Electrical Notes.

The city of San José, California, recently inaugurated its system of electrical lighting. The current is carried for a distance of 173 miles from a plant situated in the very heart of the Sierra Nevada Mountains. The current is used not only for the purpose of illumination, but also for driving the street cars and machinery of the various manufactories.

According to the London Electrical Engineer, successful results are said to have been obtained by a Mr. Storey, of Lancaster, on Lake Windermere with a boat steered from the shore by an adaptation of wireless telegraphy. The experiments were conducted in private, and no particulars are to hand as to how Mr. Storey accomplished his reported achievement. It is stated, however, that he was able to steer the boat from the shore, directing it in safety in and out of a fleet of sloops and steam launches at their moorings.

On October 13 a special train on the Grand Trunk Railway made a trip that will probably be historical. The train passed through Montreal on October 13 bound for Portland, Me. On board a complete set of wireless telegraphy apparatus had been installed for the purpose of experiment. Moving at a speed of sixty miles an hour it was possible to receive messages clearly on the train. Communication was first established eight miles from St. Dominique and continued uninterruptedly until the station had been left eight miles behind.

A paper was read before the British Association at Belfast on the electrical conductivity of certain aluminium alloys as affected by exposure to the London atmosphere. The specimens exhibited were in the form of wire, 0.126-inch (3.2 mm.) diameter, supported on a wooden frame; they were exposed on the roof of a building for thirteen months. It is assumed that the observed effects are principally due to pitting at the surface, but exposure might also affect the structure. The position of aluminium in the electrochemical series with respect to the other substances used is as follows: *Al, Mn, Zn, Fe, Ni, Cu, Si.* It should be expected that copper, widely separated as it is, would be effective in the production of corrosion. This is found to be the case, the effect increasing with the percentage of copper. Nickel is well separated from aluminium in the series, and alone has considerable effect, but if alloyed with copper the conductivity increases slightly during exposures. This specimen is specially promising, as it has a breaking load of 45,900 pounds, and limit of elasticity 36,600 pounds per square inch. It has a comparatively low percentage extension, a high coefficient of expansion, and a low temperature coefficient for electric resistance. Again, iron in the presence of nickel has a slightly increased conductivity. The results of the analysis of the different experiments before and after exposure are given in a table. For exposed aluminium alloys it appears that copper alone should not be used in the alloy; the presence of equal amounts (about one per cent) of nickel and copper certainly reduces conductivity by a small extent, but the increase in mechanical and the decrease in corrosive properties is great.

Haber and Geipert have been investigating the conditions under which aluminium is obtained by the electrolytic method, and have published their results in the Zeitschrift f. Elektrochemie. They point out that no trustworthy details of the method employed in the various works where the metal is now produced have hitherto been made public. Using a small experimental fusion cell, and the ordinary lighting supply current of the Karlsruhe Technical Institute, they were able to reduce alumina without difficulty and to obtain as much as 230 grammes of the metal in one operation. The metal obtained was remarkably pure, one sample tested containing only 0.05 per cent C and 0.34 per cent Si. The mechanical tests made with six samples of the aluminium gave an average tensile strength of 21,425 pounds per square inch. The fused mixture used in the carbon cell contained 33 per cent AlF_3, 33 per cent NaF and 33 per cent Al_2O_3, the high percentage of aluminium fluoride being conducive to fluidity. The current density employed was about 2,800 amperes per square foot, and the E. M. F. varied between 7 and 10 volts. The authors, as the result of their experiments, have come to the conclusion that the steady improvement in the efficiency of the process as carried out in the aluminium works is due, not to secret modifications in the process, but to the more careful attention now given to the purity of the raw materials employed. They also point out that the carbon contained in the aluminium obtained in their experiments was not present in the combined form, and as it was graphitic in character they assume that it represented mechanically inclosed particles, due to the disintegration of the anode and cathode carbon. By remelting the aluminium it was possible to remove a portion of this impurity from the metal. The necessity of employing carbons comparatively free from ash is insisted on, since any impurities of the carbon used will be found in the final product.

THE INFLUENCE OF GRADES.

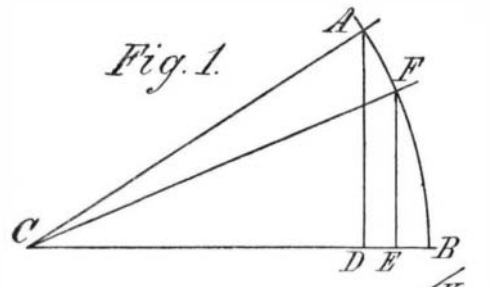
Automobilists and cyclists know, of course, that more force is required to climb a hill than to run on a level. But few know just what the relation is. When they consult a text-book, they generally run into a formula which contains "the sine of alpha;" and that usually finishes their investigations. I purpose to give a rule that is just as good, for all practical purposes, as can be had by using a table of sines, which in any case is not always accessible even if it would be comprehended by the wheelist or automobilist.

When any vehicle runs on a level road, the amount of traction (that is, the amount which would be indicated by pulling through a spring balance placed between the vehicle and the motive power if the latter preceded the vehicle as in horse traction) runs on a good surface from 1-80th to 1-50th of the weight of the vehicle, according to the character of the road surface and that of the bearings, tires, etc. That is, a 25-pound wheel would call for about half a pound of pull, and could be towed by a thread which would hold up a weight of eight ounces; and if the road were good, a 40-pound tricycle could be towed by the same half-pound effort.

On level stone pavements of good class it takes 1-40th to 1-30th of the weight of the ordinary wheeled vehicle to tow it; and on macadam in bad condition 1-20th; that is, a 20-pound racer would here take a pound to tow it empty. We will say for average road surfaces 1-30th the weights; which would give us for a one-ton automobile nearly 75 pounds average.

The books tell us, and with reason, that the extra traction on up grades increases directly as the sine of the angle of the grade; and refer us of course to a "table of logarithmic sines" for long fine work, or a "table of natural sines" where there is not much figuring to do.

That is, if we had a hill, *AC*, with an angle, *ACB*,



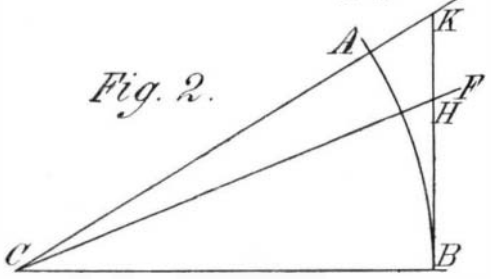


DIAGRAM SHOWING METHOD OF COMPUTING GRADES.

counting from the level, we would have the necessary increased tractive force, compared with that on a hill, *FC*, in the same proportions as the lines, *AD* and *FE*, dropped "plumb" from the ends of the arcs (that is, from the ends of the inclined radii, also) to the horizontal radius. And if we know the angles, *ACB* and *FCB*, we can get these "sines" for a radius, 1, from a table of natural sines and cipher it up that the increased traction is equal to that on a level, multiplied by the natural sine of the angle.

But road grades are not reckoned by angles; they are counted by so much rise per mile or per hundred feet or other convenient standard unit—as for instance "1 in 100," or "10 feet to the mile," or what not. Now this "rise" per hundred feet of horizontal distance corresponds exactly to the tangent of the angle of the grade; and the natural tangent is so near the natural sine that for our purposes, where the angles are small anyhow, we can use it to multiply by.

In the second figure we have the same grades, *AC* and *FC*, the same radii, *AC* and *BC*; but instead of the sines (dropped plumb from the ends of the inclined radii to the horizontal radius) we have the tangents, *BH*, *BK*, raised plumb from the end of the horizontal radius to the inclined radii produced. In both cases the lines, sines and tangents, start from an intersection of one arc with a radius.

Now using the tangent instead of the sine, we find that on any grade the amount required to tow the vehicle is equal to the original weight times the coefficient (this coefficient being 1-20th or 1-30th or 1-40th or what not, according to the grade and the condition of bearings, tires, etc.) plus the extra traction, which latter is the weight times the per cent of grade.

If this is the case (i. e., this being the case, which it practically is) we have with a coefficient of 1-30th = 3 1-3 per cent, double the traction as soon as we have a 3 1-3 grade, and triple where we have a 6 2-3 per cent grade; and when we reach an up grade of 10 feet in a hundred, four times the power is needed that would suffice on a level.

For better roads, where our coefficient is 1-40th instead of 1-30th, we have for a ten per cent grade five times the tractive force which is necessary on a level; and where we have the very best roads usually attainable, and run our traction on a level down to 1-60th the weight of the vehicle, then we need, on a 10 per cent up grade, 6 2-3 times as much as on the level. The better the roads, the greater the proportionate bad influence of grades. There are roads in France, and perhaps also in Germany, where the traction coefficient runs down to 1-80th; and here a 10 per cent up-grade calls for nine times as much power as a level!

So, in figuring up the power required to mount a hill, remember that comparatively more "notching up" is required where the roads are good than where they are bad!

Transportation in Madagascar.

With the completion of the road between Mahatsara, on the east coast of Madagascar, and Tananarivo, the capital, it is now possible to transport goods for a distance of 200 miles. To be sure, goods are transported not entirely upon land, but partly over this newly completed road, and largely by waterway formed by a series of lagoons and canals. It is hoped that before many years have passed the roads and canals will give place to a railway which is to lie between Tamatave and Tananarivo.

In order to transport goods to the coast, Hova carriers are employed to carry huge packs through the mountains. With the completion of a new road the Hova porter will be compelled to seek a new field of employment. Between four and five thousand porters usually made the trip through the mountains to the coast. When the new road was finished, carts immediately began to displace the Hovas. Where three wagons were used last January, 372 were used in June.

To be sure, the cartage is still rather primitive; for the vehicles are hauled by men. If human power is used to draw these carts, the question naturally arises, How is it that the Hova carriers are compelled to seek other employment? The reason is to be found in the fact that each cart, having a carrying capacity of 750 pounds, is drawn by three men; whereas the Hova carrier, however strong he may be, can hardly bear more than 100 pounds. When oxen and mules are substituted for men, we may expect a reduction in the price of cartage transportation.

The Current Supplement.

The current SUPPLEMENT, No. 1401, opens with a continuation of Mr. F. C. Perkins' article on "The Berlin Underground and Elevated Railway." The present installment is just as copiously illustrated as was the last. The question of using oil fuel in the United States Navy has been fully discussed in a report prepared by the Bureau of Steam Engineering. The current SUPPLEMENT contains the first installment of that report. M. Berthelet discusses researches on argon and its combinations. "Radio-Activity and the Electron Theory" is the title of an interesting paper. Dr. Lorenz's operation is concisely described. "New Apparatus for Short Distance Stereoscopic Photography" forms the subject of an exhaustive article. The French first-class battleship "Gaulois," which it will be remembered figured prominently during the Rochambeau celebration in this country, is described and illustrated. Mr. Henry Clay Weeks gives some practical suggestions on mosquito extermination in New Jersey. Mr. A. Wehnelt, inventor of the interrupter that bears his name, discourses interestingly on the distribution of current at the surface of cathodes in vacuum tubes. The usual Selected Formulæ, Trade Notes and Recipes and consular information are also published.

$2,197,789,824 of Money in Circulation.

The total stock of money of all kinds in the United States on September 1, as reported by the Treasury Department, was $2,579,306,217, being an increase of $67,446,684 over that on the same date last year. The amount in circulation was $2,197,789,824, which, based on an estimated population of 79,344,000, is a per capita of $28.55. The per capita on September 1, 1901, was $28.18, and on the same date in 1900 was $26.85.

Spencer's Latest Feat.

On the afternoon of October 20, Stanley Spencer, the aeronaut who recently made a successful trip over London, made an ascent at Blackpool, in Lancashire. After traveling about 26 miles, he descended near Preston. There was a good breeze when he ascended. At about a height of 1,000 feet he made several evolutions, and finally sailed off in the direction in which the wind was blowing. Spencer almost collided with an express train in descending, but escaped by ramming a tree. No serious damage was done.