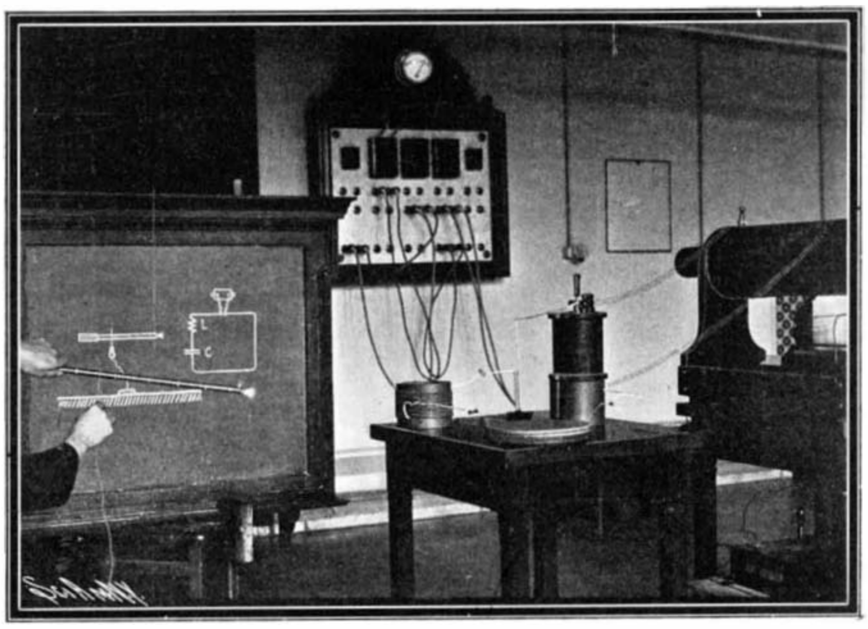
a total force of twenty-five men being constantly employed.

COUNTERWEIGHTED CABLE TRAMWAY.

BY JOHN PLUMMER.

During the work of extending one of the Sydney suburban cable tramway lines to the shores of the harbor, considerable difficulties were encountered in consequence of a rapid drop of level near the terminal point, and several schemes were proposed, that had to be abandoned on account of the costly resumptions which would have to be effected in order to carry them out, the land on either side of the thoroughfare being covered with buildings. The idea of adopting a subterranean counterweight was suggested, and, after some consideration, a scheme was devised and worked out by the officers of the state department of public works. The scheme presents some features new in Australia. The extension was an extremely short one, being only nine chains in length, but the grade was 1 in 8.48. The permanent way on the street surface is constructed of 85-pound grooved rails, tied to a center slot over a tube of concrete similar to cable tramway constructions. Upon this track the cars run, being preceded by a buffer trolley, which has a gripper attached to a steel-wire rope, fixed at one end to a small counter-weight trolley, which is weighted to ten tons. This travels on rails laid on a 2-foot 6-inch gage in a subway parallel to the tramway track on the surface. The wire rope is led round a 6-foot horizontal sheave, at a point near where the drop in the level commences, from the cable tube to the subway, at the terminal end of which a hydraulic buffer, with a cylinder 10 inches in diameter, 3-foot 6-inch stroke, is fixed, provided with weights to draw out the buffer-rod after being compressed by the impact from the weighted trolley. The track is bonded and the overhead wire construction is carried out in the usual manner. The whole arrangement has proved in every way satisfactory in the working, not a single mishap having been reported.

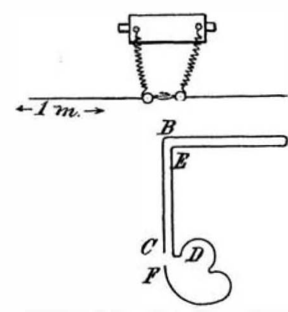


NOVEL WAVE METER FOR WIRELESS TELEGRAPHY.

A NOVEL WAVE METER FOR WIRELESS TELEGRAPHY.

BY OUR BERLIN CORRESPONDENT.

On account of the forthcoming international regulation of space telegraphy, the question of a suitable apparatus for measuring the wave length of the sending apparatus is assuming the highest importance. The writer, a short time ago, had the good fortune of inspecting in the laboratory of Prof. Slaby, of the Charlottenburg Technical High School, the "multiplier rod" designed by this well-known experimenter for the above purpose. The principle underlying the apparatus, as acknowledged by Prof. Slaby, has been found independently of himself both by Nicola Tesla and Dr. Oudin, a French physician. While testing a linear vibrating system generating quarters of a wave length of one meter, which were received by a rectangular loop receiver (Fig. 1), Prof. Slaby obtained the same tension curves both for $A\ B\ C$ and $A\ E\ D$, comprising nodes located in B and E and crests at A on one hand and C and D on the other, the tension in the two latter points being absolutely identical and of the same phase. Now, a phase difference amounting to 180 deg. (the tension remaining the same) was obtained between D and C by connecting D to a wire $D\ F$, two meters in length, so as to allow of half a wave being produced therein, which resulted in the tension between F and C increasing to values nearly twice as great as those previously obtained in C and D. Further increases were noted as Prof. Slaby, in order to give the additional wire a more convenient form, wound up the same in a coil; whenever to the tension maximum of an oscillating circuit, a wire $\lambda/2$ in length was connected, the terminal tension could be raised to multiple values in the case of the additional wire forming a coil. This is why such coils, tuned for the wave length of the system, were termed "tension multiplier." The experimenter also found that the increase in the terminal tension was attended by a distortion of the wave, previously quite regular, so that the beginning of the coil would form neither a perfect tension node nor a current node.

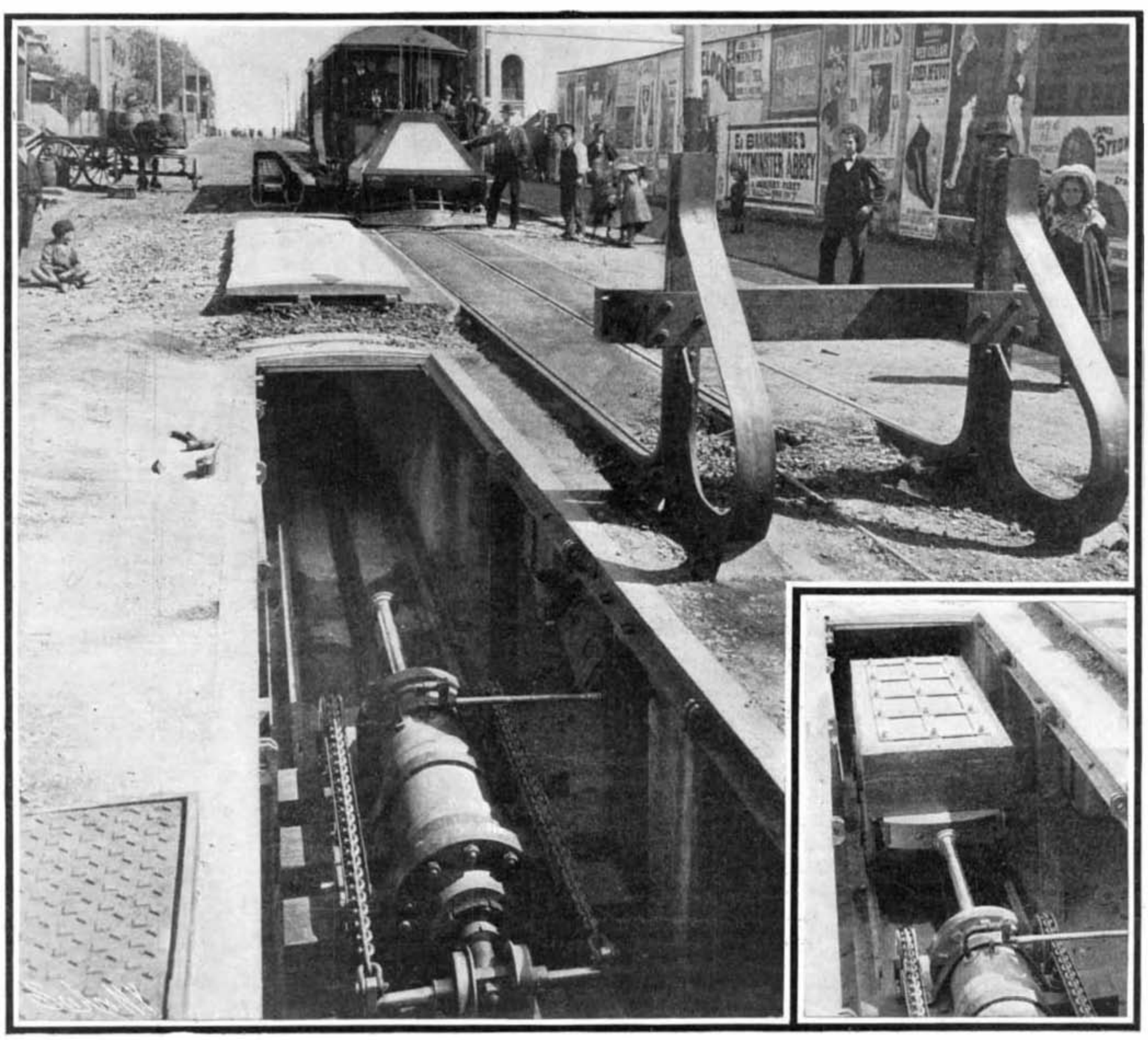


PRINCIPLE OF THE WAVE METER DIAGRAMMATICALLY SHOWN.

Prof. Slaby gives a rather simple theoretical explanation of this phenomenon, showing that any earthed wire systems, receiving an electric impulse of a certain frequency, will vibrate in resonance in case what he terms their vibration capacity (the product $C\ L$ of the electrostatic capacity by the self-induction) is the same, so that the equation $T = 2\pi\sqrt{C L}$ is satisfied. Now, the electrostatic capacity may be varied somewhat, without the above equation ceasing to be satisfied; the energy of the oscillating system, however, which depends on the electrostatic capacity, will be altered in proportion. It is shown that a system of n parallel wires, placed at mutual distances as high as possible, will have a self-induction as small and an electrostatic capacity, and accordingly vibration energy, as high as possible. Such oscillating systems are therefore most suitable for transmitting electromagnetic energy for space telegraph purposes; the surface tension at the ends of the wire cannot in fact increase beyond admissible limits, so as to produce a radiation of electric masses (electrons), which would mean a noticeable loss of energy.

Now, the reverse would be true in the case of a visible mark being required in the circuit to indicate whether the dimensions of the latter correspond to the maximum energy input, that is, whether the circuit is tuned for the frequency of the oscillation transmitted to the same. As in the latter case a radiation of electrons as strong as possible should be aimed at, the vibration capacity should be chosen so as to insure a surface tension as high as possible by combining a minimum electrostatic capacity with a maximum magnetic capacity or self-induction. This is obtained by designing the vibrating conductor as a coil. Prof. Slaby shows by simple theoretical considerations that the electron radiation of such multipliers is in the first place dependent on the pitch of the coil. Wires of a diameter as small as possible, coated within an insulating material as thin as possible, should therefore be used in this connection. Copper wires 0.1 millimeter in thickness, comprising a single silk winding or else an extremely thin insulating coating of cellulose acetate, gave the satisfactory results. This copper wire was wound on glass tubes and on ebonite and oak rods of different diameters, and the resonance length of the rods in the case of a unipolar earthing, ascertained for a given wavelength. Slaby gives an approximate relation between the capacity, self-induction, and own vibration of a coil, from which the wave length may be calculated with an accuracy of some tenths of one per cent.

Now, in regard to the question as to how the vibration energy from the circuit tested may be transmitted to the multiplier rod, so as to have the latter still vibrate in a quarter of a wave length, a direct connection would result in the wave undergoing a distortion (see above), the connecting point not being a node. This drawback was first obviated by establishing a monopolar connection between two



The Buffer Trolley descending. The Trolley ascending.

AUSTRALIAN COUNTERWEIGHTED TRAMWAY.