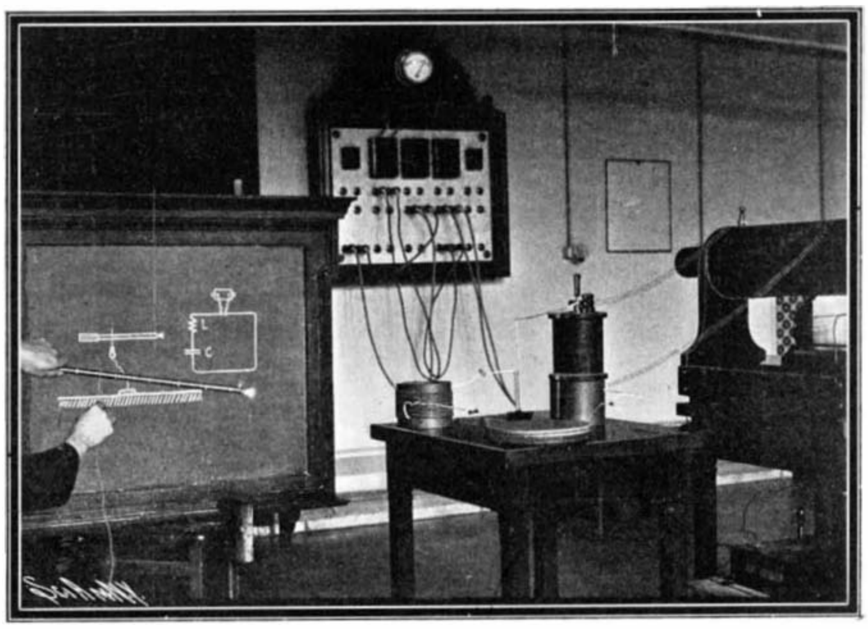
a total force of twenty-five men being constantly employed.

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.

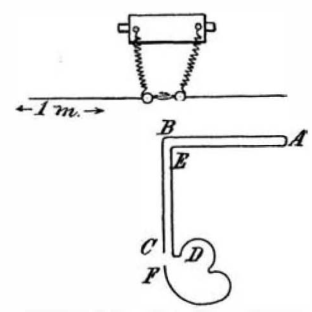


NOVEL WAVE METER FOR WIRELESS TELEGRAPHY.

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 cur[rent] node.

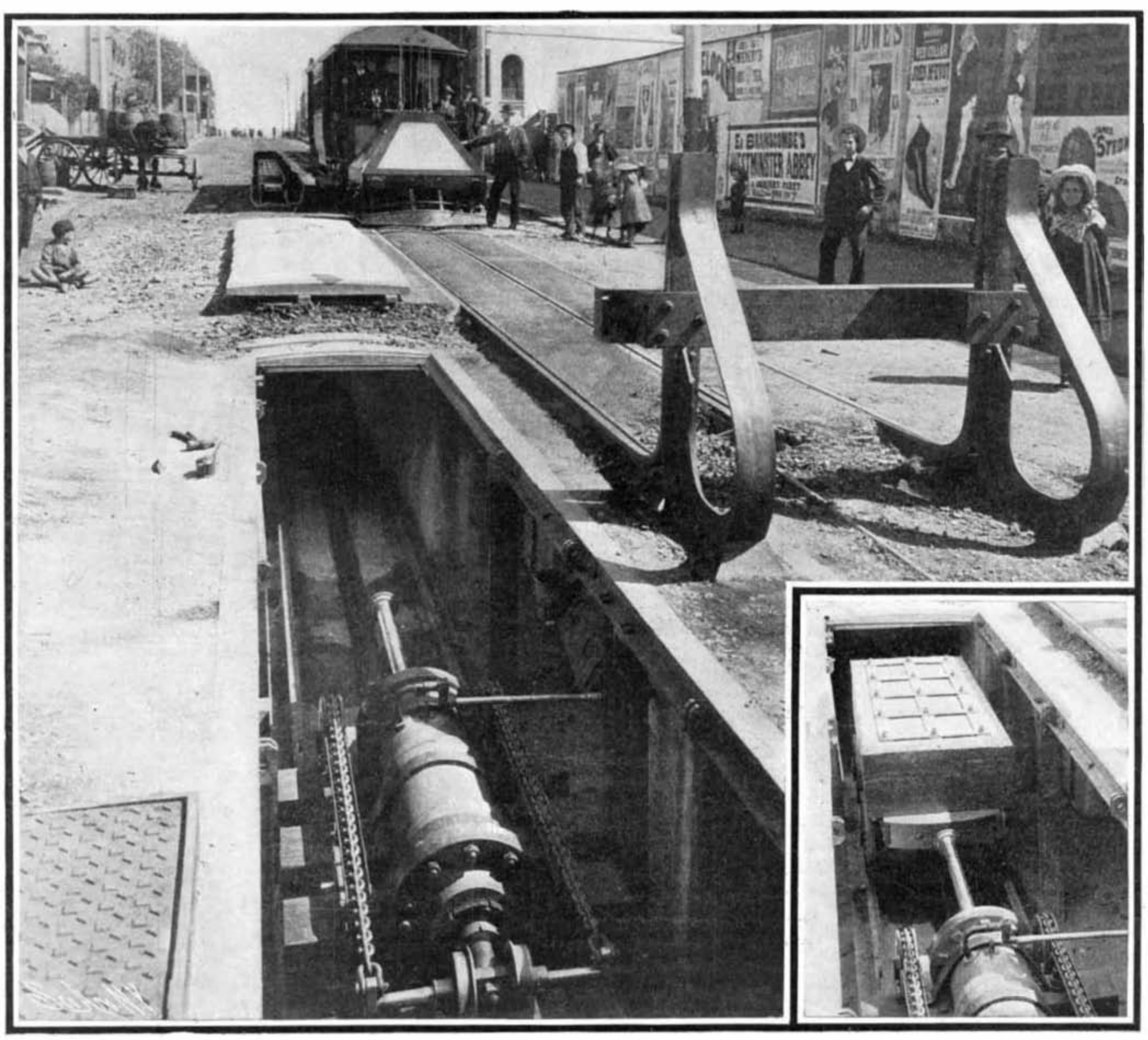


PRINCIPLE OF THE WAVE METER DIAGRAMMATICALLY SHOWN.

Prof. Slaby gives a rather [simp]le theoretical explanation of this phenomenon, showing that any earthed wire systems, receiving an electric [im]pulse of a certain frequency, will vibrate in resonance in case what [h]e 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 [a]ccordingly vibration energy, as high as possible. Such oscillating systems are therefore [m]ost 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 cellu[lose] acetate, gave [th]e satisfactory results. This copper wire was wound on glass tube and on ebonite a[nd] oak rods of different diameters, and the resonance length of the rod in the case of a [uni]polar 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.

identical multiplier rods, and causing them to vibrate in one-half of a wave length, so as to give rise to the spontaneous formation of a node in the connecting wire. Such instruments (termed "tuning fork" multipliers) comprising two parallel coils placed beside one another in a box and adjusted by a slide contact bridge (short-circuiting the lower winding, until the upper end began sparking, the rectilinear connecting wire absorbing the vibrations magnetically) gave quite satisfactory results. Now, continuing his experiments, Prof. Slaby observed that the whole room was strongly ionized as soon as an oscillating circuit was set working. A monopolar earthing was readily made in his laboratory, the floor of which is laid throughout with zinc plates, thus constituting an artificial earth of sufficient capacity (9,000 centimeters); the capacity of the human body, being about 100 centimeters, proved perfectly sufficient to impart to the multiplier the potential zero when touching its end. When keeping in the left hand a multiplier rod provided at one end with a metallic ring touching the latter, and carrying the thumb and index of the right hand alongside the rod, the free end of the latter would begin sparking as the index reached the resonance position, the more strongly as this end was turned toward the oscillating circuit; a more accurate adjustment may be obtained by carrying over the multiplier rod a short metallic rod, grounded by means of a wire which was fixed to a metallic plate lying on the ground. The best results were obtained by causing the violent radiation from the sparks to act on fluorescent bodies. When placing crystals of barium platino-cyanide in the end of the rod, an extraordinary intensity of the luminous effect was noted, so as to obtain a light-green spot, noticeable even in direct sunlight. When intermixing gold leaf with small leaves covered with the above crystals, a bright green luminous torch was noted, as an evidence of the multiplier rod being tuned.

In order to ascertain the accuracy warranted by the multiplier rod in this definite form, the inventor caused the same wave length to be measured by two different observers at different times, which difference in the case of a single adjustment was very seldom upward of 1 per cent, being in most cases below 0.4 per cent and 0.7 per cent, whereas in the case of a tenfold adjustment the average value of any two observers never differed by more than 2.5 per cent.

When considering that the determination of wave length according to previous methods required a whole series of observations, extending at least over half a day, the multiplying rod, allowing of the tuning of wireless telegraphy stations being checked almost instantaneously and in a way as accurate as possible, may be said to embody a most valuable advance, likely to materially further the development of wireless telegraphy.

Clay-Working Industries of the United States.

A chart showing in tabular form the quantity and value of the clay products of the United States in 1902 as distributed throughout the several States was published by the United States Geological Survey late in 1903. That is now supplemented by the publication of a report entitled "Statistics of the Clay-Working Industries in the United States in 1902." The author of both chart and report is Mr. Jefferson Middleton, who did the work under the supervision of Dr. David T. Day, chief of the Division of Mining and Mineral Resources.

The year 1902 was one of prosperity in the clay-working industries, the product reported increasing from $110,211,587 in 1901 to $122,169,531 in 1902, a gain of $11,957,944, or 10.85 per cent. It is significant, however, that the firms reporting in 1902 numbered but 6,045, as against 6,421 in 1901, the figures showing a decrease of 376, or 5.86 per cent. This decrease can be accounted for only by the fact that many individual firms have combined and reported as one plant, as no plants of importance that reported in 1901, except one in Texas, are delinquent in 1902. This is further shown by the fact that the average value of the output per plant increased from $17,164 in 1901 to $20,210 in 1902. A remarkable advance in the cost of labor and of building materials began in 1900, and although it does not seem to have had a serious effect on the clay-working industries during 1902, it is probable that it prevented the value of the clay product from rising above $126,000,000 in 1902, as it normally would have done.

The great coal strike of 1902 would seem to have had little direct effect on the brick and tile industry, although the pottery industry in the Eastern States, where considerable anthracite coal is used, may have suffered to some extent from the strike. The increased cost of fuel which followed the strike will undoubtedly make itself felt in the brick and tile industry in increased cost to the consumer.

One of the most significant features of the year was the successful installation of several plants for the manufacture of sand-lime brick. At the close of the year three or four plants of this character were in operation in different sections of the country, with the prospect of a large increase in their number in the near future. There seems to be no doubt that the manufacture of this class of brick will be successfully carried on in many localities. It is equally certain that sand-lime brick will not wholly displace clay brick.

A HANDLESS CLOCK.

In many a shop window of the more prominent avenues of the city of New York may be seen a novelty in the form of a clock that indicates the time, not by means of the traditional dial and hands, but simply by the exposure of numbers representing the hour and minute. If it is 21 minutes past 3, for example, the clock simply exhibits the number 3 above the number 21, and thus indicates the time in a simple and rational way. New as the idea of such a timepiece may be to many, its underlying principle is not of recent conception. Handless clocks of some form have been known for many years, but the difficulties which have attended their manufacture have prevented their commercial introduction.

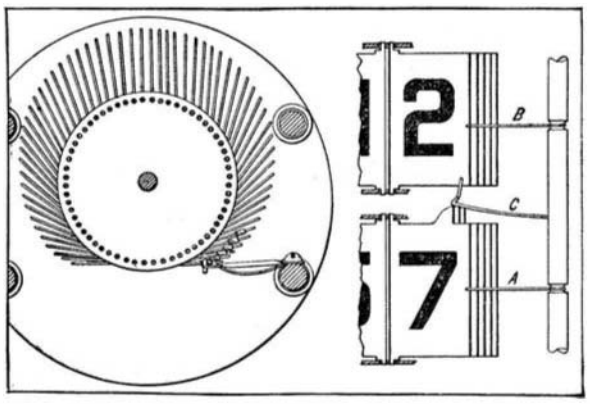


Diagram Showing the Method of Simultaneously Releasing the Hour and Minute Leaves of the Handless Clock at the End of an Hour.

In the clock to which we have referred, these hindrances seem to have been successfully overcome by its inventor, Mr. Eugene Fitch, if one may judge by the popularity of his timepiece. The makers of the clock, the American Electrical Novelty and Manufacturing Company, of 314 Hudson Street, New York city, have carried out the inventor's principles in a manner that is well worth some brief description.

A HANDLESS CLOCK.

Broadly speaking, the handless clock consists of two series of indicating leaves freely pivoted to form drums held between rotating disks. The upper drum of leaves indicates the hour, the lower drum the minute. A clock train drives the two drums in such a manner that the leaves of the minute drum flip past as each minute passes, while the hour drum still indicates the hour. At the end of the 59th minute of the hour, it becomes necessary to effect a simultaneous movement of the hour and minute drums, in order to indicate the even hour. It is the attainment of this end which has presented so much difficulty to inventors, and which has been overcome in this invention.

Mr. Fitch has effected this simultaneous change of indication by controlling the movement of the leaves of one set, the hour leaves for example, by leaves of the other (the minute leaves), so that one or more minute leaves will control each hour leaf in advance of and until the proper time for the change of indication of the hour leaf. Thus the change of indication of the hour leaf is prevented until the proper change of indication of the minute leaves has occurred. In this manner a variation in the accuracy of the hour leaf is obviated.

Referring to the accompanying diagram, two sets of spring stops are employed, the one, *B*, to hold back the hour leaves, the other, *A*, the minute leaves, for the proper interval. The control of the hour leaves by the minute leaves is effected through an additional stop, *C*, for the hour leaves, controllers in the form of projections being provided on six of the minute leaves to regulate the movement of the additional stop, *C*, so as to cause it to hold an hour leaf from the engagement of the first controller with the additional stop, until the last minute leaf carrying a controller has been released. The first minute leaf carrying a controller is that which indicates the 54th minute of the hour, and the last minute leaf carrying a controller is therefore the minute leaf which is held for the indication of the 59th minute. Should the hour leaf stop, *B*, release the hour leaf at any time during this interval of six minutes, the hour leaf will still be held by the additional stop, *C*, until the minute leaves change the indication from 59 minutes to the even hour. In this manner ample provision is made for the ordinary variations in the release of the hour leaves by the hour leaf stop, *B*. In the clock shown in the illustration there are sixty hour leaves, five for each hour. The hour leaves are changed at intervals of twelve minutes (exhibiting, of course, still the same figure), and during this interval twelve minute-leaves are changed.

Destruction of the Cork Forests of Italy.

The cork industry, which is quite an important one, will receive a fresh impetus, a new process having been discovered by which large pieces can be made out of small ones, so that cork waste can be utilized in large quantities. This is all the more important as the price of cork increases steadily, both on account of the growing demand and the lessened supply of the raw material.

Formerly Italy was a large producer of cork, but a great part of her splendid cork-oak forests has already been destroyed. In some provinces—as, for instance, in Calabria—the trees have been felled and used for charcoal making; in other provinces they have been cut down on account of their high potash contents.

Larger forests of cork-oak trees are still existing in Spain, Portugal, France, Algeria, and Tunis. None are found in Asia Minor and only rarely in Greece and European Turkey, although the climates seem to be favorable for their growth. The area covered by these forests is estimated at 300,000 hectares (741,300 acres) in Portugal, 250,000 hectares (617,750 acres) in Spain, 280,000 hectares (691,880 acres) in Algeria, and only 80,000 hectares (197,750 acres) remain in Italy.

While Spain still furnishes 32,800 tons of cork annually, the production of Italy has decreased to 4,000 tons. The value of the Spanish exports of cork amounts to $6,000,000 per year, against less than $250,000 for Italy. Only Sicily and Sardinia are still producing cork to any considerable extent in Italy, while the former great oak forests of Calabria are almost totally destroyed. It seems incomprehensible that this destruction has been permitted. The trees easily reach an age of 200 years. They yield cork in their thirtieth year and continue to do so every seven years. Seventy-five years ago the English demand for cork was supplied exclusively from Italy. The destruction of the remaining forests goes on uninterruptedly, and nobody seems to try to prevent it or to plant new forests in spite of the fact that Italy possesses the most favorable climate and soil for the cork oak, the most favorable conditions for its growth being found in the volcanic soil of the peninsula.

The recent three-hundredth anniversary of the death of Gilbert, of Colchester, the founder of the science of electricity, was honored by the presentation, by the Institution of Electrical Engineers of Great Britain to the borough of Colchester, of a painting by Mr. A. Ackland Hunt, representing Dr. Gilbert showing his electrical experiments to Queen Elizabeth and her court. Gilbert discovered the augmentation of the power of a loadstone by arming or capping it with soft iron cheeks, the screening effect of a sheet of iron, the method of magnetizing iron by hammering it while it lies north and south, the destruction of magnetism by heat, and the existence around the magnet of a magnetic field. Generalizing from small to large, he advanced the entirely novel idea that the globe of the earth is itself a magnet. His book *De Magnete*, over which he spent eighteen years, was published in 1600, and for the next three hundred years remained the standard work on magnetism.