable compound* DECOMPOSES *with explosive violence. Again, iodide of nitrogen, composed of one atom of nitrogen, one atom of hydrogen, and two atoms of iodine,* is so unstable that it will explode under water and in the dry state will explode if falling particles of dust are allowed to touch it.*

In the next Article we shall discuss chemical action, a subject of vast importance, because it embraces the perpetual redistribution of atoms which takes place throughout the entire realm of nature and in most manufacturing processes.

(*To be continued.*)

* This is its composition given by Szuhay and confirmed by Gladstone. According to Gay-Lussac the formula is NI_3.

DYNAMO AND MOTOR ATTENDANTS AND THEIR MACHINES. By Frank Broadbent, M.I.E.E. Ninth Edition. London : S. Rentell & Co., Ltd. 3s. 6d. net.

Sufficient evidence of the popularity and utility of this work is contained in the fact that it has now reached its ninth edition. Its aims, as we have indicated when reviewing previous editions, is to provide a collection of practical information for those whose business it is to attend to dynamos and motors in the course of their daily work, and for this reason the theoretical side of the subject, save in the preliminary pages, is scarcely touched upon. Particularly useful chapters are " How to Choose a Dynamo or Motor," " The Erection of Dynamos and Motors," " Faults and Breakdowns in Armatures, Magnets, etc.," and " Faults and Breakdowns in Motors." Wireless men employed on land stations will find much help to them in this handy work.

MANUAL OF WIRELESS TELEGRAPHY AND TELEPHONY FOR NAVAL ELECTRICIANS. By Captain S. S. Robison, U.S.N. London : S. Rentell & Co., Ltd. 8s. 6d. net. Postage 5d.

" Robison's Book " is well known to the more senior wireless operators as one of the first textbooks to deal with the practice of radiotelegraphy in its modern aspect, without recourse to historical disquisitions and a fog of formulæ.

With the rapid advance of radiotelegraphy, several reprints and new editions have appeared, and now we have before us the fourth revised edition, which is fully three times as thick as the original work. This year, owing to Commander Robison's preoccupation in war work, we have the collaboration of Captain D. W. Todd, U.S.N., and Commander S. C. Hooper, U.S.N., both men well known in the radio world, while a number of suggestions have been made by other members of the Wireless Service of the United States Navy.

The new edition follows the same lines as the previous one, but a number of additions are noticed, particularly the inclusion of six pages devoted to the Federal Poulsen systems. Wireless Telephony, however, is still inadequately treated, barely a page being given up to the subject, notwithstanding the title of the volume which certainly leads one to expect more. Thermionic valves, too, are given, less than three pages in spite of their extensive use in the American Navy. If the omission of fuller treatment of these two subjects is due to lack of space, then we would suggest dropping some of the out-of-date matter, which is of historic interest only. Surely we no longer need diagrams of forgotten De Forest, Massie and Stone circuits, particularly when they are labelled as obsolete.

Perhaps the most interesting feature of the new edition—to the English student at all events—is the description of the U.S. Naval Type "A" receiving set. Those who think that they have nothing to learn in the way of receiving circuits will be surprised at the variations from the normal here shown. Thus, the usual inductive coupling, requiring either rotating or laterally moving coils, is replaced by a condenser coupling for which is claimed a much higher efficiency on long waves. The "standbi" circuit has also points of novelty, and the whole instrument is particularly well explained both with diagrams and photographic illustration.

On the other hand, the Lowenstein diagrams, which really have few points of novelty, are models of how *not* to illustrate wireless circuits.

Analysed and redrawn on conventional lines, they present few points of difficulty, but a certain degree of expertness is required to do this. As it stands, Fig. 105 must be incomprehensible to the student for whom the book is designed. We would suggest some modification of this drawing in subsequent editions. However, in spite of the minor defects above mentioned, the volume remains in the front rank of "wireless" textbooks, and well deserves the wide popularity it has attained.

THE AEROPLANE SPEAKS. By H. Barber, A.F.Ae.S. Sixth and Revised Edition. London: McBride, Nast & Co., Ltd. 6s. 8d. net.

Among the many textbooks in aviation now available, this work stands out prominent by reason of its originality of treatment. "The reason impelling me to "write this book," says Captain Barber in his foreword, "is a strong desire to help "the ordinary man to understand the aeroplane and the joys and troubles of its "pilot; and secondly, to produce something of *practical* assistance to the pilot "and his invaluable assistant the rigger." How admirably the author achieves his first aim can only be realised by those who have read the work, while as to his second, the popularity of the book among aircraft workers, and in the air service itself, is sufficiently convincing without any word from us.

The main point of originality in treatment consists in making each part of an aeroplane describe its work and argue with the other parts as to its relative importance. As a result, we get some delightfully humourous touches, which do much to keep our interest alert in those parts of the subject which would otherwise prove "dry." Thus, starting with a brief explanation by a Surface, we come to an argument between the Propeller and Efficiency, and one by one, as the defects become apparent, the other portions of the aeroplane enter into conversation, until, by the end of the part, we have covered the whole ground of the elementary principles. Part 2, entitled "The Principals having settled their Differences finish the Job," is written in the same amusing strain. It is no mean achievement to explain in two chapters the meaning of such terms as thrust, drift. and stability, in their relation to the modern flying machine, and to make clear such points as, why in a modern biplane the two surfaces are staggered in relation to one another; what is meant by the optimum angle of incidence and the dihedral angle. It is safe to say that he must be a dull reader indeed who has not a fair comprehension of these matters by the time he has reached this point. Parts 3 and 4, entitled "The Great Test" and "Cross Country," are particularly brilliant pieces of descriptive writing, in which is described how the machine previously designed was taken out of the aerodrome and flown across country to its destination. These parts serve the double purpose of describing how the machine is controlled in the air and introducing a great deal of flying "slang," which, unless explained, is likely to cause a deal of trouble to those studying aviation.

Particularly informative is the illustration on page 42 showing the pilot's seat, together with the numerous controls and indicating devices which have to be kept constantly under his supervision. The layman who thinks that the pilot has to control merely the "joy stick," and the rudder, and find his way by observation and a map, will be surprised to find in the picture an oil gauge, ignition switch, throttle control lever, inclinometer, watch, air safety indicator, altimeter, petrol gauge, and compass, apart from the many devices which are of special war utility, and which, of course, cannot be described in a textbook for general circulation. It is quite permissible to mention, however, that in single seater machines, the pilot has not only to observe all the instruments already mentioned, but also to handle the delicate bomb-dropping mechanism, machine gun, camera and wireless instruments.

Professional flying men will be interested in the discussion on what changes in the design of the average machine most pilots would like. Speaking of the difficulties of landing with a fast machine, the author puts it into the mouth of the pilot to say that " it is all the fault of the tail. There is hardly a type of aeroplane " in existence, in which the tail could not be raised several feet, and that would make " all the difference. A high tail, means a large angle of incidence when the machine " touches ground, and with enough angle, I will guarantee to safely land the " fastest machine in a five acre field." The obvious difficulties in the way of carrying this out are suggested in the argument between the pilot and the observer which then follows.

These three parts complete the prologue, or that portion of the book which is written in the conversational style. Following this come five chapters dealing with the principles of flying on more conventional lines. Here, as in the previous part of the book, the author displays the same lucidity of explanation which is such a valuable feature of the work, the manner of treatment allowing the construction of the machine to be dealt with in far greater detail. Chapter 1 deals with flight, and such matters as chord, drift, head resistance, angle of incidence, camber and aspect ratio; chapter 2 with stability and control, and chapter 3 with rigging. In order to rig an aeroplane intelligently and to maintain it in an efficient and safe condition, it is necessary to possess some knowledge of the stresses the machine is called upon to endure, and the strains likely to appear. All of these are very thoroughly dealt with by Captain Barber both textually and with the aid of diagrams. Finally, we have an excellent glossary, which is followed by a large number of plates illustrating the evolution of the aeroplane.

We understand from the publishers that a seventh edition will be ready very shortly, and with the increasing interest displayed by the public in aviation this should soon be absorbed.

Altogether the book is eminently readable and informative, and can be recommended to those who, with no previous knowledge of the subject, wish to obtain, in the shortest possible time, a sound basis of knowledge on aviation.

Share Market Report

LONDON, *September 11th*, 1918.

The market in the shares of the Marconi group has been very active during the past month, with considerable investment buying of the shares of the Marconi International Marine Communication Company, Limited.

The prices of all the issues show a marked improvement as we go to press. Marconi Ordinary, £4 7s. 6d.; Marconi Preference, £3 12s. 6d.; Marconi International Marine, £3 5s. 9d.; Canadian Marconi, 14s. 6d.; American Marconi, £1 10s. 3d.; Spanish and General, 12s. 3d.

Personal Notes

A NEW POST.

THE first resident inspector in Montreal to represent the Marconi International Marine Communication Company, Ltd., has recently been appointed in the person of Mr. J. C. Hawkhead, the author of the well-known *Handbook of Technical Instruction for Wireless Telegraphists*, whose photograph, taken whilst holding the position of Director of Posts and Telegraphs, British Somaliland, is reproduced. Mr. Hawkhead has had long and varied experience in wireless. Appointed a learner at the Seaforth School of the Marconi Company in 1906, he was, with the exception of a period of shore duty at Niton station, operating at sea until 1910, when he joined the Madeira Marmoré Railway Company under a year's contract, and was appointed to the high-power wireless station at Mañaos.

Returning to England in 1911, he again took up sea duties, and was serving on board s.s. *Olympic* at the time she was rammed by H.M.S. *Hawke*, and later for a period on the Egyptian State Yacht *Mahroussa*, receiving a gold monogram scarfpin from the ex-Khedive Abbas Hilmi II. in recognition of his services.

From its inception in 1912 Mr. Hawkhead acted as an instructor in the Marconi House School until September, 1913, when he accepted an appointment under the Colonial Office Service as Superintendent of Telegraphs, British Somaliland, and in 1917 Director of Posts and Telegraphs in that territory, which latter he has relinquished for reasons of health, resuming his employment with the Marconi Company in July, 1918. We wish Mr. Hawkhead all success in his new undertaking.

MR. J. C. HAWKHEAD.

AN AMERICAN HERO.

Misinterpretation of fog signals is believed to have been the cause of the collision between an American coastwise liner and another vessel, off Atlantic City, U.S.A., early in May, causing the loss of 68 lives.

F. J. Doherty, the wireless operator, stuck to his post, sending calls for help. Captain A. G. Forward, commander of the liner, three times ordered Doherty to leave his post and save himself but the operator refused. He was working the key as the liner sank.

AWARDS.

Twice previously mentioned in dispatches, Major E. J. M. Nash, eldest son of Mr. A. J. Nash, a General Manager of the Royal Mail Steam Packet Company, has recently been awarded the D.S.O., and promoted to be Acting Lieut.-Colonel, for special services in Mesopotamia.

MAJOR B. S. BENNING, R.A.F., of Dunstable, formerly in the service of Marconi's Wireless Telegraph Co., Ltd., on the staff of the Chief Engineer, has been awarded the Croix de Guerre, with palm leaf, for signal service in France.

IN KHAKI.

SAPPER H. J. LEGG, R.E.

The accompanying is a photograph of one of Marconi's Wireless Telegraph Company's staff, SAPPER H. J. LEGG, R.E., now doing duty at an Army wireless station " somewhere in England."

AN INTERESTING WEDDING.

The marriage took place recently at Heckmondwike, Yorkshire, of Miss Olive North and Wireless Operator Percy Hanson, R.N.R., who was formerly a telegraphist at the Post Office.

The bride was one of the passengers who had the good fortune to be rescued from the torpedoed *Lusitania*, and the bridegroom, who joined the R.N.R. shortly after the outbreak of war, has also been lucky in escaping from disaster at sea.

CRICKET.

A cricket match arranged by Mr. L. P. Grice in aid of St. Dunstan's Hostel for Blinded Soldiers was recently played at K.E.S., Five Ways Grounds, Edgbaston, between Marconi Wireless C.C. and Mr. L. P. Grice's XI. The latter side won by 112 to 51.

OBITUARY.

We regret to record the death of WIRELESS OPERATOR F. C. LOCK, Canadian Regiment of Royal Engineers, formerly a telegraphist at the Cardiff Post Office, who was killed in action in France in June last.

Prior to joining the Army he was doing duty as a wireless operator at Vancouver, B.C., where his loss will be deeply felt. Operator Lock was the eldest son of Mr. and Mrs. F. C. Lock, Splott Road, Cardiff, to whom we tender our sympathy in their bereavement.

Questions & Answers

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. There are no coupons to fill in and no fees of any kind. At the same time readers would greatly facilitate the work of our experts if they would comply with the following rules:* (1) *Questions should be numbered and written on one side of the paper only, and should not exceed four in number.* (2) *Replies should not be expected in the issue immediately following the receipt of queries, as in the present times of difficulty magazines have to go to press much earlier than formerly.* (3) *Queries should be as clear and concise as possible.* (4) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. This will save us needless duplication of answers.* (5) *The Editor cannot undertake to reply to queries by post, even when these are accompanied by a stamped addressed envelope.* (6) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom-de-plume."* (7) *During the present restrictions the Editor is unable to answer queries dealing with many constructional matters, and such subjects as call letters, names and positions of stations.*

T. E. D. (Dublin)—(1) Spark frequency is the frequency at which the *oscillation-trains* occur. For every condenser discharge a group of oscillations takes place, the frequency of the oscillations themselves being purely dependent upon the capacity and inductance of the circuit in which they take place. If we take the case of a circuit adjusted to a frequency of 500,000, and charged from a 50-cycle alternator, then, with a synchronous discharger, the condenser will be charged twice for each cycle, and will give 100 sparks per second. The "spark-frequency" will thus be 100, and the "oscillation frequency" 500,000. You will see that the spark frequency is independent of the capacity and inductance of the circuit, while the oscillation frequency depends on these factors only. (2) Your question is not quite clear. The voltage at the terminals of the secondary of the transformer is dependent upon the ratio of the number of turns in the secondary to those of the primary. Thus, if there are twice the number of turns in the secondary, then there will be twice the voltage, although the current will be approximately halved. (3) Yes, the frequency is the same in both cases. (4) For the reason that you cannot take out of the transformer more energy than you put into it. If the voltage is doubled the current is halved. If the voltage is multiplied by ten, then the current is only one-tenth of that in the primary, and so on. You should study the principles of the transformer in Bangay's *Elementary Principles.*

R. D. (Norwich).—(1) The Post Office wireless stations are operated by men who have been recruited from the Post Office wire telegraph service, and there are no vacancies for men not previously so employed. (2) It is possible, although we cannot in any way forecast post-war conditions, that there might be a vacancy suitable for you in Marconi's Wireless Telegraph Company or the Transocean Wireless Telegraph Company after the war. We are not aware of any vacancies at the present time. The address of both of the above companies is Marconi House. In peace times they operate Poldhu, Clifden, and Carnarvon.

L. S. (Mansfield).—(1) Yes, he must pass the Marconi Company's own doctor before being accepted for employment. (2) At the present moment £1 5s. per week, board and accommodation being provided on board ship. The rates may be revised at any moment, possibly before this page appears in print. (3) Operators in the employ of the Marconi Company are required to sign an agreement to serve for at least twelve months. An operator may be placed in charge of an installation after making but one or two trips, if he shows the necessary ability. He then receives an additional 5s. per week charge money.

"A STUDENT" (Aberdeen).—(1) and (2) Full particulars of "How to Become a Wireless Engineer" were printed in our issue for May last. (3) Conditions vary. Why not apply to the R.A.F. Recruiting Officer, Music Hall, Edinburgh? He will give you full particulars. He will also answer your question. (4) We believe in the affirmative, provided you are found suitable. Thank you for your good wishes.

LEADING TELEGRAPHIST (H.M.S. ——).—(1) As much information as it is permissible to publish on this subject appears in the current *Year Book of Wireless Telegraphy and Telephony*. (2) No, the Marconi double-note magnifier, which has been designed to give good magnification with the utmost simplicity and the minimum of adjustment, works by the "cascade" method without recourse to the "reaction" principle. There are, of course, other Marconi receivers working on the reaction principle. We are glad you like our magazine. With regard to further articles on Valves and Continuous Wave work, we hope to publish many others in the near future. We are labouring under certain disadvantages in this connection, seeing that the most interesting developments in valves and continuous wave work are under the ban of secrecy, being used in the Army, Navy, and Air Service.

Y. L. S. (Guildford).—Yes, it is necessary to take into account the inductance of the earth lead in calculating the wave-length of an aerial, for, as you say, it may possess a considerable value in certain cases. For greatest efficiency, the jigger should be as close as possible to the actual earth connection.

G. L. W. (Auchtertool).—(1) No, we do not think so from present appearances. If you wish to study wireless telegraphy with a view to becoming a wireless operator in the Mercantile Marine, it is still open to you to take a course at one of the wireless schools advertised in this magazine. On obtaining the P.M.G. first-class certificate, you can then make application to the Marconi Company to be placed on their waiting list. (2) The wireless training at the Crystal Palace is in connection with the R.N.V.R., particulars of which may be obtained at the nearest Naval Recruiting Office. This also answers your question (3). (4) The training is free, but is given only to enlisted men.

ALPHA (Essex).—The medical standard is, we believe, the same as that for other commissions. In view of the fact that you had four years' O.T.C. training before you took up the study of wireless, we would suggest that you get into communication with the Recruiting Officer, Royal Air Force, Hotel Cecil, London, W.C.2, giving him full particulars of your qualifications and making application for a commission. For the R.E. Wireless Section, you should communicate with Major Handley, R.E., Wireless Training Centre, Worcester. Either branch of the service will give you the other information you require.

"TRANS" (B.E.F., France).—With an "inverted L" aerial, 80 feet high and 600 feet long, there should certainly be a marked directional effect in reception, the best signals being received from the direction opposite to that of the free end. (2) With two such aerials set at right angles, with the earthed ends adjoining, the strength of signals is equal in each, when the line of direction from which the signals come bisects the right angle. Otherwise, that aerial will receive the strongest signals which is nearest in direction to the point from which the signals proceed.

T. G. (Bayswater).—You would be well advised to study wireless telegraphy in your spare time, as, if you obtain a Postmaster-General's 1st Class Certificate, your chances of acceptance are very much higher. We do not anticipate that the Marconi Company will be taking any men other than those who possess a 1st Class Certificate for a long time to come, and we see no prospects of the free training scheme reopening at present. If you obtain such a certificate within a reasonable time, your prospects are good, provided, of course, you are otherwise suitable.

SPECIAL NOTE.

THE MARCONI FREE TRAINING SCHEME IS NOW CLOSED.

Correspondents who wish to train as Wireless Operators should apply to the nearest Wireless Training School or College.

THIS MAGAZINE CAN BE SENT FREE TO OUR TROOPS ABROAD BY LEAVING IT AT A POST OFFICE.