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Explosion of a Submarine Mine at Willet's Point.

THE SUBMARINE MINE.—[See page 160.]

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NEW YORK, SATURDAY, AUGUST 26, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receivespecial attention. Accepted articles will be paid for at regular space rates.

DELAY IN BUILDING THE AMBROSE CHANNEL.

The failure of the company that has taken the contract for dredging out the Ambrose Channel at the entrance to New York harbor to live up to its contract is assigned by Lieut.-Col. Marshall of the United States Engineer Corps as the reason for the backward state of this work. It seems that the government has endeavored to be lenient and has made several modifications in the contract in order to encourage the contractors in pushing the work through to completion. The original appropriation for the digging of the channel was $4,000,000, and up to the present time the dredging company has been paid $1,200,000 of this amount. In order to assist in the prosecution of the work the government has expended $700,000 in the construction of two dredges of its own, of which one was put upon the work in the autumn of 1904, and the other in the spring of 1905. The contract is for a 40-foot channel, and Lieut.-Col. Marshall states that he hopes to have a 35-foot channel ready by the beginning of 1906.

As showing that the government has been lenient, it is stated that the first modification was to grant an extension of time. It was followed by an easing-up on the question of the amount that was to be dredged in a given time, the quantity being cut down from 1,200,000 to 400,000 yards per month. This last concession was accompanied by an agreement that the government should put its own plant to work and that all the work which it accomplished should be deducted from the dredging company's contract at the contract price of 9 cents per yard. Even under the last-named conditions the work does not seem to have progressed any better; if anything, indeed, it has moved more slowly. It appears that from the experience gained with the government type of dredge, the material can be taken out for from 3 to 5 cents per yard instead of the contract price of 9 cents. In view of the above facts we heartily agree with the engineer in his conviction that the best plan under the circumstances would be for the government to cancel the contract and hire the necessary dredges to finish up this important work.

AN OLD PROBLEM IN A NEW FORM.

The publication of our recent article on the leap-frog railway has awakened an active discussion of the question of the speed at which the two cars pass each other. Some of our correspondents claim that if each car has a speed of eight miles an hour when they meet, they must pass each other at a relative speed of sixteen miles an hour. Others again claim that when the over-riding car passes on to the rails carried by the lower car, its wheels continue to revolve at a rate corresponding to a speed of eight miles an hour, and the two cars therefore pass each other at that speed. One correspondent clinches his argument by quoting the supposedly analogous case of a person who is walking, at a speed of four miles an hour, to the rear of a passenger car which is running at a speed of sixty miles an hour. In this case, he argues, the man and the car pass each other at a speed of four miles an hour, the speed of the man, like that of the upper leap-frog car, being independent of any speed possessed by the object over which he is moving.

The fallacy of this last argument is due to the very common error of confusing absolute and relative speed, or speed with reference to a fixed object such as the ground, and speed with reference to a moving object such as the lower leap-frog car, or the train on which a man is walking.

In the case of the leap-frog cars, the lower car is moving (let us say south) past a fixed point on the ground at a speed of eight miles an hour. The upper car is moving (let us say north) at eight miles an hour with reference to the same fixed point on the ground.

The cars, therefore, are approaching each other at a speed of $8 + 8 = 16$ miles per hour, and if they were on different tracks, side by side, they would pass each other at a speed of sixteen miles per hour.

But they are on the same track, and one has to climb over the other.

What effect does this climbing have on the speed of the cars?

It absorbs some of the momentum of each car, and reduces the speed proportionately. Most of the energy absorbed is expended in lifting the north-going car through a height of six feet and a smaller portion of the energy is expended in overcoming the increased friction, shock, etc.

The loss is divided between the two cars (action and reaction being equal and opposite) and it amounts to a reduction of about four miles per hour in the speed of each car.

During the time that the north-going car is passing over the south-going car, the only new element that is introduced affecting the speed of the two cars with reference to the ground, or the *absolute* speed, is the work done in lifting one car and in overcoming increased friction, shock, etc.

This expenditure of energy results, as is shown when the cars are in actual operation, in reducing the speed of each car from eight to four miles per hour, speed being reckoned with reference to a fixed point on the ground.

Hence, while the cars are passing each other, the north-going car passes a fixed point on the ground at a speed of four miles per hour, and the south-going car passes the same point at a speed of four miles per hour, and they, therefore, pass each other at a speed of $4 + 4 = 8$ miles per hour.

Let us consider the leap-frog car problem under two conditions, A and B.

CONDITION A: If the lower car formed part of a train that carried upon its roof tracks that were, say, five hundred yards long, and the upper car started from rest on these tracks on the roof at the same time that the train containing the lower car started from rest, in the opposite direction, on its own tracks on the ground, and if by the time the two cars met, each car had accelerated to eight miles an hour *with reference to the track on which its own wheels were turning*, then the cars would pass each other at a speed of eight miles per hour only.

CONDITION B: But in the case in question the conditions are totally different. Both the upper car and the lower car start and accelerate to a speed of eight miles per hour on the *same* tracks *on the ground*. When they meet, the upper car, moving at an *absolute* velocity of eight miles per hour, passes on to a pair of rails that already have an *absolute* velocity of eight miles per hour in the opposite direction. The resultant *relative* velocity, as between the upper car and the rails on the roof of the lower car (and, therefore, the lower car itself) is evidently $8 + 8$ miles per hour (if we disregard friction and climbing effort) or $4 + 4$ miles per hour, if we allow for these.

The man walking toward the rear of a train is an analogous case to Condition A, but not to Condition B.

To make it analogous to Condition B the man must be walking towards the rear of the train *on the ground* at four miles per hour, and then, still facing the rear and still moving four miles per hour, he must *step on the train.*

His legs will be knocked from under him; but for the instant of time before he falls, and his body strikes the train and is retarded, he will be passing the train at $60 + 4 = 64$ miles per hour.

Similarly, at the instant that the forward trucks of the upper car first strike the inclined rails of the lower car, they are passing these rails at a speed of $8 + 8 = 16$ miles per hour. The retardation immediately commences, and is at its maximum effect by the time the steep grade to the roof has been surmounted, when the relative passing speed has slowed to about 8 miles an hour.

RUSSIAN ARMY HYDROGEN BALLOONS.

At the recent Aerostatic Congress which was held at St. Petersburg, Dr. Helbig described the new hydrogen generators which the Russian army is using for field work in connection with war balloons. The new apparatus has now been adopted by the aerostatic corps of the army. The process is designed to reduce the weight of the apparatus as much as possible, so as to make it easier to transport. Up to the present, hydrogen has been prepared for balloons by acting on iron with dilute sulphuric acid. But there is another reaction which is available, that of alkaline hydrates upon aluminium, in which hydrogen gas is given off.* Two different types of apparatus have been designed for the army, one for field work, mounted on a carriage, and a second for mountain use. These apparatus are built of iron, as the alkaline solutions have no effect upon that metal. A gas generator and a scrubber form the two different parts. The generator contains a caustic soda solution, in which is placed an iron basket containing aluminium scrap. At the upper part, the generator is connected with the scrubber by a long sheet iron tube. The gas bubbles through the water contained in the scrubber, leaving the traces of alkaline matter which are brought over. From thence the hydrogen is brought to the point where it is to be used, by a flexible tube made of canvas treated with impermeable varnish. If need be, several generators of the above type can be coupled together. The different joints of the apparatus are made by hydraulic pressure, and are very tight. When once commenced, the aluminium is attacked by the soda solution with great energy. The gas comes off very rapidly and the liquid heats up to the boiling point. But as the proportion of free soda in the solution diminishes, the reaction becomes slower. In order to finish the gas production with a sufficient activity, the generator needs a supply of caustic soda which is above the theoretical value. If the above formula is taken as the starting point, we find that to obtain 1 cubic meter (1.26 cubic yard) of hydrogen we need 1.8 pounds of aluminium and 7.9 pounds caustic soda. But as the commercial metal is generally only 99 per cent pure and the commercial soda only has 77 per cent at most of sodium hydrate, we need to use 10.3 pounds of the latter. The weight of raw materials which must be transported in order to furnish 1 cubic meter hydrogen is therefore 12 pounds. With the usual process using iron and sulphuric acid, the weight to be carried is 15.5 pounds. The new method thus gives an economy of 20 per cent as regards weight. There is also a reduction in the weight of the apparatus, which can be made much lighter, seeing that they are not built of sheet iron covered with lead, as in the other cases. The hydrogen which is obtained by the new process is of much greater purity. It does not contain any volatile hydrocarbons which increase its density and diminish the lifting force, nor any hydrogen arsenide which is often met with and renders the gas dangerous on account of its poisonous properties. The only impurities it contains are water vapor and traces of alkaline liquid. A great advantage is the use of soda, which is solid, as compared with the corrosive sulphuric acid, when we consider the question of transport. The only disadvantage which the new process shows is the cost of the hydrogen, which Dr. Helbig figures as high as $0.02 per cubic foot. Until the price of aluminium drops considerably, it is doubtful whether the process can be used except in cases where the cost is a secondary matter.

* This reaction is represented by the formula:

$$Al + 3\ NaO, HO = 3\ H + Al\ O_3, Na_3.$$

THE GOVERNMENT'S NEW COAL-TESTING PLANT.

For a long time the Kaiser's engineers have been testing the coals in the German empire. Coal measures have been surveyed and samples analyzed so that the government knows the chemical and relative values of its coking, steam-producing, domestic, and gas-producing coals. It has experimented with machines for compressing slack coal into briquettes. What was waste a few years ago now forms one of the best locomotive fuels. Slack coal is also pressed into what is called eggettes—forms small enough for stoves and grates.

The coal surveyors of France are not behind those of Germany, while Belgium profits by the investigations of both. On the British Islands lignites, peats, and even turfs, have been surveyed and their economy carefully ascertained by scientific methods. No nation has a more accurate knowledge of its fuel resource than Great Britain.

The people of the United States mine and consume more coal than do the French, Germans, or English. Our coal fields extend over more territory and supply a greater variety of mineral fuels than do the coal fields of any other people. We need coal tests more and have had them less than our competitors.

Since the first of last September the United States Geological Survey has conducted the initial line of government coal tests. They were preliminary. They were conducted under act of Congress, approved March 18, 1904. This act carried an appropriation of $30,000, increased by the general deficiency bill, approved April 17, 1904, to $60,000. Resulting from these preliminary tests came a suggestion of how more than a million dollars may be saved to the federal government annually in coaling naval vessels, at the same time increasing the efficiency of cruisers and men-of-war. The suggestion is still more important to manufacturers using coal under boilers. These dominating facts led Congress at the last session to appropriate $200,000 for a continuation of the tests.

Under the terms of the appropriation the United States Geological Survey is now entering upon a comprehensive and scientific examination of our coals and lignites. Two conditions attach to the availability of the appropriation: (1) Samples of coal in car lots must be furnished at the testing plant free to the government; (2) the service of machines, apparatus, and devices used in making the tests must be free. As coal mine operators and transportation companies are deeply interested in these tests, no difficulty attended the first condition. When the preliminary tests were made the plant lacked somewhat in unity and adaptation. The equipment is now closely standardized and reconciled to one purpose.

The director of the United States Geological Survey appointed Messrs. E. W. Parker, J. A. Holmes, and M. R. Campbell, a committee to conduct the investigation. This committee erected the necessary buildings and established the testing plant on a terminal railroad in Forest Park, St. Louis, Missouri. Many of the superintendents and operators who made the preliminary are now engaged in making the formal tests, so that the plant is served by trained men. The same building, stacks, scales, etc., are used. Some of the equipment has been repaired. All has been readjusted. Some has been added. The main parts of the equipment are engines, boilers, conveyors, generators, motors, washing machines, gas machines, briquetting machines, coke ovens, and a chemical laboratory. The qualities of the coals are ascertained by analyses, by steam tests, gas-producer tests, coking tests, briquetting tests, and washing tests. From twenty-minute readings a log is made of each test. These tests will be tabulated and printed in a report for distribution as any other public document in the Department of the Interior.

Each steam test will require ten hours and consume approximately 10,000 pounds of coal. Each log will show the number of the test, name of the sample, size and condition of the coal, and twelve technical items composing the standard method of steam tests approved by the American Society of Mechanical Engineers. The sample will be tested for economy of fast, slow, or medium feeding, and for size of grate.

Each gas-producer test will continue thirty hours and consume approximately 10,000 pounds of coal. The coking tests will require forty hours and consume in each charge approximately 10,000 pounds of coal. Results of washed samples will be compared with results of unwashed. The results of the briquetting will show the general character of the product, its behavior in weathers, its behavior in burning, and its crushing strength. Eggettes will be made and tested. Experiments will be made with binders. All facts gleaned will be printed in comprehensive tables.

Now the question arises, what feature of the results of the preliminary experiments induced Congress to depart from its general policy and to make a liberal appropriation for continuing the operation of this coal-testing plant? Of course the chemist and the engineer will be interested from a mere technical standpoint, but of what benefit were the preliminary assays to the mass of people? Sixty-five carloads of sample coals from seventeen States were received. The results were:

1. Fourteen bituminous coals from nine States show a power efficiency in the gas-producer plant two and one-half times as great as their power efficiency under the boiler—put in another way, one ton of these coals used in the gas-producer plant developed as much power as two and one-half tons of the same coal used under the steam boiler.
2. Eggettes and briquettes may be made from the slack of some soft coals and probably from the culm of hard coals.
3. Lignites from North Dakota and Texas have shown unexpected high power-producing qualities when used in the gas producer. More than one-third of North Dakota is underlaid with lignites. These are the major results. The minor results are not unimportant.

The method of obtaining fair run-of-mine samples is of prime importance. One member of the committee devotes his entire time to field work. His method is interesting, but the details are too special and complicated to be given here; suffice it to say that it is practically impossible for operators to obtain assays from selected or unfair samples.

For the first time the government is taking steps to give its citizens information relating to our coal measures—information long since in the hands of German and French cittizens relating to their coal measures. Gas engines of prodigious power are coming into operation. Every year shows an increase in power and an improvement in performance. The yearly coal bill of the United States navy approximates $2,500,000. The gas engine would save half this sum and enable war vessels to make longer voyages with greater ease and rapidity. Such is the meaning of this new coal-testing plant. What it means to States like North Dakota, with large mines of lignites, no one can tell.

POWER SITES ABOUT NIAGARA FALLS.

BY ALTON D. ADAMS.

Lake Erie stands 573 feet, and Lake Ontario 246 feet above sea level, so that Niagara River drops 327 feet in its course of 27 miles between them. Nearly all of this fall is concentrated in that part of the river between Port Day, in the city of Niagara Falls, and the foot of the Niagara Escarpment at Lewiston and Queenston, a distance of about eight miles.

At Port Day the approximate level of Niagara River is 560 feet above tide water, and at Lewiston the river surface is only a little above that of Lake Ontario, so that the fall between these points is about 313 feet.

It may thus be seen that the perpendicular plunge of 163 feet at Niagara Falls, on the American side of the river, is only about one-half of its total drop in a distance of eight miles. A little below Port Day, and some three-fourths mile above the falls, the upper rapids begin, and from their head to the foot of the falls the drop is about 210 feet. From the foot of the falls to the head of Whirlpool Rapids near the old suspension bridge, something less than two miles below, the descent of the river is comparatively slight, but from this latter point to the Devil's Hole at the mouth of Bloody Run there is a fall of approximately 90 feet in a distance of less than two miles.

Looking at a large scale map of Niagara River and of the east and west ends respectively of lakes Erie and Ontario, with the above facts as to the fall of the river in mind, several practicable plans of power development present themselves. As the east end of Lake Erie extends parallel with the west end of Lake Ontario, and only 27 miles therefrom, for a distance of more than 40 miles, it is evidently possible to dig a canal north and south across this territory between the lakes and thus obtain a water head equal to almost their entire difference of level. This plan is rendered all the more practicable by the fact that the land between the lakes has few changes in elevation save along the Escarpment, where it drops down to the Ontario level, and that this Escarpment is 6 to 7 miles south of the Lake Ontario shore line, so that the length of a power canal need be only about 20 miles. Power development on these lines has already been carried out on quite an extensive scale by firms who draw water from the Welland Canal. Among the plants thus operated is a large electric installation whence energy is transmitted 35 miles to Hamilton, Ontario. Further developments of similar kind may be expected in the future. The most serious impediment in the way of such plants is the great cost of a 20-mile canal, but this impediment will not retard development until the capacity of the Welland Canal is reached.

Another glance at a large scale map of Niagara River shows that its great sweep north of Grand Island, from Tonawanda to Niagara Falls, a distance of some 6 miles, gives a shore line of that length from which canals may be dug either to the Escarpment about 9 miles to the north, or to points on the Niagara River below the rapids, only six or seven miles away. The situation is made more favorable for power development on this plan by the fact that the territory through which such canals would run is very nearly flat, and lies only a few feet above the level of the upper river. Power developments on this plan would have an available head of about 300 feet of water. On the Canadian side of the river the situation is less favorable for canals similar to those just suggested, because such canals would necessarily be longer and their cuts would be much deeper. The favorable situation for canals and power plants on the American side of the river has already attracted attention. Among several such projects the most prominent may be mentioned, which contemplates the construction of a canal 37,500 feet long from La Salle to the Devil's Hole, a deep ravine in the bank of Niagara River just north of the city limits of Niagara Falls. The head of water thus made available is 300 feet.

Most of the power developments now under construction, or in operation, are centered about Niagara Falls, and draw water from the river above only to discharge it into the gorge just below the great cataract. On the American side of the falls there are two such plants, both in operation, one of which conveys the water across the city of Niagara Falls in an open canal, and the other discharges through a deep horizontal tunnel cut in solid rock. Both of these plants take water from the river at or above Port Day, and thus take advantage of the rapids above the falls as well as of the latter. On the Canadian side of the river three large power plants are under construction, and a fourth much smaller plant is operating. One of the three large plants takes its water from the river above the rapids, and thus obtains a head of more than 200 feet, like that of the plants on the American side, but the other two large Canadian plants draw their water from the very midst of the rapids, and so have somewhat lower heads. All three of these large Canadian plants discharge their water near the foot of the Horseshoe Falls, two through horizontal tunnels, and one from a power house located in the gorge below. One of these tunnels opens directly behind the foot of the Falls.

The small plant just mentioned utilizes less than one-half of the available head, and discharges its water high up on the face of the perpendicular cliff that forms the side of the gorge.

For purposes of easy power development with the head of water furnished by the great cataract and the rapids just above, the city of Niagara Falls, N. Y., is much more favorably located than is the territory directly across the river in Ontario. This is due to the fact that the river changes its course by more than a right angle as soon as it takes the great plunge, so that the city forms the acute angle between the upper and lower stretches of the river, and to the further fact that the Ontario bank grows high very rapidly, while the New York bank remains level. The narrow strip of low land on the Ontario bank of the river a little above the falls, forming Queen Victoria Park, has its water front entirely taken up by the four power plants already located there. If other plants are to be located on the Ontario bank of the river to utilize the head afforded by the upper rapids and the falls, canals, pipe lines, or horizontal tunnels several miles in length must be constructed, and the two former can only be carried through very deep cuts, largely in rock. On the New York side of the river several miles of low water front above the falls might easily be used for the intakes of power plants whose pipe lines, canals, or tunnels could reach the gorge below, with lengths of between one and two miles.

All of the plans for power development thus far considered involve reductions of the volume of water going over the great cataract. With an intake near the old suspension bridge on the New York side, and a tunnel about 8,000 feet long to the Devil's Hole, the entire flow of the river may be utilized, if desired, at a head of nearly ninety feet, and still leave the grandeur of the great falls undiminished.

Plans are now said to be under way for a development of this sort, and aside from the tunnel the cost is very moderate.

SCIENCE NOTES.

A wild grape vine upon the shores of Mobile Bay about one mile north of Daphne, Ala., is commonly known as the "General Jackson vine," from the fact that Gen. Andrew Jackson twice pitched his tent under it during his campaigns against the Seminole Indians. This vine in June, 1897, was reported to have a circumference of 6 feet 1 inch at its base. Its age was estimated at that time to exceed 100 years.

In no respect have the services of engineering science to public health science been more conspicuous than in the application and the further study of the principles involved in the processes of water purification. It has lately been shown, for example, that the introduction of pure water supplies has in many cases so conspicuously lowered the general death rate as to make it impossible to escape the conclusions (1) that the germs of a greater number of infectious diseases than was formerly supposed are capable of prolonged life in, and ready conveyance by, public water supplies, and (2), as a promising possibility, that as the result of the greater purity of the water supply the physiological resistance of the consumers of pure water is enhanced, in some manner as yet unknown; the net result being that the general death rate is lowered to such an extent as to lead to a rapid increase of population in communities previously stationary or multiplying far less rapidly.

According to Dr. Charles Davison, F.G.S., of Birmingham, England, a violent earthquake occurred on Saturday, July 15, last, of which, however, no news has yet reached us. The professor possesses a well-equipped seismological station, and as he entered his observatory at 10 o'clock on the above morning he had the rare opportunity of witnessing the instrument recording a distant earth tremor of exceptional violence. As he approached the instrument, the point of the writing lever was just beginning to register the first of the preliminary tremors—those which traverse the body of the earth by the shortest possible route. Quickly these tremors increased in magnitude, becoming also longer in period, and it was soon evident that the advance waves of an earthquake of the first order were crossing the country. In about sixteen minutes from the start these early tremors were succeeded and dwarfed by long-period undulations, which had traveled along the surface of the earth. Dr. Davison said that never before has he seen waves so large depicted on the smoked paper. Several times the pointer struck the time-marking lever near one edge of the paper, and then swept seven or eight inches across, almost to the other edge, and once beyond it, so that had he not been there to adjust the pointer immediately, the remainder of the record would have been lost. Generally, the movement was a slow, steady march, each oscillation being completed in slightly less than half a minute. But often the pointer seemed to hesitate or stagger, either to recover itself, or to swing back in the opposite direction. The extensive oscillations lasted for about ten minutes; then they decreased, though irregularly, in size until, after twenty minutes more, they were no larger than the concluding undulations of many another distant shock. At about quarter-past twelve the movement ended with waves which, traveling along the surface in the opposite direction through the antipodes of the center of disturbance, reached Birmingham, enfeebled by their long journey, but strong enough to leave a distinctly visible trace. The origin of the earthquake must have been distant from England by about 4,000 miles, so that it may have been situated in Venezuela, in India near Lahore, or in Russian Turkestan. In any event, according to the record of the seismological station, the earthquake was of great magnitude, exceeding any that has occurred within recent years.

PROCESSION OF THE GIANTS.

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Among the most interesting ceremonies in Europe are the giants' processions, as they are termed, which are held annually in various cities. They are especially popular in the Flemish provinces of France and Belgium, where every community of importance has some personage of huge proportions intended to represent a hero or other notable of the past.

Although of enormous size, as the photograph shows, the giants are carried about the streets with little difficulty, owing to the material of which they are composed. The skeleton is usually formed of light wood with possibly one or two iron rods extending from the head to the feet to give strength to the structure. Over the skeleton is fastened a stiff fabric, such as canvas, and the proper proportions are obtained by padding with cotton, hay, or some other suitable material. Upon this groundwork is placed the papier-maché which usually forms the exterior. This substance is so light and is applied with such skill that the resemblance to the human features and figure are really remarkable. Occasionally the face is formed by a mask showing the flesh tints, but the majority of the giants may be termed enormous dolls, since their mode of construction is so similar to that of this familiar toy, and so much of the same material enters into their composition. The group of giants in the accompanying photograph are known as the Gayon family, and are among the largest in Europe. The father of the family is no less than 20 feet in height, from the top of the plumes in his helmet to his feet, while his spear is over 20 feet in length itself and the shield larger in circumference than the wheel of an ordinary wagon. Madam Gayon is 18 feet in height, but, as the illustration shows, of excellent proportions and extremely lifelike in appearance. They are supposed to have three children, the largest of whom is 11 feet in height, the next 10 feet in height, while the one called the "baby," which can be seen to the left of the mother, is a foot higher than any of the crowd of people surrounding the family.

At least once a year the giants are placed upon vehicles and drawn about the streets in a procession, in which military and civic soldiers take part, their escorts sometimes numbering a thousand people.

The New Anæsthetic.

In a recent issue of the Clinique (Vol. 26, No. 7) Dr. Theodore S. Proxmire refers extensively to somnoforme, a new anæsthetic, that has been thoroughly tested at the Bordeaux School, Paris, and throughout the British Isles. Somnoforme is a combination of chloride of ethyl 60 per cent, chloride of methyl 35 per cent, and bromide of ethyl 5 per cent. The administration of somnoforme is very similar to that of nitrous oxide. The average dose of two and one-half cubic centimeters has an average induction of 30 seconds and an average duration of 78 seconds. When properly and carefully given there are practically no after effects whatever. There is a complete absence of respiratory trouble; the heart is slightly stimulated throughout the administration; the complexion remains normal, and there is no cyanosis whatsoever.

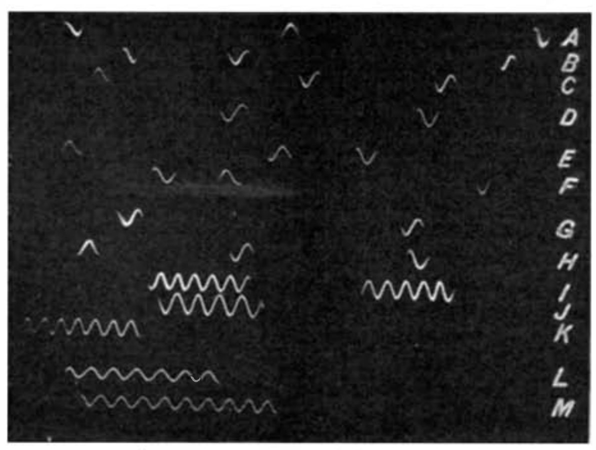
DETERMINING THE SPEED OF A PHOTOGRAPHIC SHUTTER.

BY J. IRVING TRACY.

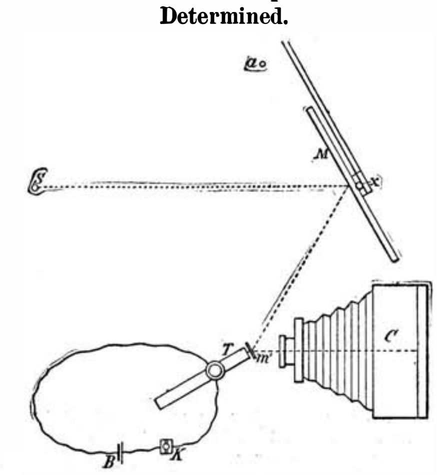
A modern photographic camera is usually fitted with an automatic shutter, which opens for a specified time to expose the plate. The accurate timing of exposure is of first importance to the photographer. He usually depends on the dial of his shutter to give the exact time. In some cases the time the shutter is open depends also on the size of the stop used, and the time indicated by the dial may not be the time of exposure.

When a ray of light falls on a mirror which is attached to a vibrating tuning-fork, it is reflected as a straight line of light. If, however, the ray of light is reflected on the vibrating mirror by a revolving mirror, the line of light is drawn out into a sine curve, and each wave of the curve represents one vibration of the fork, and hence the time of one vibration. A camera can be focused on this curve, and if photographed, the product of the number of waves by the period of the fork represents the time of exposure. For visual observations the persistence of vision will enable the observer to determine the number of waves for exposures less than one-tenth of a second.

The apparatus is set up according to the figure. *M* is a mirror revolving on the axis, *x*; *T* is an electric tuning-fork with a small mirror, *m'*, attached; *S* is the source of light, and the dotted line shows the direction of the light. Focus the camera, *C*, on the spot of light. As the mirror, *M*, turns from *a* to *b* the spot of light passes from one side of the ground glass of the camera to the other. Start the fork vibrating by means of the battery, *B*. After noting the position of the index and the size of the stop, snap the shutter while slowly turning the mirror between *a* and *b*, and observe or photograph the number of waves produced. When the waves are photographed, several exposures can be made on the same plate by having the room dark, and the camera so arranged on an adjustable stand that the back of it can be raised or lowered without changing the position of the lens in front of the fork.



The Records from Which the Speed of the Shutter is Determined.



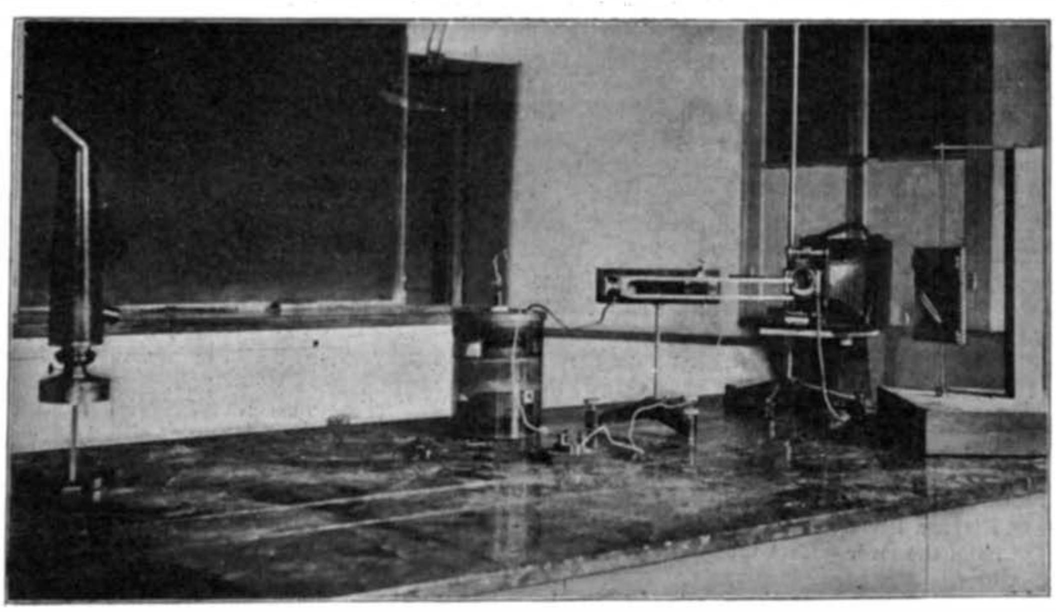
Arrangement of the Mirrors.

The annexed print will give an example of the results of this experiment. The conditions of exposure are given in the table. The fork used has a period of one-fiftieth of a second.

For this experiment the source of light should be small, and as intense as possible; either a lamp with a dark chimney which has a small hole in it, or an arc light placed at some distance from the mirror. The camera should be very near the vibrating mirror. To avoid secondary waves, which are caused by reflections from the glass surface, the mirrors used should be silvered on the top side. This makes the waves much clearer without changing the results.

	Index.	Stop.	Waves.	Time in sec.	Error per cent.
A	I	6.2	.9	018	—
B	I	8	.9	.018	—
C	I	11	1.	.02	—
D	I	16	1.	.02	—
E	1/50 sec.	16	1.	.02	0.
F	" "	11	.9	.018	10.
G	" "	8	1.	.02	0.
H	" "	6.2	9	.018	10.
I	¼ "	6.2	5.1	.102	59.2
J	" "	8	4.75	.95	62.
K	" "	11	6.75	1.35	46.
L	" "	16	6.6	1.32	47.2
M	" "	32	9.5	1.9	24.

It will be seen that the exposure varies as much as 60 per cent from the indicated value for this particular shutter. For another shutter tested, the exposure was very much decreased by decreasing the stop, and showed other irregularities which would not ordinarily be observed, save by the over or under-exposure of the plate. Every photographer will appreciate the importance of knowing the exact time of his shutter under various conditions.



METHOD OF DETERMINING THE SPEED OF A PHOTOGRAPHIC SHUTTER.

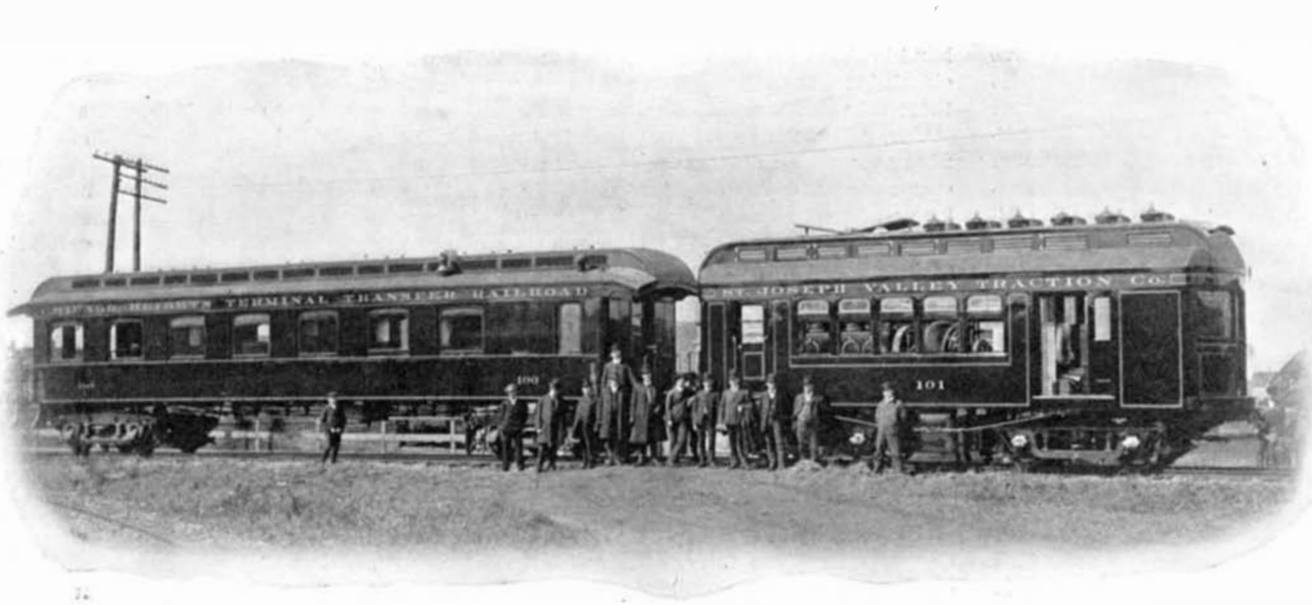
Turin Hydraulic Plant.

One of the largest of the hydraulic plants in the north of Italy is the station which has been erected in the Alpine region at the foot of Mont Cenis in order to supply current to the city of Turin over a long transportation line. The new station is remarkable both for the power now generated and the provisions for the future, as well as the high tension which is used on the line. The station is installed on the Italian slope of the Alps, and uses a fall of the Cenischia torrent, which is fed from glacier water. A 2,700-foot head of water is secured here, with an output of 300 gallons per second. This represents about 12,000 horse-power available from the fall. This is to be raised to 16,000 horse-power by future hydraulic work. In order to avoid the trouble which might arise from using a too high pressure in a single station, it was decided to erect two separate plants one above the other, and obtain half the power in each. The station which is erected at the lower part of the fall has been built first, and a second higher up will follow when required. The present plant contains three direct-coupled generating groups of 1,600 horse-power each. All the electric part of the plant is furnished by the Mediterranean Thomson-Houston Company. Two more groups are to be added. The turbines, of the Piccard and Pictet make, run at 500 revolutions per minute on a 1,300-foot fall. The alternators work at a tension of 3,000 volts. Owing to the length of the line to Turin, a tension of 30,000 volts is employed, secured by transformers having water circulation.

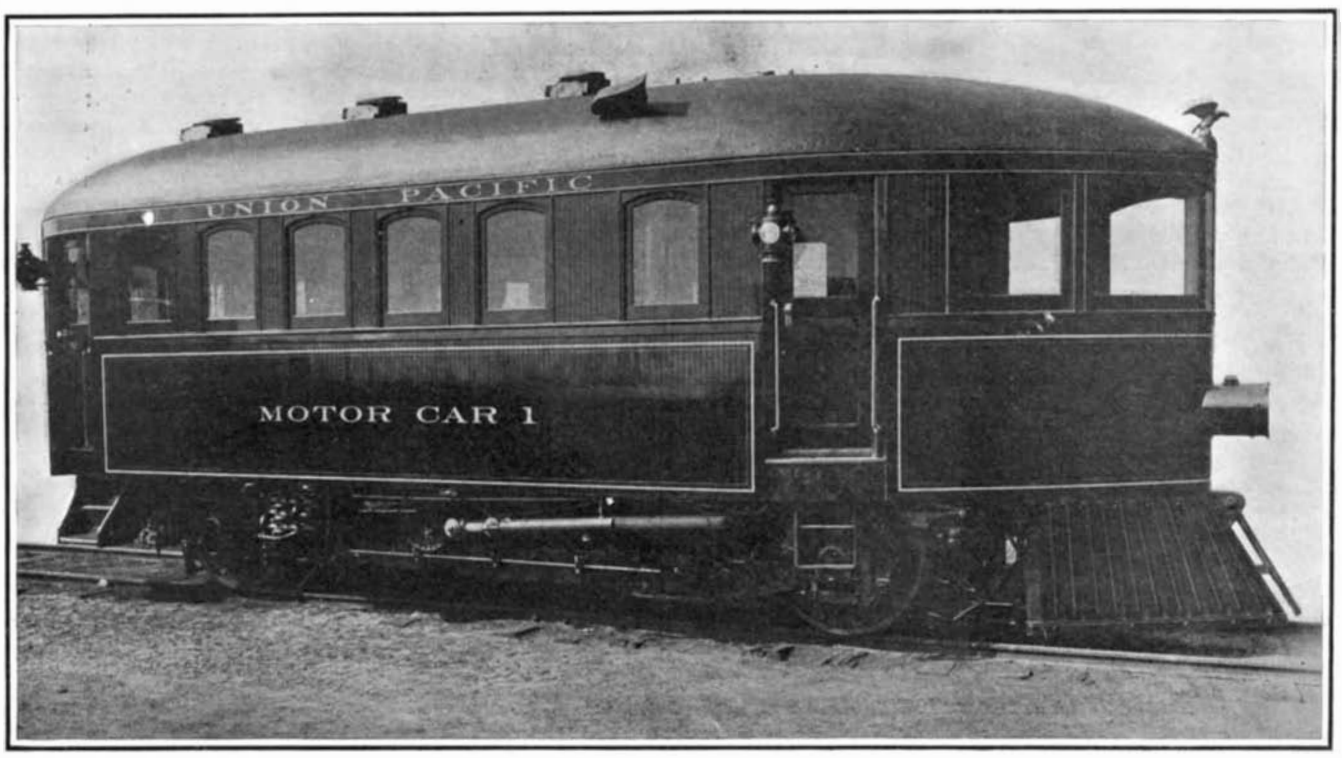
AMERICAN GASOLINE RAILWAY MOTOR CARS.

The application of the gasoline motor to a railway car, which was first experimented with and put into actual use a year or so ago in England, has recently been taken up in this country; and there are now several motor cars in operation here, which are giving the greatest degree of satisfaction.

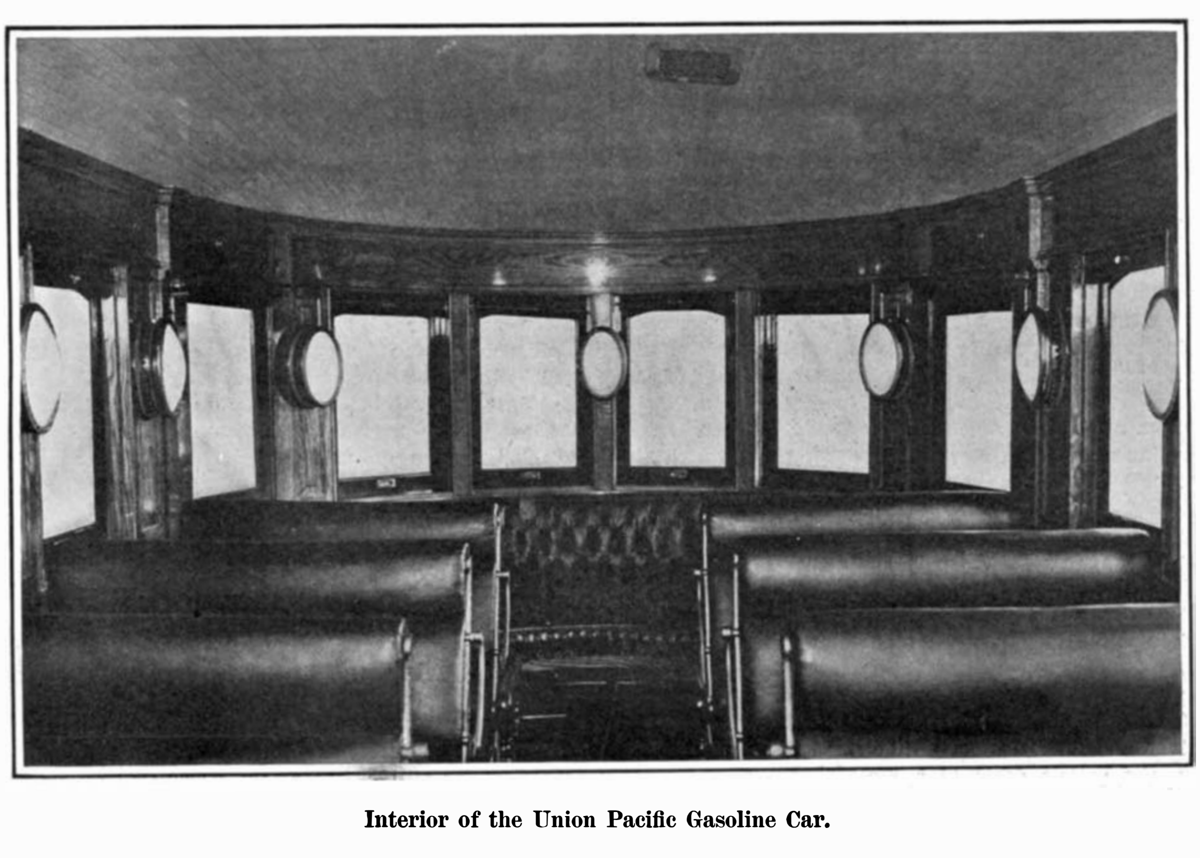
In solving this problem there are two methods of attack. Either the gasoline motor is arranged to drive the axles of the car through a transmission which gives two or three speeds ahead and a reverse, on the principle of a gasoline automobile, or the engine is direct-connected to an electrical generator which supplies current to electric motors at the car axles. A very successful car of the first type was constructed, last winter, in the shops of the Union Pacific Railroad Company. This car is of the single-truck, four-wheel type, and is designed for light branch and interurban passenger service. It has a seating capacity of twenty-five people. Its weight, complete, is a little over 20 tons. The car is 31 feet in length and mounted on 42-inch wheels. The design of the body is similar to that of a racing yacht, the front end of the car being tapered to a sharp point, and the roof rounded off from the top so as to present no flat surface to the resistance of the atmosphere. The rear of the car is rounded off so as to avoid the vacuum produced by cars of the square-end type. This shape tends to reduce wind resistance to a minimum. The car is thoroughly ventilated by means of roof ventilators which exhaust, by suction, the air inside of the car, while fresh air is drawn in from the front part of the car roof. The air in the car can be completely changed every four minutes, if desired. The floor of the car is entirely watertight and can be easily and thoroughly cleansed by flushing with hot water, which tends to destroy all germs and keeps the car in a thoroughly sanitary condition. In winter the car is heated by hot water from the engine cylinder jackets, which is circulated through radiating coils on the sides of the car. In summer this water is sent through radiating coils beneath the car. It can be directed through either set of coils, as desired, and the temperature of the car in cool weather can thus be regulated to a nicety. The car is lighted by acetylene lights placed behind opalescent panels, and a powerful acetylene headlight is also provided. The acetylene gas is generated in two Adlake generators shown in one of the illustrations. The air-brake system is supplied by means of an air-pump driven from the motor crankshaft, and which maintains 100 pounds per square inch air pressure in two reservoirs each of 13 cubic feet capacity. Tests at a speed of twenty miles per hour have demonstrated that the car can be stopped in from 112 to 115 feet without inconvenience to the passengers. The air-brakes are of the direct type and are applied on all four wheels. The car is also equipped with a ratchet lever hand-brake for emergency use. The construction of the whole car is very substantial in character, which assures the greatest possible safety to the passengers in the case of an accident or wreck, as the strength of the car is such as to almost entirely preclude the possibility of telescoping. The car is driven by a six-cylinder "Standard" gasoline motor of 100 horse-power, and having 8 x 10-inch cylinders. The engine is a vertical one, very similar in construction to the well-known "Standard" marine motor. The six cylinders are arranged in sets of three each, connected together, with the result that three impulses are obtained for every revolution of the crankshaft. The engine has a wide range of control, which affords great



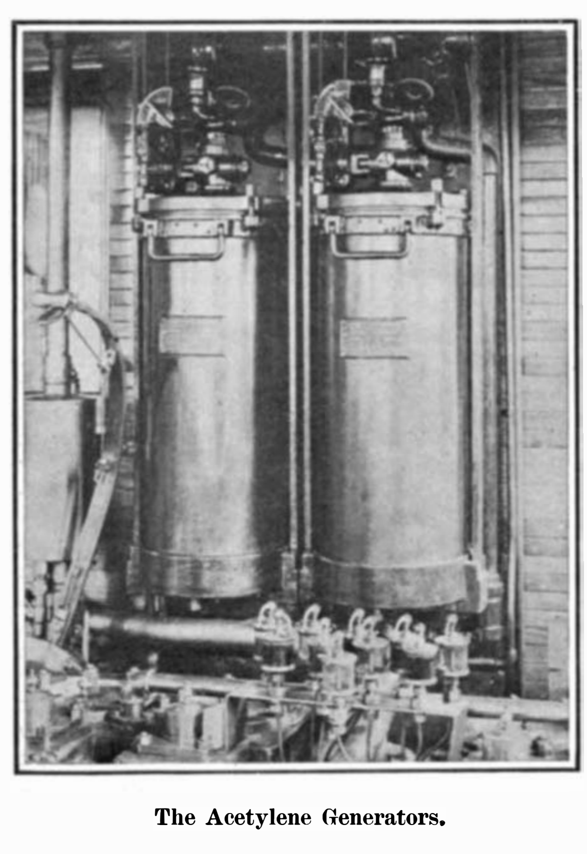
The Twenty Horse-Power Gasoline-Electric Car of the St. Joseph Valley Co.



The Union Pacific's Gasoline Car.



Interior of the Union Pacific Gasoline Car.



The Acetylene Generators.

THE GASOLINE-DRIVEN SUBURBAN CAR OF THE UNION PACIFIC RAILROAD.

economy under variation of loads. A synchronizer facilitates and simplifies the variation of speed, while the reverse, throttle, and spark levers are all conveniently located within easy reach of the operator. On the high speed the engine is geared direct to the driving axle of the car by means of a special form of chain. The engine is reversed by admitting compressed air into three of the cylinders after the valve cams have been changed for running in the opposite direction. This arrangement makes the engine almost instantly reversible and does away with any complicated reversing gear. A sliding gear transmission furnishes three positive speeds, and, because of the reversibility of the motor, these may be had in either direction. The car is geared to make a speed of thirty-five miles per hour at the regulation speed of the motor. Its acceleration when starting from a standstill to 300 feet is superior to that of an electric car of the same horse-power; for, while the acceleration for the first fifty feet is much slower than that of the electric car (there being, however, no uncomfortable jerk in starting), from 100 feet on the acceleration is very rapid. The car can be started on the high gear on a level or one-half per cent grade; but on anything over a half per cent grade, or when pulling a heavy trailer, it is necessary to resort to the positive gears for starting. The vibration and noise of the engine have been almost entirely eliminated. The exhaust is thoroughly muffled, and is scarcely perceptible.

This car, which is designated as motor car No. 1, was put on the rails the latter part of March. Before being used in actual road service, it was thoroughly tested in the vicinity of Omaha. During these tests the car was coupled to two cars—a standard mail car, weighing 52,100 pounds, and a standard coach, weighing 60,000 pounds. These cars were successfully started and accelerated on a one-third per cent ascending grade, the motor thus starting a total load of 152,100 pounds. The standard mail car was drawn to South Omaha and back, up a 1.6 per cent grade, which was ascended at a speed of eleven miles an hour. The total load pulled in this instance was 94,000 pounds. In another test the car successfully ascended a 7.8 per cent grade, of about 400 feet to the mile, and it was stopped and started repeatedly on this grade. After receiving its preliminary testing, the car was started, on April 2, on its first long-distance run, which was made to Valley, 34.8 miles distant. On April 10 a second test run was made to the same place, the car running the whole distance both ways on the high speed. On April 16, the car went to Grand Island, Neb., and made the entire run of 154 miles in a very satisfactory manner. From the 17th to the 22d of April it was in regular service on the branch line between Grand Island and St. Paul, Neb., making two round trips, or 89 miles, each day. On the 23d, it made 137 miles from Grand Island to North Platte, while the following day a run of 278 miles was made to Denver without delay. The car afterward was run to the Pacific coast. It has been under test since on the heaviest mountain grades of the company's system, and has been found to operate very satisfactorily.

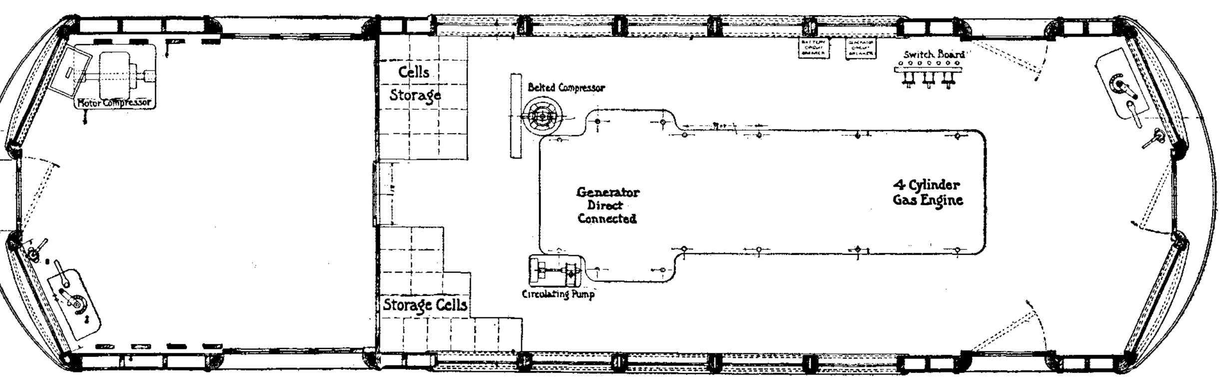
Some time ago, in Supplement No. 1481, we illustrated an English gasoline-electric railway car which has been in service for over a year in that country.

Recently, in this country, the St. Joseph Valley Traction Company has had built by F. M. Hicks & Co., locomotive and car builders, of Chicago, a gasoline-electric car of 70 horse-power fitted with a "Walrath" four-cylinder, marine type gasoline engine direct-connected to a 50-kilowatt, 250-volt, direct-current generator, which supplies current to four 35-horse-power motors mounted on the trucks. A "Chloride" battery of 120 cells supplies the extra current needed when starting and rapidly accelerating the car. The cells are placed in two compartments, one on each side of the car at about its center, as can be seen from the diagram. Any gas given off by the battery is drawn from the compartments by special ventilating fans.

The wires from the battery and generator terminate at a special switchboard, where they are connected in parallel to the main controller leads. Consequently, when the generator voltage drops below that of the battery owing to a heavy load, the latter supplies the extra current needed for the moment; while when the generator voltage is greater than the battery voltage (as it is normally), the generator charges the battery at the same time as it runs the car. The generator also supplies current for the lights and feeds a 4-horse-power electric motor which works the air compressor for supplying the air-brake system. This is of 5.9 cubic feet capacity, capable of maintaining a pressure of 200 pounds per square inch. It is connected to two storage reservoirs which in turn are connected to the air-brake cylinders through reducing valves which bring down the pressure to 90 pounds per square inch. The National Electric Company's automatic type of brake is used, and the car is provided with emergency hand brakes as well. Mounted on the switchboard are circuit breakers adjustable for different amperages, and these take the place of fuses.

The engine can be started either by the dynamo running as a motor on current from the batteries, or by compressed air. The former method is ordinarily used. The engine develops 70 brake-horse-power at 325 revolutions per minute on a fuel consumption of one pint of gasoline per horse-power hour. The gasoline is pumped from the 125-gallon tank to the carbureter by a small reciprocating pump. The cooling water is rapidly circulated through 800 feet of radiating pipe by a rotary pump, and the radiation of heat is aided by two large fans which exhaust through the roof of the car. The cylinders of the engine can be taken out through the ventilating doors in the car roof if it is ever necessary to dismount them. The engine runs very quietly and without undue vibration. It is of the standard four-cycle type made by the Marinette Gas Engine Company. The car frame upon which it is mounted is of composite steel and wood construction designed especially to stand severe strains. Its length is 34 feet, and width 9 2-3 feet, while the height of the car is 14 feet. There are two compartments, one forming the engine room and the other being for baggage. The large engine and dynamo can be seen through the windows of the car in our illustration. The propelling machinery and the car body and trucks each weigh 20 tons, which, besides 5 tons for miscellaneous fixtures, makes a total weight of 45 tons. During a test run of ten miles the car hauled a 45-ton trailer loaded with over seventy passengers this distance on 6½ gallons of gasoline at a cost of seventy-eight cents for fuel, and this despite the fact that the roadbed was in poor condition and there was a heavy ascending grade. The speed maintained was over thirty miles an hour. From this it can be seen that the car has an abundance of power, and it can doubtless be made to draw two or three trailers if necessary.

These two cars are typical examples of the application of the gasoline motor to a railway car, and it is probable that in a short time there will be a considerable number of similar cars in use upon the branch lines throughout the country.



PLAN VIEW OF THE UNION PACIFIC GASOLINE CAR SHOWING ARRANGEMENT OF DRIVING AND ILLUMINATING APPARATUS.

The Current Supplement.

The Paleontological Department of the Paris Museum of Natural History has recently mounted an important collection of Quaternary animals. These are described and illustrated by the Paris correspondent of the Scientific American in the current Supplement, No. 1547. Prof. G. Lippmann writes instructively on the Progress of Astronomy. The dangers of the domestic use of illuminating gas and the means of avoiding them are discussed by Dr. Henry Leffmann. The first installment of a series of two articles on reinforced concrete is published. The article will review very exhaustively the existing methods of the use of iron and Portland cement in combination. Case-hardening is fully discussed by David Flather. F. C. Perkins writes on a new system of air brake which has recently been brought out in Berlin, which is electrically controlled and is said to have advantages over electric brakes, pneumatic brakes, and mechanical brakes now in operation on steam railways and electric roads. Prof. Otto N. Witt writes one of his highly interesting articles, his subject this time being the origin of coal and of carbonated spring waters. By far the most important contribution that has appeared in the columns of the Supplement for months is one on "Chemical Affinity" by no less an authority than Sir Oliver Lodge. Excellently illustrated and lucidly written, the article deals in a most simple way with a subject that presents not a little difficulty to electrical and chemical students.

The Track of the Approaching Total Solar Eclipse.

On August 30 the sun rises totally eclipsed just to the south of Lake Winnipeg, in Canada; then the shadow track crosses James' Bay, passing into Ungava and Labrador, entering the Atlantic Ocean near Sandwich Bay and the Hudson's Bay Company's post of Cartwright. Two expeditions will be stationed in this region—the first, the official expedition of the Canadian government, under the leadership of Dr. W. L. King, chief astronomer of the Canadian government observatory at Ottawa, which will be encamped near the Hudson's Bay post of Northwest River on Lake Melville, at the head of Hamilton Inlet, the longest of the many fjords by which the coast of Labrador is indented. A strong party from the Lick Observatory, under the leadership of Mr. C. Perrine, will be stationed on the coast of Labrador, or on one of the small islands off it. These two parties will have their eclipse at about eight o'clock in the morning, local time.

The next observers will not have their eclipse until noon is past, for the shadow track next meets land in Spain, the whole of the north coast of Spain, from Corunna almost to Santander, being involved in the shadow of the moon. The chief astronomical expeditions will not be placed on the north coast, however, but on the highlands inland, or else upon the Mediterranean coast. The fine old cathedral city of Burgos, at a height of nearly 3,000 feet above the level of the sea, will be the chief center to which observers and sightseers will direct their steps. Here the chief Spanish official party, under Señor Iniguez, director of the Madrid Observatory, the first of five parties sent out by the permanent eclipse committee of the Royal and Royal Astronomical Societies, under Mr. John Evershed, and two parties of amateur astronomers organized by the British Astronomical Association under Mr. C. Thwaites and Mr. H. Krauss Nield respectively, will all take up their positions. On the Mediterranean coast of Spain, near Oropesa, or Castellon de Plana, will be the second expedition of the permanent committee, with Prof. Callendar, Prof. A. Fowler, and Mr. W. Shackleton as its chief members, and a party from the naval observatory, Washington, U. S. A. A little group of rocks, the Columbretes, lying almost exactly on the central line, will be the headquarters of a third American party, and also of the official German expedition. Both of these expeditions will be supported by cruisers of the navies of their respective countries. An English cruiser will similarly act as basis for the third expedition of the permanent committee, under Sir Norman Lockyer, at Palma, in Majorca. Prof. Porro, from Turin, will lead an Italian party here; and the fourth expedition arranged by the British Astronomical Association, under its president, Mr. A. C. D. Crommelin, will also come to Palma.

The shadow track now leaves Spanish ground for French territory, Philippeville, in Algeria, and Sfax, in Tunis, marking respectively the points where the central line enters and leaves the country. A number of French parties, official and private, will find their way to Philippeville; while M. Trépied, the director of the Algiers observatory, has installed a very complete equipment at Guelma, in the interior, where he will be joined by Mr. H. F. Newall, of the fourth party of the permanent committee. The official party of the Royal observatory, Greenwich, under the direction of the astronomer-royal, Sir W. H. M. Christie, will be stationed at Sfax.

The last observing party, the fifth, sent out by the permanent committee, under Prof. H. H. Turner, Savilian professor of astronomy at Oxford, will have their post on the Nile at Assouan. Here the eclipse will be total about half-past four in the afternoon, and will last two minutes and a half. The path of the shadow will sweep eastward across the Red Sea into Arabia, and the sun will set totally eclipsed near the coast of Hadramaut, in South Arabia.

It is well known that during active growth special foods may be taken out of circulation and stored up. The stimulus to such storage is not easily determined. In many instances it is apparently the protoplasm which is decomposed in order that these storage products may be formed; therefore, so far as possible a study of all protoplasmic decomposition phenomena is especially necessary. The deposition of the cell plate and the storage of reserve cellulose are especially interesting. It will be extremely difficult to follow the succession of changes involved, yet some information will undoubtedly be gained.

Correspondence.

A Rival of the Pecos Viaduct.

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in your recent number of the SCIENTIFIC AMERICAN a reproduction of the Pecos viaduct, from all accounts one of the highest in America.

The Makohoine viaduct, of New Zealand, although it cannot be compared with the American structure, is considerably higher. The viaduct spans a gully 586 feet, and the height is 375 feet above the stream below. The viaduct is situated on the North Island Main Trunk Railway, and is one of several to be constructed on that line. C. E. TURNER.

Palmerston North, New Zealand, June 15, 1905.

The Lunar Rainbow Again.

To the Editor of the SCIENTIFIC AMERICAN:

The item in your issue of July 8 concerning "A Lunar Rainbow" brings up a subject in which I am especially interested. Some eleven years ago at Ypsilanti, Michigan, I observed a lunar bow that was very perfect. The moon was covered at the time with a haze and was surrounded by a complete circle in which all the usual rainbow colors were distinctly visible. During the school year 1895-6 at La Junta, Colorado, under practically similar conditions I saw another lunar bow which was just about as perfect. Again, during the school year 1901-2, at Weston, Oregon, on a night when there was no sign of haze, but when there were numerous light fleecy clouds in the sky, just as the moon was covered by one of these clouds, I noticed that it was surrounded by a bow that was more brilliant than those that I had seen before. The spectrum colors showed very distinctly in the primary bow and there was a well-defined secondary bow. Several times during the same year and at the same place I observed other lunar bows, but in no others did the colors show so plainly.

I am not quite sure that these phenomena that I have described are of the same character as the one noted in the item above referred to, which evidently describes a real rainbow. In all that I have seen the bow surrounded the moon and was not a rainbow, as there was no rain at the time. In conversing with people, I find very few that have ever observed a lunar bow exhibiting the rainbow colors. However, although the occurrence is somewhat rare, I am convinced that this is not so much from the rarity as from lack of observation.

Some authorities say that lunar bows of this kind are caused by the refraction of the moon's light through ice crystals. For myself I am not entirely satisfied that the ice crystals are always present, but I suppose that it is possible.

Detroit, Mich. HARRY CLIFFORD DOANE.

A Filipino Fire Maker.

To the Editor of the SCIENTIFIC AMERICAN:

An article in a recent issue of the SCIENTIFIC AMERICAN recalls to my mind a curious contrivance used by some of the natives of Northern Luzon, Philippine Islands, for the purpose of obtaining fire. This consists of a hardwood tube of about one centimeter internal diameter and six centimeters in length, and a piston of slightly less diameter and length. The tube is closed at one end by an air-tight plug or, instead, the piece of wood of which it is made is not bored completely through its entire length. The inside of the tube is smooth and highly polished. The piston has a handle and resembles the piston of the small boy's "popgun." The end of the piston is made to fit the tube air-tight by a wrapping of waxed thread, and directly in the end a shallow cavity is cut. Lint scraped from weather-beaten timber and well dried is used for tinder. A small bit of this lint is placed in the cavity at the end of the piston, the latter is inserted a half inch in the open end of the tube and then driven quickly home with a smart stroke of the palm. Upon withdrawing the piston the lint is found ignited, the sudden compression of air generating the necessary heat.

Of course there is nothing new in this to the student of physics, but I do not remember ever to have heard of the application of this principle by uncivilized tribes. The instrument is not in common use even in the district mentioned. I saw only one of the kind during a stay of over two years in the Philippines. E. A. DEAN,

Captain, Medical Department, U. S. Army.

Fort Riley, Kan., July 27, 1905.

The Artist and the Moving Horse.

To the Editor of the SCIENTIFIC AMERICAN:

I note in your last very striking number of your valuable paper, in the article in regard to the "Evolution of the Horse" that you say: "The traditional representations by artists of the trot and gallop are usually wrong." Will you allow me to take issue with you, and to express the opinion that the Muybridge instantaneous photos have worked a great wrong in the field of art, and have spread in a very marked degree the error, especially among illustrators, of representing action as it is, instead of as it appears. The latter only is the province of art. The most painful instances of this error appear in drawings showing the horse in rapid motion. Hardly an illustrator of the present day is free from the fault of putting his rapidly moving horses in such positions as would result in inevitable "croppers" if the limbs of the animal when in the position shown, were moving so slowly as to appear to the eye to be in such positions. Recovery in time to prevent the downfall of the moving body would be impossible, as any horseman knows who has observed for any length of time the actions of running or jumping horses. In addition to the fault of disseminating errors in showing the horse as he is, and not as he appears, which is all the eye can do for us—the beauty and the grace of swiftly moving horses truly shown in art for 1,000 years—has been by the modern draftsman totally eliminated. Lend your help to correct this fault, I beg of you.

R. E. SHAW, C.E.

Moundsville, W. Va., July 29, 1905.

Some Old Locomotives with Big Drivers.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 10, 1905, Mr. Herbert T. Walker writes interestingly of the "old high-speed locomotives," illustrating his remarks on the diameter, 8 feet 6 inches, of the driving wheels of the "Cornwall," built at the Northern Division works of the L. and N. W. Railway, Crewe, by Trevithick in 1847.

In 1854-5 the writer was engaged at the works of the southern division of the same company, Wolverton, J. E. McConnell, superintendent. At that date the standard diameter of driving wheel on this division was 7 feet 6 inches, and all the new engines were built by private firms.

There was, however, in the shops at Wolverton, a locomotive called the "Mangle" or "Mangel" (now whether that was only a shop name, not the true name of the engine, I am unable to state) with 9-foot 6-inch or 10-foot driving wheels, built to compete with the Great Western Railway locomotives and also with the Trevithick engines of the L. and N. W. Railway. There was as much rivalry between the two locomotive superintendents of the same company as there was between them both and the superintendent of the locomotive department of the Great Western Railway Company.

If my memory serves me there was some difficulty in getting the "Mangle" through the tunnels after the machine was first built. JOHN H. HARDEN.

Phœnixville, Pa., August 14, 1905.

Improvements Needed in Schooners.

To the Editor of the SCIENTIFIC AMERICAN:

During the last thirty years the schooner rig in American waters has driven out almost every other form. The multi-masted vessel with its fore-and-aft sails has enormous advantage over all other forms of sailing craft. The vessel is handled more easily, and her evolutions are quicker than with any system of square rigs. With the exception of the masts, the spars are smaller, and with the proper forms of hulls the schooners can sail closer to the wind, and this, with their quick evolutions, enables them to work to windward much more rapidly. But their important advantage is the vast reduction in the number of men employed. Five of the men above take the place of twenty-five. Two men on deck often handle a vessel that might with another rig require six or seven. The rig is not only simpler, but it is less costly.

As the multi-masted schooner has grown in size, steam power has been added, and with the five and six-masted vessels there is practically no manual labor required in handling anchors, sails, boats, and cargo. Even the single example of a seven-masted schooner shows advantages which are by no means unimportant. But there is one difficulty with which the schooner has to contend for which a remedy is greatly needed. Reefing is practically out of the question on account of the size and weight of the sails themselves. These are from 80 to 90 feet in height and the canvas is of course of great thickness and corresponding weight, and as stiff as the proverbial board and quite as unmanageable.

When we say reefing is out of the question, it simply means that the canvas is too heavy to be handled by manual labor. As far as the hull is concerned, the lowering of one or more sails answers every purpose. The hull is relieved from the strain of the wind and can be easily maneuvered under one or two sails, but the sail that remains is spread to its full area, and the strain on its masts, shrouds, and stays is not in the least lessened. The result of this is that as the sail becomes more lofty, the danger to the spars increases very rapidly. So great are the dangers of these lofty and heavy sails that the insurance companies do not look upon the larger schooners with any favor.

What is needed imperatively is some means of reefing the sails so that the strain on the masts, etc., can be relieved at will. This, of course, must be done by power. Some rolling device worked by the donkey engine would answer. When this is accomplished, the six and seven-masted schooners will be as advantageous for foreign voyages as for the coastwise trade. This invention, once perfected, will be extremely profitable, for it will be widely adopted.

All of the larger schooners carry power, and are often fitted with dynamos for furnishing light and distributing power to the hoists and for handling sails. None of them, however, have successfully used their engines for driving a screw, although the power carried is ample for moving the vessel. The reason that a screw is not used is because of the greatly increased power necessary for screw propulsion over that actually needed for driving the vessel through the water. Most of the large schooners carry sufficient power, if applied in towing, to handle them readily in calm and light winds. By putting a motor into one of their largest boats and connecting the dynamo with it, through the towing cable, they would be able to obtain a speed of three or four miles an hour in calm weather. The same power applied to a screw in their own hulls would fail to give them a forward motion.

These two fields for invention and improvement are most promising and apparently successful inventions along these lines would remove all the objections to the unlimited use of the schooner rig. It would seem as if some form of electric motor could be utilized in the management of the sails, supplied with current from a central generator, which in turn could be operated by a gas engine. A storage battery could also be used to energize the motors in emergencies.

F. C. P.

Engineering Notes.

One of the largest items of annual expense in the city hotel or club house is that of cleaning draperies, rugs, and furnishings, and of redecorating walls and ceilings. A great part of this is directly chargeable to coal smoke. The presence of more or less sulphur in the soot renders it a corrosive as well as a discoloring agent and greatly increases the damage done. Trees and shrubs suffer in such an atmosphere and are frequently killed outright by the presence of sulphurous smoke. The effect on human beings has not been definitely determined, but the deposition of soot on the delicate tissues of the respiratory organs can hardly be beneficial.

From 1850 to 1865 the interest in superheating revived considerably, and a moderate degree of superheat was quite extensively employed toward the latter part of that period. Hirn, in 1857, published the results of experiments made by him at Colmar, which were the most carefully conducted tests that had, up to that time, been carried out, and showed that, on a simple engine, working with a boiler pressure of 55 pounds, economies of 20 to 47 per cent could be obtained with superheat of 100 to 190 deg. F. In 1859, John Penn read a paper before the Institution of Mechanical Engineers describing several applications to steamships, the superheater consisting of a number of tubes about 2 inches diameter placed in the uptake just as it left the boiler, through which the steam passed on its way to the engine. The superheating surface was about 15 per cent of the boiler heating surface, and with a boiler pressure of 20 pounds on a condensing engine, about 20 per cent saving on fuel was obtained with a superheat of 100 deg. F. John Ryder, in 1860, in a paper before the same society described the Parson & Pilgrim superheater, which consisted of two horseshoe-shaped pipes placed in the internal flue of the boiler over the fire grate, and the Partridge, which was a cylinder filled with tubes through which the gases passed, the steam being around them. Both of these systems were stated to have given good results, which may appear rather questionable in the case of the former, but a total of 5,000 horse-power had then been equipped. The superheating surface employed was 2½ to 2¾ square feet per nominal horse-power, or about the same as that described by Penn, and the economies obtained were practically equal. Sundry other systems were in more or less extensive use about this time, such as the Cross-land, Wethered, etc., and extensive experiments were carried out by Isherwood, in the American navy, which confirmed the good results obtained abroad.

Peary's Progress.

The following cablegram from Commander R. E. Peary was received by the Arctic Club:

"Domino Run, Labrador, July 29, 1905. Arrived this evening. Cross to the Greenland coast from here. All well. PEARY."

This indicates that the "Roosevelt" and "Erik" have made a record run from Sidney, where they were reported July 26, three days before the date of this dispatch, and unless unexpected obstacles were met in Melville Bay the expedition is now at Etah, Greenland, or Cape Sabine, Grinnell Land.

Commander Peary probably will not send his summer ship, the "Erik," back this year until September, as he has mapped out considerable work for her which still remains to be done.

THE SUBMARINE MINE.

Throughout the great naval conflict in the Far East, which, to all intents and purposes, was closed by the battle of the Sea of Japan, it must be admitted that the most destructive agent has been the submarine mine and its first cousin, the torpedo. This, at least, is true of the earlier phase of the campaign, and, indeed, of all that part of it which preceded the above-named battle. The accounts of the fierce struggle in the Straits that have so far been made public are so confusing, and in some respects contradictory, that it is difficult to determine how far the wiping out of the Russian fleet was due to the gun, and how far to the torpedo. The concensus of opinion, based upon these reports, gives the credit for the destruction of Admiral Rojestvensky's fleet mainly to the gun, although it is generally agreed that in many cases the final death blow was delivered by the torpedo, after the sting of the Russian fighting ships had been drawn and they were in no condition to repel torpedo attack. The torpedo is to all intents and purposes merely an automobile mine, the charge of high explosive being carried in the bows of a self-steering and self-propelled vessel in the case of the torpedo, and being carried in an anchored vessel in the case of the submarine mine.

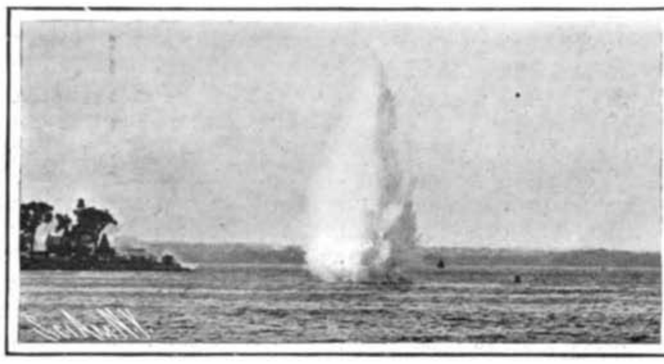
Great things were expected of high explosives in the present war, and they have certainly vindicated their reputation with a vengeance. The list of fatalities to ships of both fleets is certainly a tremendous one. Among the Russian warships put out of action, permanently disabled, or sent instantly to the bottom are such costly ships of the Russian navy as the battleships "Czarevitch," "Retvizan," "Petropavlovsk," "Pobieda," and "Sevastopol," in the Port Arthur compaign, several battleships and cruisers in the Sea of Japan, and the battleships "Hatsuse" and "Yashima," and the cruiser "Takasago" on the Japanese side, to say nothing of many a cruiser and torpedo boat of less size and value than these that have felt the deadly stroke of this much-dreaded weapon.

Although the submarine and the floating mine have been used by both the Russians and the Japanese in what might be called active or aggressive warfare, it is generally recognized that the legitimate sphere of the submarine mine is that of harbor defense and the obstruction of channels, straits, and other waterways. The supreme value of the mine lies in its perfect adaptability to harbor defense, for which purpose it holds a position which many experts consider to be more important even than that of the high-powered breech-loading rifle. As a matter of fact, however, artillery, heavy and light, go hand-in-hand with the submarine mine for harbor defense; for no matter how heavily and scientifically the approaches to a harbor might be sown with mines, they would present but little real obstacle to the entrance of an enemy's fleet, were they not themselves covered and protected by numerous and well-placed batteries of rapid-fire guns. Without such protection, it would be entirely possible for a hostile fleet to send out its boats and steam launches in pairs, with a cable passing from stern to stern of each pair, and by dragging this cable slowly across the mine field to locate the mines and explode them prematurely. This is provided against by mounting, in positions commanding the mine field, batteries of rapid-fire guns, big and little, which cover the mine-strewn area so completely with their rapid fire as to render sweeping operations of this kind impossible.

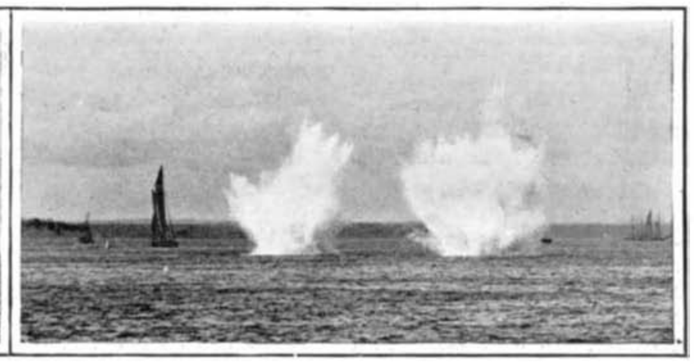
In all well-defended harbors there is a co-operation of artillery mines, searchlights, and range and position finders which is so complete as to render the entrance of a hostile fleet well-nigh impracticable, or at least so hazardous that no admiral would feel himself justified in incurring the inevitable loss of ships that would result from attempting to force a passage. The truth of this will be evident from the consideration of the defenses of New York harbor. Here we have several lines or zones of protection. A fleet attempting to enter the harbor, say for the purpose of placing itself within shelling range of the most valuable section of Manhattan Island, would encounter the first line of defense at a distance of, say, 7 or 8 miles from Sandy Hook, where the ships would come within accurate range of the 10 and 12-inch guns mounted at the forts. As the fleet drew closer, to within a range of, say, 5 or 6 miles, the ships would be subject to an almost vertical fall of 12-inch mortar shells, which would begin to rain from the sky, passing easily through the protective decks, which would merely serve to burst their high explosive charges within the magazines, engine rooms, and boiler rooms of the ships. As the ships drew yet closer, the 12-inch and 10-inch guns, to say nothing of the 8-inch pieces, would begin to deliver their projectiles against the armored portions of the ship with a velocity that would insure penetration; for the fleet, if it were successful in finding and following the main entrance channel, would have to draw in almost within point blank range of the heavy artillery at Sandy Hook. Here also it would begin to pass over the outer mine fields. The ships that succeeded in passing Sandy Hook would now be subjected to a deadly and accurate fire from the big guns located at Fort Hamilton and Fort Wadsworth, on opposite sides of the Narrows, and such vessels as had not already been disabled or sunk by gun-fire, or wrecked by submarine mines laid in the entrance channel, would, in attempting to pass the Narrows, be certain of destruction either by gun or mine. The ships would be under close range of the guns on either shore and they would have to thread their way through a channel so thickly sown with mines as to render their passage unharmed an absolute impossibility.

Submarine mines are divided broadly into three different kinds. First, observation mines, fired from shore when a ship is judged to be within range—a type seldom used to-day; second, automatic mines, which are self-firing when they are struck by a passing ship, which is the type that did the damage in the Japanese war; and third, electrical-contact mines which, when they are touched by a ship, give notice to an operator on shore, who, by throwing a switch, fires the mine. This last type is particularly suited for the defense of harbors and waterways which are frequented by friendly ships, either ships of war or merchant vessels; for if these are used, a vessel may pass through the mine field and touch the mines without coming to grief, the firing of the mine being intelligently directed.

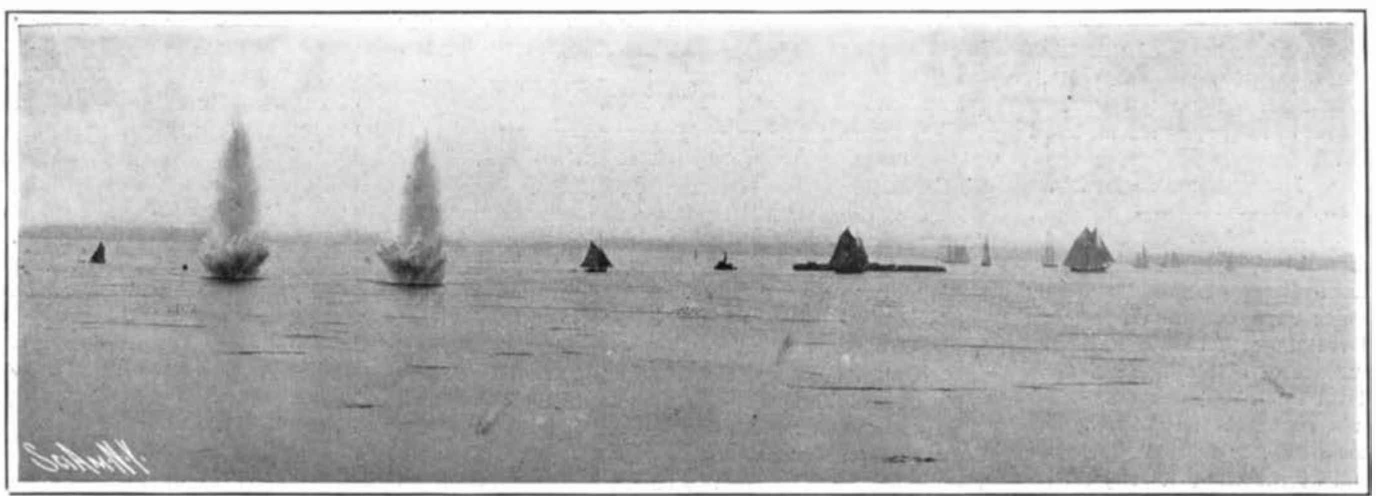
The accompanying illustrations were made from photographs taken when mines that had been laid in certain harbors and channels of the United States were exploded as the most expeditious way of removing them after the close of the Spanish-American War. The heavy column of water thrown up to the great height shown in our front-page engraving gives a very realistic impression of the energy exerted by the gases of explosion. When this energy is let loose against the thin plating of a ship's hull, it can easily be understood that a large section of the ship is blown bodily inward. Although, as the war has shown us, contact with a submarine mine does not mean necessarily the immediate and absolute loss of the vessel, as in the case of the "Hatsuse," or the "Petropavlovsk," it does in every case mean the total disablement for the time being of the vessel struck.



Effect of 200 Pounds of Gun Cotton.



The Mines are Laid so Closely that a Ship Cannot Pass Through Without Contact.



Exploding Two Submarine Mines in Long Island Sound.

THE SUBMARINE MINE.

Primeval Insect Finds.

Some highly interesting finds of insects have recently been made in Permian groups (lower division of red sandstone rock) in Russia, about which an interesting paper has now been filed among the minutes of the Imperial Academy of Science at St. Petersburg. In the coal fields of Europe and North America, and in the immediately adjacent lower divisions of the Permian formations or Dias of both countries, the finds hitherto made have (apart from members of the Blattoidea) consisted exclusively merely of remains of such insects which could not be classified with certainty with any of the still existing orders. In the Russian Permian strata there have now been brought to light what may well be termed "the missing links" between extinct and recent groups of those orders which are already met with (in many and highly developed forms) in the mesozoic or secondary period of the earth's existence or development. Retschajew, in his work dealing with Russian Permian formations, has already described some fossil forms which, however, only demonstrate the existence of true Ephemeridæ and of what are assumed to be Perlidæ, which, until that date, were quite unknown as being contemporaries of the Paleozoic period, although some predecessors or rather forerunners of the family have been found among insect remains in Carbonaceous deposits. Among the new and highly valuable finds made by Prof. Koken, of Tübingen, at Tichagori on the Kama (a tributary of the Volga) and which have been sent to the museum of the Imperial Academy of Science in St. Petersburg, there are included forms which may be regarded as the direct ancestral group of the bug family (Hemiptera) as they plainly show the characteristics of the two still existing sharply defined groups of bugs. One of the most interesting forms is that of a praying cricket or mantis, a comparison of which with the wings of those found in Jura formations shows a remarkable correspondence whereof with all the characteristic features of the family. From the point of view of the evolutionist it is a most interesting fact that these, relatively speaking, already at the time highly organized insects were so well defined as early as the Paleozoic period, their different orders being then apparently as sharply and clearly defined as at the present time. In marked contradistinction to this, vertebrate animals have required a far longer period for their development. As is well known, the first birds and mammals are found in the Mesozoic period, while man—"creation's crown," as he calls himself, or is called poetically but perchance satirically—does not appear upon the scene till a much later date. Human fossil remains are found only in diluvial strata; the deposits or formations of the immediately preceding Tertiary period only show traces of his existence in the shape of very crude stone implements, but no traces of the makers have ever been found.

The Danube flows through countries in which fifty-two languages and dialects are spoken.

THE TRAINING OF THE MODERN SHOP SUPERINTENDENT.

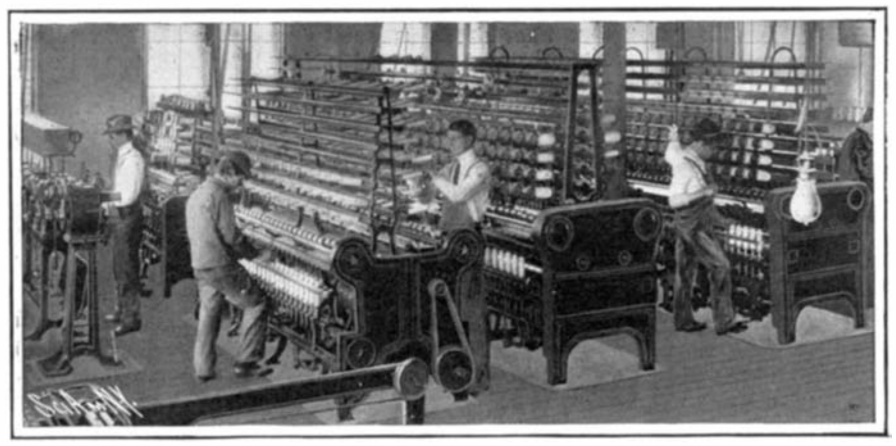
BY CHARLES C. JOHNSON.

It has come to be a popular belief that textile, mechanical, and electrical engineering and allied knowledge, as taught in schools devoted to imparting such facts, is largely theoretical. Indeed, the statement is not infrequently heard that this mill superintendent or that mechanical engineer is a practical man, because he went through a systematic course of labor in an establishment like that of which he is now the head.

It would be difficult to point out a more total misunderstanding of fact. The technical school of to-day is now, or is rapidly becoming, as practical as the mill, the smithy, the machine shop, or any other place within the domain of a captain of industry.

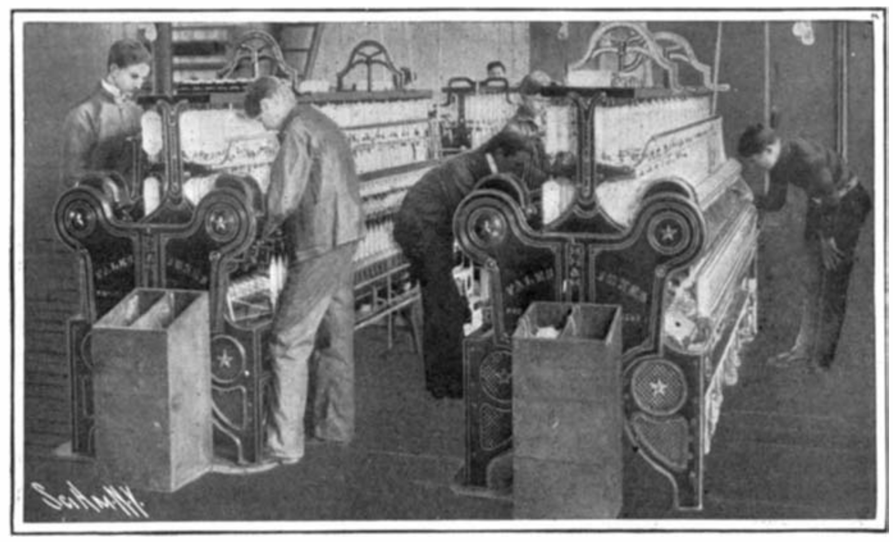
In the most advanced of these technical schools there is among the students a considerable element repre-

Quantitative Analysis in the Laboratory.

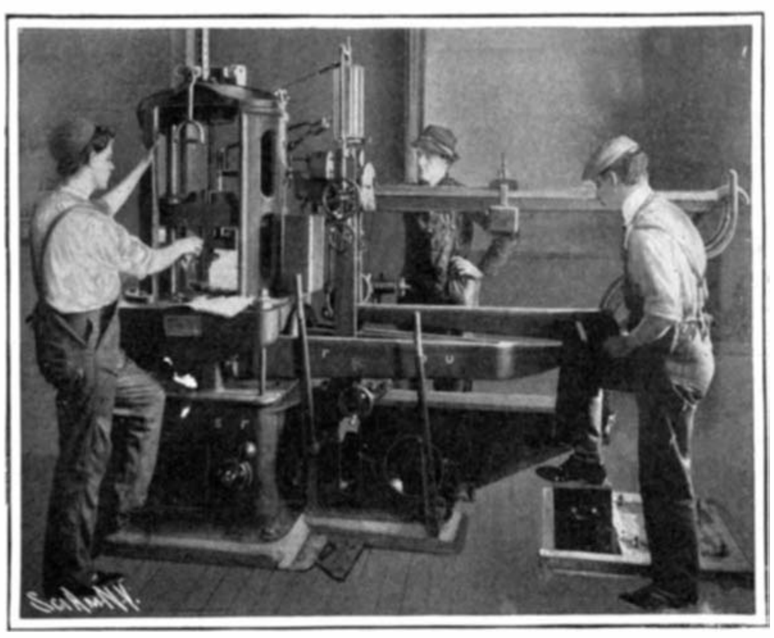


Students Operating Cone Winders and Twisters.

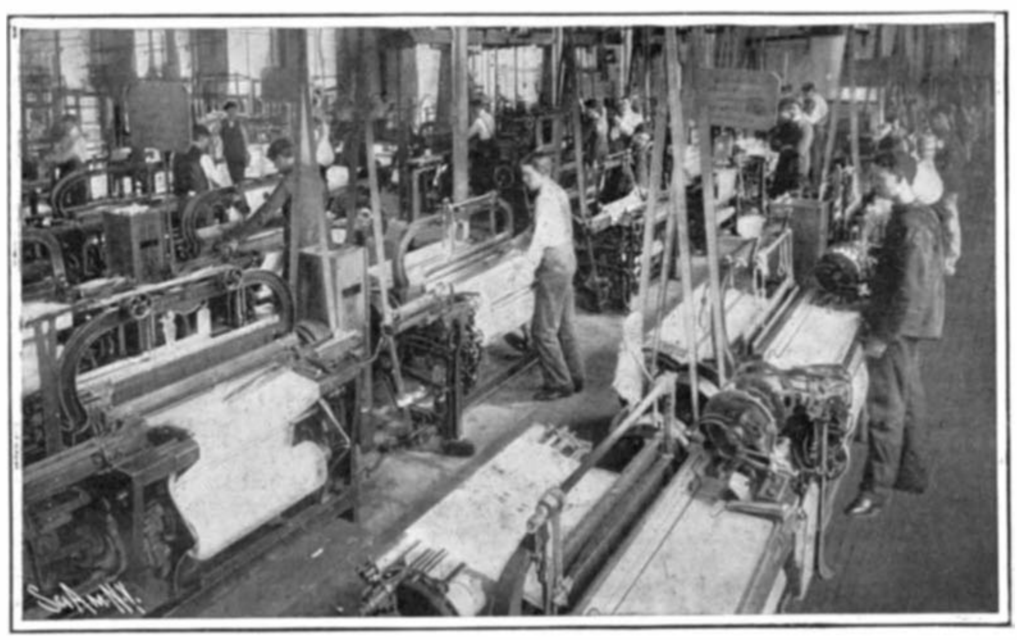
Casting and Molding in the Iron Foundry.



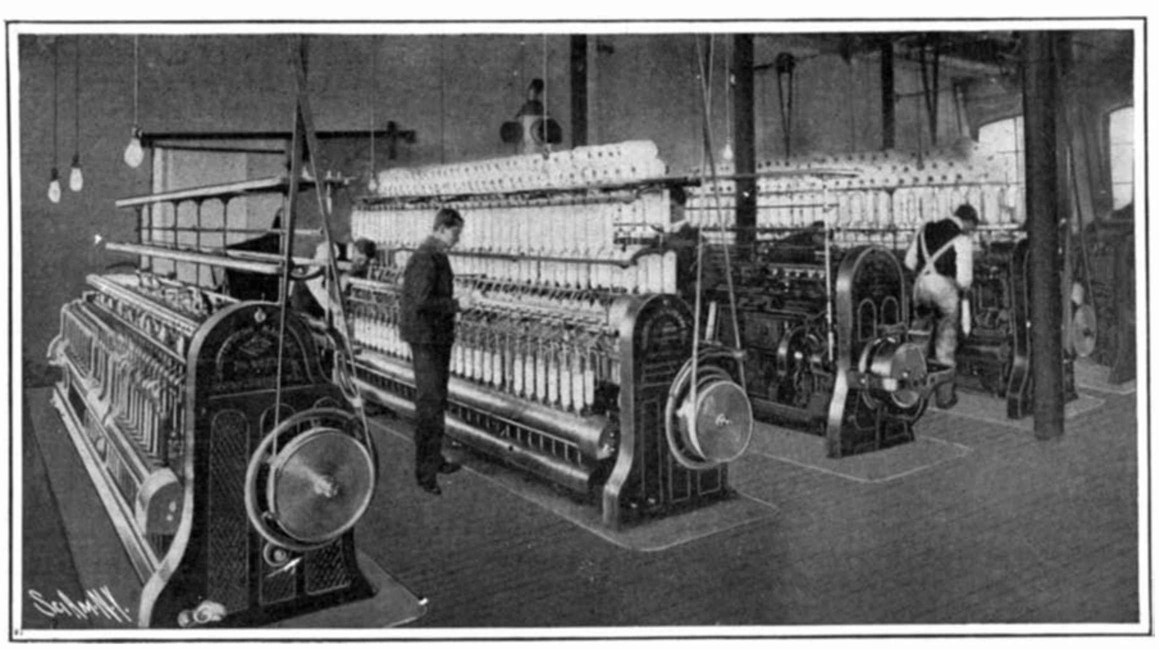
Ring Spinning.



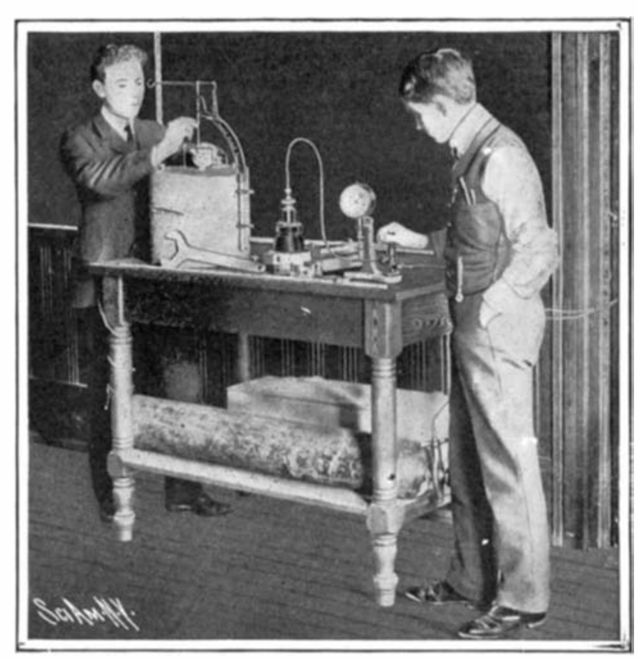
Testing Steel with a 100,000-Pound Automatic Machine.



Power Loom Practice.



Practice on the Fly Frames.



Testing by means of the Calorimeter.

THE TRAINING OF THE MODERN SHOP SUPERINTENDENT.

senting the mill and shop owners who have sent their ambitious sons and successors-to-be to these institutions, realizing that the instruction there given is equally practical and far more thorough than is obtained in their own mills or shops, besides including a host of things that neither weave room nor machine shop can teach.

No man of intelligence denies that theoretical courses are of primary importance in affording mental discipline not to be derived from practical research. So in these schools, theory and practice are made to go hand in hand, on the basis that from continual and practical applications of theoretical conclusions a broader and more tangible conception of their truths may be derived.

An excellent example of the practical plane the technical school has gained is Georgia's State School of Technology. The manufactures resulting from the work of the students, where the product is not for the use of the school itself, are sold, just as the output of any other producing plant is disposed of. The student understands from the first that his work is practical, and he is required to exercise the same energy and skill he would devote to his task if his daily bread depended on the result of his efforts.

The growth of the textile industry in the Southern States has resulted in an increasing demand for executive mill men, superintendents, and others, who combine with the practical training the mills give that knowledge which runs to cause and effect, what may be called the higher education in textile matters, including a sound foundation in engineering subjects.

So the technical-school course includes, besides the usual subjects of the textile school—such as carding, spinning, weaving, designing, and dyeing—extensive courses in chemistry, physics, mechanics, drawing, strength of materials, steam engine, electrical work, mill construction, and shop work.

The course not only covers the theoretical sides of the different subjects, but is extremely practical. For example, with a few exceptions where very fine or fancy yarns are required, students make and dye all the yarn used in the weave room. This yarn and the cloth product are kept up to the standard as jealously as in the mills of the highest class, because the product is placed on the market and sold.

The subject of fabric structure is given especial attention in its relation to the different combinations of textures and weaves, the classification of fabrics, the "balance of cloth" necessary to give the maximum of wearing qualities, and best general appearance, influence of twist in the appearance of the fabric and on textures, the influence of the texture on the appearance of the weave.

Formation of fabrics by interlacing threads introduced at right angles is included in the instruction in fabric design, as well as the three foundation weaves, the plain or cotton weave, the production of fancy effects on a plain weave foundation, the various features of twills and satins. All these, and much that is taught beside, enable a student to learn the origin and application of all the simpler weaves used in designing the various classes of textile fabrics.

Every effort is also made to familiarize the student with the rules and best systems of cloth analysis. He is furnished with samples of every grade of cotton fabrics, and his analyses thereof are thorough.

As a preliminary to carding and spinning instruction, or it may be termed a preliminary course, a study is made of cotton fiber, including botanical classification of cottons. The cotton-producing districts of the world and their products are studied. Commercial grading and classification and the chemical and physical properties of cotton are also considered.

Ginning, mixing, the picker room, and carding are taken up in detail, practical instruction therein being given with marked thoroughness. In fly-frame practice proficiency is required in the use of a 32-spindle slubber with improved differential motion, a 42-spindle intermediate, 72 and 64-spindle fine roving frames, 96-spindle jack frame, roving reel, and scale and roving trucks.

It is required of a student in ring spinning that he be thoroughly up in all calculations pertaining to carding and spinning, the grinding and setting of the cards, and the manipulation of white and colored stocks. This knowledge only comes in time, to be sure, but it is demanded of a student that during his course he gain the necessary knowledge. Every student must produce a stated amount of warp, filling, and twist yarns. He must also be able to take apart, re-erect, repair, and care for 80-spindle, 64-spindle, and 160-spindle combined warp and filling frames, an 80-spindle filling frame, a 360-spindle 1½-inch gage spinning mule, and a dozen other of the most modern machines used for twisting, spooling, winding, and reeling. Lectures, recitations, demonstrations, and practice on all the most modern looms constitute the weaving curriculum.

A technical knowledge of dyeing is of marked importance to a textile manufacturer. It is, therefore, a fact of interest that in the thoroughly up-to-date technical school, the laboratory and dye house form a feature of note. The object of the course in dyeing is to give the student a clear idea of the fundamental principles which underlie the arts of bleaching and dyeing. This is done by experiment and research, assisted by lectures. Every student is required to properly bleach cotton cloth and yarn and to dye several kinds of textile materials. As a result, he gains expert knowledge concerning artificial coloring matters, compound shades, matching off, testing and valuation of dye stuffs, detection of dyes in the fiber, comparative tests, and the manufacture of dyes.

Besides understanding the different processes of cotton manufacture, a mill superintendent is called upon to manage the motive power, operation, and general economy of an entire plant. This knowledge is gained in the technical school by a thorough course in mechanical engineering, including investigation of the laws of statics, the underlying principles of the various general features of machinery, dynamics, strength of materials, the steam engine, power transmission, machine design, mill construction, ventilation, and sanitation. The department of physics in a technical school affords an excellent illustration of the thorough nature of the training. As a rule, physics are not attempted until the student's second year, when his work has fitted him for the solution of the problems that will present themselves. Every modern appliance, or more correctly the most important of these, are utilized in the course of instruction, the Olsen testing machine and the throttling calorimeter being notable examples. It is an interesting fact that in several technical schools the students have constructed some of the most important of the apparatus in use.

A broad foundation in general and theoretical chemistry is established, so that in future work new problems may be intelligently met and solved. Especial instruction is given in industrial chemistry. The knowledge he gains here will enable and has enabled the graduate student in business life to determine the relative value of the raw materials offered by dealers, and to conduct intelligently operations based on chemical principles, detect imperfections in them, and suggest improvements. He is prepared in this way to undertake analytical work of almost any description.

So the student gains a practical knowledge of quantitative analysis, consisting of general, applied, and analytical chemistry; inorganic chemistry, qualitative analysis, general methods, applied analytical chemistry; fuel, iron and steel, water, and fertilizer analyses; oil testing, organic chemistry, metallurgy, and physical chemistry.

It is plain that the commercial helpfulness of the graduate of a technical school is based on what he can do, rather than on what he knows. Throughout the various courses of a technical school of the first class not an instructor is permitted to either forget the urgency of this principle or to allow his pupils to lack appreciation thereof. So what is known as workshop practice must not be classed with manual school training, valuable as the latter undoubtedly is. The two bear much the same relation as the grammar school and the university.

In the workshop the entire force of knowledge of the student in mechanical engineering is called into play by his work in the machine shop, smithy, foundry, and woodshop. Throughout the first or apprentice year two days of eight hours each are devoted weekly to shop practice. About two-thirds of this time is spent in the woodworking shop. When sufficient skill has been attained to begin elementary pattern work, the student goes to the foundry, and is given elementary practice in molding. This enables him to understand the conditions imposed by the foundry upon the pattern maker. The remaining three years of a course are generally divided, as regards this class of work, between pattern making, foundry, smith shop, and machine shop. Here the student becomes expert in his understanding, in his practical knowledge, of the work that is always performed in establishments of this sort.

It is apparent that the mission of the technical schools of to-day consists largely of training the rising generation of those who are grouped under the title "captains of industry." They teach not only what the superintendent, the man of affairs in manufacturing work, must know in order to completely discharge his own duties, but they train him as well to look at the applied principle of work from the standpoint of the man at the loom, the forge, the dynamo.

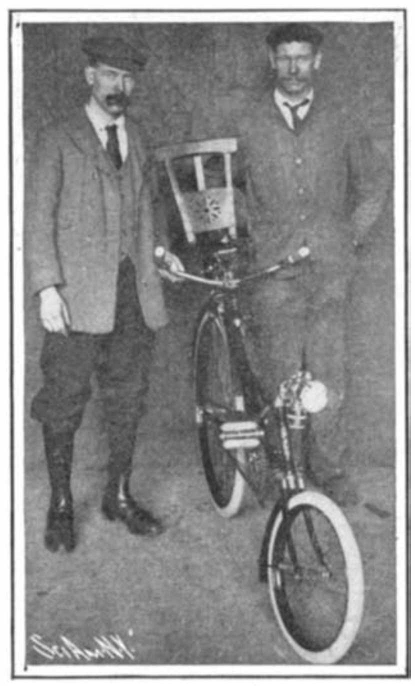
THE LATEST IN CYCLES.

A novel bicycle has been built in London which has been pronounced "as comfortable as a rocking chair" and which shows remarkable mechanical ingenuity. This new machine is fitted with an anti-vibrating easy chair-like saddle which affords wonderful relief to a tired back and which proves a luxury when coasting down long hills. The ladies' machines are meeting with particular favor. They are of exactly the same construction as are the machines built for the men. The illustration gives some idea of the comfort found in these new bicycles.

Besides the chair-like saddle, the machine has another improvement. Note the position of the handle-bars. They are almost directly under the saddle. It is this arrangement that enables the woman to ride the diamond frame with ease. The steering gear is under perfect control and it will be seen that a smaller circle can be described on this machine than on any other.

The first machine of this make was built by P. W. Bartlett, of Richmond, England, for a Java resident. He was so pleased that he has now placed an order for twelve more of the same construction. The weight is somewhat greater than that of the light-weight racing machines, but as these bicycles are built for comfort and not alone for speed this is no detriment. The cost is the same as of any other high-grade bicycle.

How the Bicycle is Ridden.



End View of the New Bicycle.

THE LATEST IN CYCLES.

THE REMORAS.

BY CHARLES FREDERICK HOLDER.

Any one who has spent any time in Southern waters, or engaged in shark fishing, is familiar with the remarkable fish, remora, shown in the accompanying photograph clinging to the glass by its singular sucker. Nearly all sharks have attendant remoras. I have found them on the swordfish, drum, black grouper, and even upon turtles in the Mexican gulf, and have also caught them when none of these fishes was in the vicinity. When a large shark is seen near the surface, on its dun-colored hide, or against it, will be seen a very distinct black streak parallel with the body about a foot long. Often several will be seen. If at such a time bait is thrown over, the black streak separates itself from its protector and appears as a long, slender, flat-headed fish, the remora, that in a sense is parasitic upon the shark.

So strong is the instinct of the remora to cling to the large fish that in most instances it will refuse to leave it when the latter is hauled out of the water, clinging with such energy that it can only be torn away by the display of much strength. I have seen them come ashore on the hammerhead at Santa Catalina, a huge specimen which I captured after several hours, and which only started inshore when four boats were made fast to it. I have also seen it on the sand shark and the white shark in the Mexican gulf, and doubtless other large fishes are used as a refuge by one or more species. The remora is easily "tamed." I have kept several in confinement to experiment with, and legend and psuedo history have played many merry pranks with them. Thus the old Romans called them ship stayers, and several of the classics contain references to them—fishes that fastened themselves to the war galleys and aided in their defeat by holding them back. It will be remembered that Pliny, among others, gravely informs us that Antony's ship at Actium was held by a remora, though several hundred sailors pulled at the oars. Then, too, we are told that Caligula's ship was held between Astura and Actium by a remora that was seen clinging to the rudder, pulling successfully against the oars of four hundred stalwart seamen.

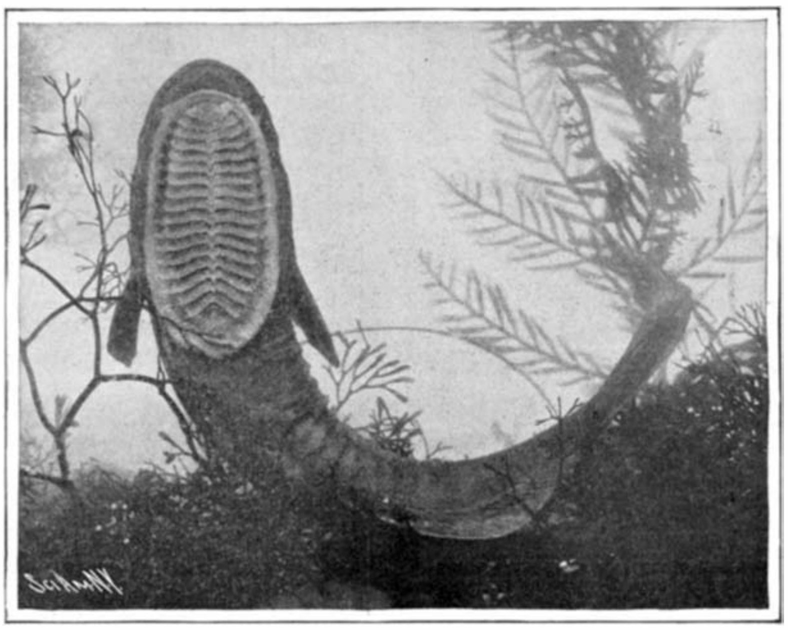
The peculiar feature of the remora is the large sucker on the top of its head that is so conspicuous that an observer who had never seen one would select the belly as the dorsal surface. The fish appears to be tipped upside down; but as stated, the sucker is on the top of the head, and doubtless is a modification of the first dorsal fin, forming a perfect sucker which clings so tightly that I have lifted a bucket full of water by allowing the fish to attach itself to the bottom and lifting it by the tail. This sucker resembles a Venetian blind with its cleats, being made up of cartilaginous plates in a double series whose edges are sawlike or serrated. This disk is on the head and neck and often overhangs the mouth and always the eyes, calling to mind in a very superficial way some of the hornbills among birds.

The lower jaw generally projects beyond the upper. The fish is dark, or lead colored, sometimes striped, and presents a singular appearance as it swims about. I once saw a very large man-eater, possibly fifteen feet in length, swimming about my boat, in a deliberate fashion, and as attendants it had six or seven remoras and as many pilot fishes. The latter swam near its head, venturing only a few feet away, while the remoras roamed about in every direction, and when I threw pieces of crayfish into the water they rushed at it greedily but were not joined by the pilots.

There are several genera, as *Phtheirichthys*, *Echeneis*, *Remilegia*, *Remora*, and *Rhombochirus*. One of the most interesting remoras is *Phtheirichthys lineatus*, as it has two very pronounced white bands running laterally, which give the fish a very striking appearance. In specimens preserved in alcohol or formaldehyde the stripes fade out, but in several which I took from a large hammerhead shark off Avalon Bay, Santa Catalina, the stripes were pure white and the fish a very dark blue black, a most conspicuous object, long, and very slender. I find no record of the fish having been seen on the Pacific coast, Jordan giving its range in the Atlantic north to North Carolina and Pensacola. It is said to attach itself to barracudas in the Atlantic or Gulf of Mexico. I have never noticed this, although I have taken by grain and line many specimens of this large fish. The Bahaman barracuda, at least on the outer reef, is a "solitary." It lurks in certain places, remaining quiet and poised for long periods, and has a habit, also distasteful to the remora, of swallowing its food entire without crushing it.

The remora affects wanderers like the shark, swordfish, and animals which, in their savage rush at prey, crush and macerate it, so that particles escape into the open water, which can be secured.

In *Echeneis naucratis* the disk is long and has from twenty to twenty-eight laminæ. Its color is brown, with a dark belly, a dark stripe with a white edge extending along the side and through the eye. This appears to be a world-wide roamer, carried hither and yon by large sharks, and common on each side of the continent, and especially in southern seas. It is this remora of which the story is told that fishermen employ it in the Caribbean Sea to catch turtles. The remora is kept, so runs the story, in a pail; a ring is placed about its tail and to this a line. When the men sight a turtle the remora is slipped overboard and it is supposed darts at the turtle, seizes it, and holds on with such firmness and vigor that the animal can be hauled in. I lived on the Florida reef, winter and summer, several years and had a remarkable experience with the various fishes, and among other things I experimented with the remora; but the fish invariably refused to dart after the turtle, preferring to find shelter under the boat. One tossed at a shark was seized by the latter, that doubtless thought it a votive offering. Possibly something was wrong; our remoras may have been stale; they surely were not ship stayers, or turtle. I do not mean to insinuate that this tale is not possible, as so good an authority as Columbus refers to it, and in 1884 Mr. Frederick Holmwood, British consul at Zanzibar, described fishing with the remora in that latitude. The fishes, it is said, are kept in a well, and the ring is so firmly placed on the tail that it becomes imbedded in the flesh, so that a large turtle can be caught by them.



THE REMORA, SHOWING SUCKING DISK WITH SEVENTEEN LAMINÆ.

Taken from large shark at Santa Catalina Island, Cal.

This remora is found as far north as Gloucester, and Monterey on the Pacific side, and is the common ship stayer of song and story. Two presumable species have been described; one with from twenty-two to twenty-six laminæ, and another with from twenty to twenty-one. A rare and little known remora is *Remilegia australis*, described by Bennett, and found clinging to a dolphin in tropical water seas. It is a rich brown color and easily distinguished from other remoras by the size of the sucking disk, which is very large and elongate, and has twenty-seven laminæ.

The genus *Remora* is well known, the species of that name being a dark fish about fifteen inches in length, with a large sucking disk, and found on the large sharks that are commonly caught at Santa Catalina in summer, especially the huge monsters that affect the grouper banks in the San Clemente channel. I saw four or five of these remoras on one large specimen and the same fish is taken on large sharks at Nantucket and Block Island in the summer, and occasionally found on the large swordfishes of the latter waters. It is also common on the Florida reef, and said to follow the big sailfish of Cuban waters.

The so-called white remora, *Remora albescens*, which is not white, rather a gray tint, has thirteen or fourteen laminæ in the sucking disk. It is found in the warm waters of the Pacific Ocean, and doubtless strays north in summer, when many large varieties of sharks go north.

A similar remora is included in the genus *Rhombochirus*, having been found on the swordfish Tetrapturus on the Atlantic coast ranging from the West Indies north to Cape Cod. A fossil remora is known, described by Cope as *Opisthomyzon*. It was in general appearance more normal, according to Storms, than the typical remoras of to-day. Its head was not so flat, the jaws were equal, the head was narrower, and the sucking disk much smaller than that of the remora of to-day. In all probability, the fish was more active, a better swimmer, and not so dependent upon other fishes as are the present forms. Very little, if anything, is known of the breeding habits of remoras. In Florida I kept them in dead coral inclosures in order to watch them, but could never find the young.

Few more interesting groups of fishes are known than the remoras, which have figured in legend and history, well known to a few, rarely if ever seen by the majority. The accompanying illustration is a photograph of the fish in the water, taken at Santa Catalina Island, California, under my direction by Charles Ironmonger. It shows the sucker and its partitions perfectly, and doubtless is the only photograph ever taken of the remora, as the fish is rarely caught except when sharks are brought in alive.

THE GREAT SEA WALL AT GALVESTON.

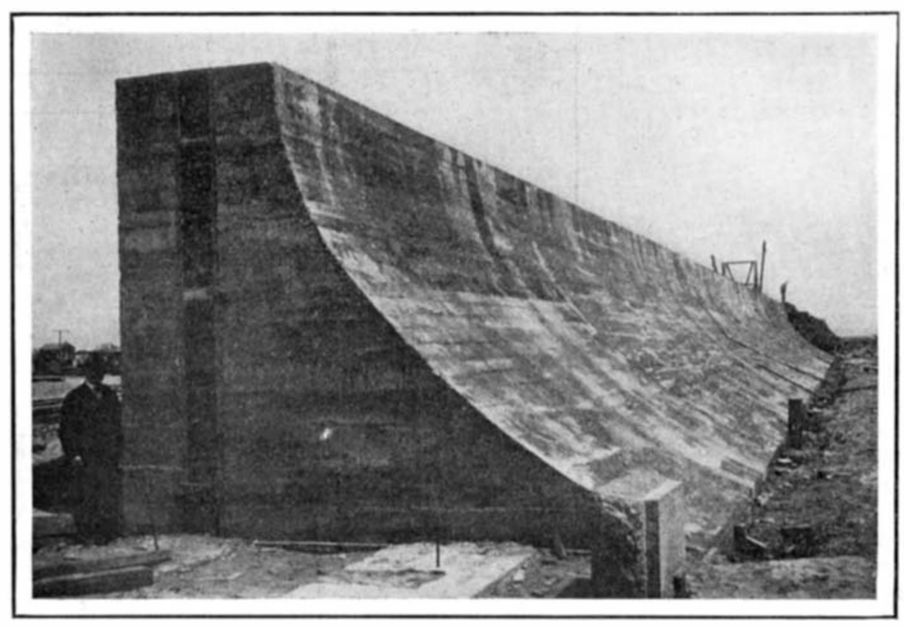
BY W. S. HUDSON.

The completion of Galveston's great sea wall marks the first step toward making that city, the most important port on the Gulf coast, storm-proof for all time to come, and also marks the successful culmination of one of the most unique and gigantic engineering undertakings in recent years. The building of a solid concrete wall 4½ miles in length and seventeen feet high and the elevation of the city's grade to the level of the top of the wall is an achievement of which any city twice the size of Galveston might well be proud, and when the conditions under which this undertaking was begun are considered, the wonderful nerve of Galvestonians is more properly realized.

Although repeatedly warned to take some measure for the protection of the city from the occasional overflows of the Gulf, it remained for the great disaster of September 8, 1900, to bring the people of Galveston to a complete realization of the necessity for such protection. In the great storm of that date over 8,000 lives were wiped out of existence, more than $20,000,000 worth of property was destroyed, and faith in the stability of the rapidly-growing city so rudely shaken that five years have not entirely sufficed to restore public confidence. When the city had partly recovered from the overwhelming disaster the board of city commissioners passed a resolution calling for the appointment of a committee to select competent engineers to report upon the following:

1. The safest and most efficient way for protecting the city from overflows of the sea.
2. Plans and specifications and estimates of the cost

BUILT OF GRANITE AND CEMENT, THE GALVESTON SEA WALL IS 4½ MILES LONG AND WEIGHS 40,000 POUNDS TO THE FOOT.



THE GALVESTON WALL MEASURES 16 FEET AT THE BASE, IS 17 FEET HIGH AND 5 FEET ACROSS AT THE TOP.

of a breakwater, or sea wall, of sufficient strength and height to prevent the overflow of the city from the Gulf.

3. Plans and specifications and estimates of the cost for filling and grading the city, so as to protect it from overflow, and to secure sufficient elevation for drainage and sewerage.

The board of engineers selected for the purpose were Gen. Henry M. Robert, chief of engineers, U. S. A., retired; Mr. Alfred Noble, and Maj. H. C. Ripley, all engineers of national renown. In January, 1902, this board submitted plans calling for the construction of a solid concrete wall and the raising of the grade of the city to the level of the top of the wall. Under the plans submitted, which were unanimously adopted, the total estimated cost of the sea wall and grade-raising was $3,505,040. The wall was planned to extend 3½ miles around the Gulf side of the city, and the government later agreed to further extend the wall nearly a mile, at a cost of $591,046.25, making the total length about 4½ miles. The sea wall was to be constructed by the county, while the grade-raising was to be done by the city, with the exception of 100 feet along the sea wall right-of-way, to be carried out by the county. The county issued bonds sufficient to carry out the building of the sea wall, while the aid of the State was sought in the grade-raising. The city was authorized to issue bonds to the amount of $2,000,000 for grade-raising purposes, and the State legislature agreed to remit the taxes for eighteen years, the taxes to be paid as usual, but the share which formerly went to the State to be used as a sinking fund for the redemption of the bonds and to pay the interest.

Work on the sea wall was started in October, 1902, and the county's extension was completed in July, 1904. The government extension of one mile was finished this month. Some idea of the immensity of this undertaking may be obtained by considering the following figures: The wall is built of solid concrete made of Texas granite and Portland cement. It is 4½ miles long and weighs 40,000 pounds to the lineal foot. The wall is built upon a round piling foundation, the piles being 45 feet in length, and not less than 12 inches at the top and 17 inches at the base in diameter. The piles are driven in four rows at intervals of 4 feet from center to center. The wall proper measures 16 feet at the base, is 17 feet high, and 5 feet across the top. It is protected from undermining on the Gulf side by an apron of rip-rap 27 feet wide, as well as by a row of sheet piling extending the entire length of the wall, and driven down to a depth of twenty-four feet.

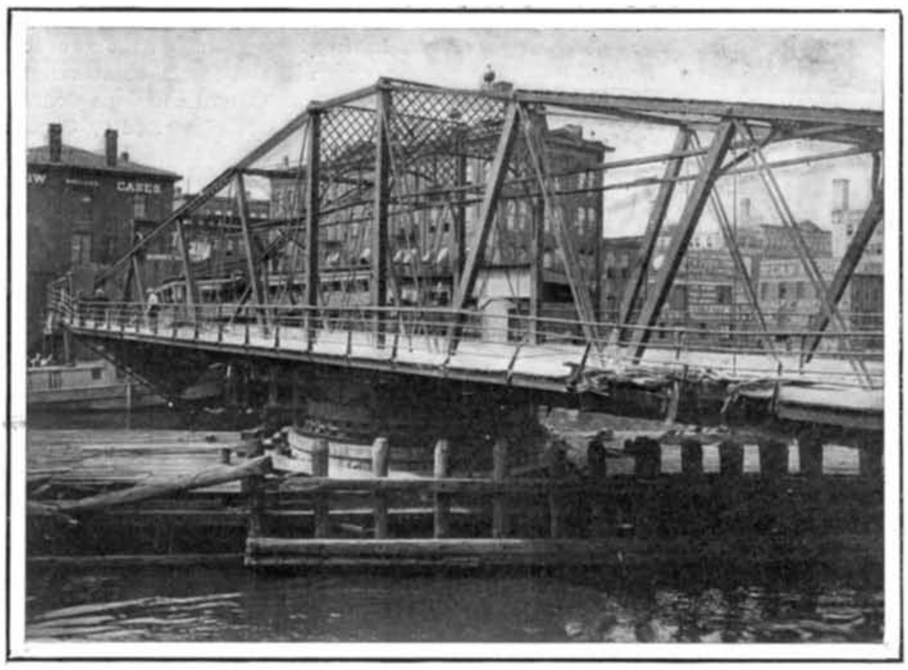
In the 3½-mile county extension were placed 13,300 carloads of material—5,200 carloads of crushed granite, 1,800 carloads of sand, 1,000 carloads of cement, 1,200 carloads round piles, 400 carloads sheet piling, 3,700 carloads of rip-rap, and 5 carloads of rim-filling rods.

Work on the grade-raising has been in progress fifteen months and the entire undertaking is expected to be completed early in 1907. The plan for filling in, while unique, is very satisfactory and its practicability has been fully shown. The initial move was the digging of a canal parallel to the sea wall and intersecting the avenues of the city. The material taken from the canal was used for filling in the sea wall right-of-way. The canal right-of-way was leased for a nominal sum and all the houses removed. With the building of the canal the material for filling in the city is being obtained from the bay and from between the government jetties by self-loading and discharging and self-propelling dredges. These steam from the excavating ground through the canal to pipe-line stations at points where the canal intersects the avenues. At these points the excavated material is forced through pipes running down the avenues, the sand remaining to fill up, the water running off through a discharging canal. In this manner very rapid progress is made. The harbor entrance is also deepened by the removal of the excavated material from between the jetties, which extend 5 miles out into the sea, and which were constructed by the government at a cost of $8,000,000.

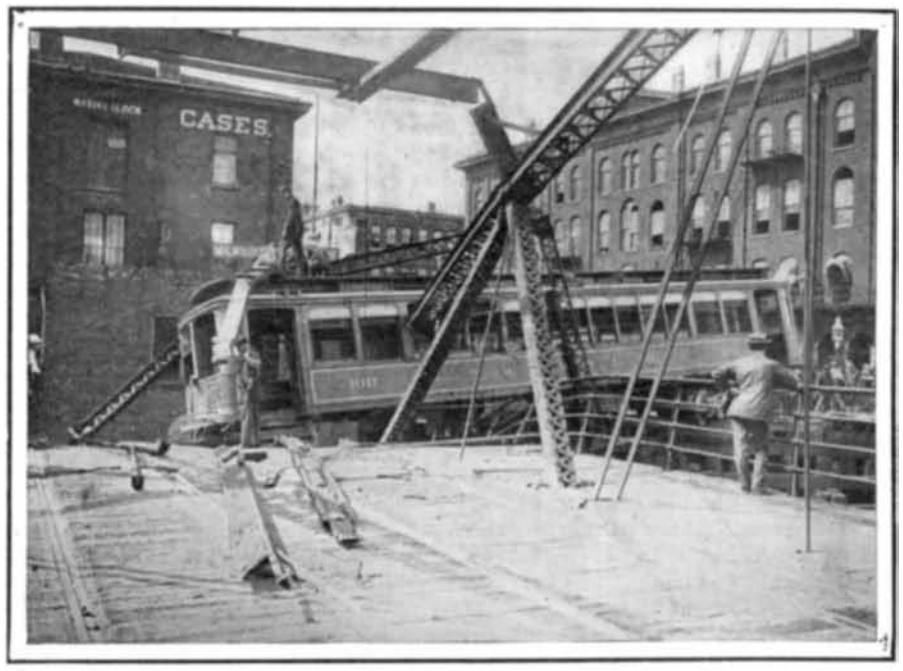
When the grade-raising is completed the dredges will back out of the canal, filling it up firmly as they go, and the houses removed therefrom will be restored.

The grade-raising necessitates the raising of 2,156 houses. The territory raised embraces private property as well as streets, sidewalks, and alleys, and there is no special tax or charge made against the private property for the filling placed thereon, although the expense of raising the houses is borne by individuals.

When the grade-raising is completed to the level of the top of the wall, the top of the embankment for about 50 feet from the sea wall will be protected by a pavement, and 40 feet further by soil and Bermuda grass. Thus a fine driveway will be the result, 50 feet in width, which, added to the available part of the top of the sea wall after an iron railing has been placed upon it will give a sidewalk 9 feet in width overlooking the Gulf of Mexico.



View Showing the Point at Which the Bridge was Rammed by a Steamer.

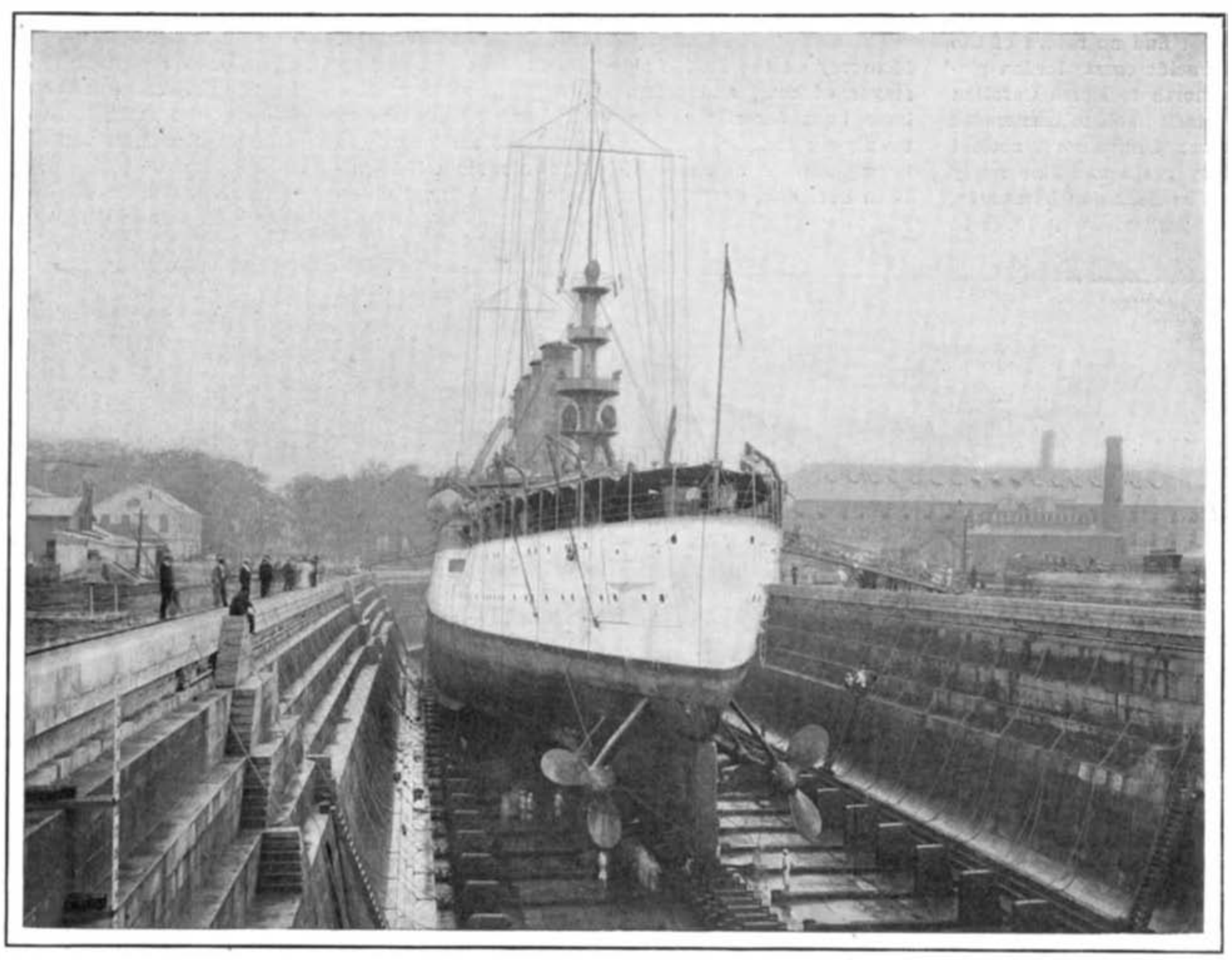


After the Collision; the Car is Resting Partly on the Bridge and Partly on the Street.

A CURIOUS DRAWBRIDGE ACCIDENT AT MILWAUKEE.

A CURIOUS BRIDGE ACCIDENT.

An unusual combination of circumstances rendered an accident that recently occurred on a street car on one of the bridges of the Milwaukee River of very special interest. A large and heavy street car had just crossed the bridge, which was of the ordinary draw-span type, and its forward trucks were already on the abutment, when a steamer, through some misunderstanding, ran into the opposite half of the draw span, causing it to turn on its turntable and twisting the street car into the perilous position shown in our engraving. As the bridge swung round the side of the car carried away the end of the panel of the truss, and the floor of the bridge, having no support, sagged down, leaving the outer end of the car suspended in the perilous position shown. The street railway company immediately made the necessary arrangements to place the car back on the track, and this they did by floating a scow beneath the car and building up a mass of blocking, by means of which the car was jacked up and run on to the tracks on shore. A fortunate feature of the accident was that no lives were lost, and that all the passengers made their immediate escape. The forward set of trucks remained on the abutment, but the after set fell into the river when the floor of the bridge collapsed.



The New Armored Cruiser "Maryland," 502 Feet in Length, on the Blocks.

OPENING OF THE BOSTON NAVY YARD DRYDOCK.

OPENING OF THE STONE DRYDOCK AT THE BOSTON NAVY YARD.

Time was when all the drydocks of this country, including those built for the government, were constructed of timber. Considerations of economy of first cost alone determined this selection, for the timber drydock has proved in many cases to be a troublesome structure, standing in constant need of repairs and liable to settlement and heavy leakage. Of late years both the government and the private shipyards, or rather those of them that can afford the more costly construction, have favored the use of masonry and concrete for drydock construction. The government, it is true, has built some masonry docks of the smaller size, and they have given most excellent service. It is pretty safe to say that all future drydocks built for the United States navy will be of the more durable construction; for although the first cost of the timber dock may be less, the cost of up-keep and the necessarily short life of the timber dock, to say nothing of the delay and anxiety incidental to its construction, more than offset the first cost.

In our issue of April 29 of the present year we gave an article which illustrated the various stages in the process of building the handsome stone-concrete drydock at the Boston navy yard, which has recently been opened by the docking of one of the largest ships in our navy. The new dock has a total length on coping, from the head to the outer end of the table, of 788 feet. From head to outer gate sill it is 750 feet in length, and on the floor from head to outer gate sill it is 729 feet. The width on the coping is 114 feet and on the floor of the dock is 72 feet. From the coping to mean high water, it is 5 feet 2 inches, and the depth of water over the sill at mean high water is 30 feet. The drydock is built on the site of an old basin, that was used in the early days of the dockyard. This resulted in considerable saving of excavation, and, fortunately, the dock everywhere is underlaid by an excellent quality of hardpan, which was so good that no piling whatever was necessary. The dock structure consists of a monolithic mass of concrete covering the whole of the floor and sides of the dock, upon which the cut granite facing has been laid. The concrete backing is 11 feet thick on the floor, and, in places, it is as thick as 18 feet in the side walls, the granite masonry being 4 feet thick over the floor and as much as 7 feet thick in the side walls and altars. In the construction of the dock it was necessary to excavate 170,000 yards of blue clay and hardpan and then lay in place 61,800 cubic yards of concrete and 21,000 cubic yards of cut granite.

The placing of the dock in actual service was accomplished when that fine armored cruiser, the "Maryland," was floated into position over the keel blocks; and the accompanying illustration is of particular interest since both the ship and the dock are examples of the latest and best work that has been done by the two bureaus of construction and of yards and docks. The "Maryland" was built by the Newport News Shipbuilding and Dry Dock Company, and on her trial she easily exceeded the contract speed of 22 knots per hour. She and her sisters are the longest warships in our navy, measuring 502 feet over all. On a mean draft of 24 feet she displaces 13,680 tons. She is protected by a waterline belt 6 inches in thickness, and she has a further protection of from 6 to 6½ inches over her barbettes and turrets, the central battery being protected with 5 inches of steel. Her main battery consists of four 8-inch guns in twin turrets, and fourteen 6-inch guns mounted in casemates.

Another Experiment With Ludlow's Airship.

Israel Ludlow, the lawyer-aeronautic-inventor, made five attempts to fly his dirigible man-carrying kite on Thursday, August 17. The big aeroplane, constructed after the fashion of an Eddy double box-kite, was transported from a vacant lot at 78th Street and West End Avenue, where it was built, to an open place on the North River front, near the railroad tracks, by a horde of willing helpers, including nearly all the small boys of the neighborhood. Charles Hamilton, a professional aeronaut, was the passenger, and it is generally conceded that he was fortunate to have escaped without injury at the conclusion of the trial. The machine was placed upon the ground facing the wind, and attached by means of a long rope to an 80-horse-power automobile. Three times the rope broke or became disentangled under the strain, and, with the exception of the first attempt, the aeroplane refused to rise. At the mentioned initial trial, when the rope parted the structure had risen some 10 feet and fell with a crash, rudely bumping Hamilton, but leaving him otherwise uninjured. The fourth time the airship was sent aloft without a passenger. It soared for a few moments and then fell, breaking its rudder and otherwise somewhat damaging the framework. At the fifth trial, with Hamilton aboard, the aeroplane rose gracefully into the air under the powerful tractive effort of the giant automobile and continued to glide as long as the pull on the rope was maintained—some two or three minutes. As soon as the automobile stopped, however, the motion of the aeroplane became very erratic, and despite Hamilton's efforts to keep it righted, fell with a crash from a height of approximately 100 feet, hopelessly smashing its framework. To the astonishment of the numerous spectators, Hamilton emerged smiling and uninjured from the wreckage.

Notwithstanding the seeming failure of the experiment, Mr. Ludlow expressed himself as satisfied that the brief flight had demonstrated the practicability of his design, and that within a few weeks he would be ready for further tests with a new and greatly improved machine.

Vagaries of the Gulf Stream.

The exceptional resistance encountered by transatlantic steamers on their journeys to this country has aroused not a little interest among oceanographers. So great, indeed, has been the resistance offered that some of the vessels fell short of their usual daily runs by 25 to 40 miles when within two days of the United States. Along the southern Atlantic coast the velocity of the Gulf Stream fluctuates between one and one-half and two knots an hour. As it travels northward the speed gradually reduces until when the stream reaches Nova Scotia it is so far widened and grown so shallow that it is almost imperceptible. It sometimes happens, however, that the speed does not diminish and that it even increases as the current changes its course. At times the northwestern limits of the Gulf Stream approach New England and Nova Scotia more closely than at others.

Naturally, such marked changes are not without their effect on climate. A change is noted in the movement of the air over the ocean. Indeed, it is not improbable that the change in the direction of air motion is the direct cause of the change in the Gulf Stream's motion. And since the winds in turn are controlling factors of our weather, it follows that a change in the Gulf Stream's direction of flow must be accompanied by some modification in our climatic conditions. The present phenomenon is merely a temporary aberration.

Jupiter's Seventh Satellite.

Harvard Observatory officials have received a telegram from the Lick Observatory at Mount Hamilton, San José, Cal., that a seventh satellite of Jupiter has been observed. On August 8 the satellite was seen at 289.07 deg. distant 54.05 minutes; on August 9 298.05 deg.; on the 10th, 289.04 deg.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICALLY-ENERGIZED FENCE.—A. D. McNAIR, Dallas, Texas. The invention refers to fences and admits of general use, but is of special value as applied to fences intended to prevent the escape of animals—such as cattle, horses, and hogs—therethrough. It further relates to means for exciting the wires of the fence electrically, so as to give the animals the sensation of pain upon making proper contact with the wires. Also relates to time-controlled mechanism for rendering the electric action of the fence intermittent, so as to save the battery-current.

PHOTOPHONE.—R. W. HARTMANN, deceased; B. SAENGER, administrator, Berlin, Germany. The present invention relates to improvements in photophones, whereby the conveyance of speech over greater distances than hitherto is rendered possible and the size and the weight of the photophone are kept within moderate limits, so that the latter can be easily transported, while a greater secrecy of the conversation both at the sending-station and at the receiving-station is insured.

SYNCHRONIZING SYSTEM.—P. RIBBE, Halensee, near Berlin, Germany. In this system the objects are, to provide at each station the rotary operating-disk of the clockwork with one or several radial slits, and a corresponding number of armatures on the periphery; to dispose an electro-magnet for attracting either of these armatures, the former being connected with line of transmission and may be connected at will with ground or local circuit; to dispose at each station on one side of disk a stationary screen with a slit, the latter adapted to register with the one or several radial slits of the disk periodically and consecutively; to provide a selenium-cell behind the screen slit and inserted in local circuit; and to provide at each station a source of light on the other side of the disk in line of the screen slit.

RUHMKORFF COIL.—J. McINTYRE, Jersey City, N. J. The invention relates to coils for use in electro-magnet apparatus—such as shown and described in application for letters patent of the United States, formerly filed by Mr. McIntyre. His object is to provide a coil arranged to allow continuous running of the apparatus without requiring retruing of the contact platinum portions and insuring a proper readjustment and contact between the platinum portions without danger of quickly burning their registering faces.

RECEIVER FOR USE IN WIRELESS TELEGRAPHY.—E. BRANLY, 3 Rue Boursault, Paris, France. This receiver essentially comprises two metallic parts in contact, one polished, one oxidized, contact of the latter with the polished surface preventing the passage of the current under normal conditions, but of immediately becoming conductive on emission of electric spark at a distance, and instantly resuming its resistance under action of very slight shock. One of the parts is constituted of metal rods, whose blunt points are oxidized and rest upon polished metal plate, or conversely the plate oxidized and points polished. By means of the device operation of receiver is always insured, as always at least one contact is capable of being rendered conduc[illegible] under the influence of electric waves.

Of Interest to Farmers.

SELF-PROPELLING COMBINATION HARVESTING-MACHINE.—J. J. TROEGER, Chicago, Ill. This improvement comprises self-propelling means, a cutter, a reel, and means for conveying the cut material from the cutter and elevating it from the machine to a thresher, which is to be connected to it, an auxiliary force-feeding device for the conveyer, and other features. The invention relates to each of these features separately, as well as to the combination as a whole.

DITCHING-MACHINE.—H. W. SARGENT, Near Fonda, Iowa. The invention comprises a wheeled-frame mounting a cutting and elevating mechanism, so that these parts may be vertically adjusted, the cutter turning on a vertical axis and being adapted to extend into the ditch and cut away earth, while the elevator takes up the dislodged earth and disposes of it, discharging it either at one side of the ditch or back into the ditch in rear of machine. The depth dug may be regulated by vertical adjustment of cutter and by adjustment of a shoe which follows the plow at base of cutter and may be operated to control the position of the cutting apparatus.

GRAIN-SEPARATOR.—L. T. MANN, Moline, Kan. One purpose of the inventor is to provide a series of lifting-fingers over the chaffer having reciprocating movement in a vertical direction and means for conducting the straw and grain from the concave and cylinder, into the said fingers, the rearmost of which fingers deposit the threshed straw upon the raddle, which in its turn conducts the straw to the delivery end of the thresher.

DEVICE FOR CATCHING AND HOLDING HOGS, ETC.—D. P. FUNK, Monroe, Wash. In this case the invention relates to an improvement in devices for holding hogs, sheep, calves, or other animals while applying rings to their noses and for other purposes. The object is to provide a cheap and efficient device which can be applied to the nose or leg of the animal while the ringing operation is taking place and one which shall be positive in its action.

PNEUMATIC COTTON-HARVESTER.—W. F. HARBOUR, Atlanta, Ga. The object of the invention is the production of an implement which is adapted to be advanced over a field of cotton and operated so as to gather the cotton and separate it from the leaves or other foreign objects which may be gathered therewith. The invention contemplates the employment of pneumatic means for effecting both gathering and separating operations. The construction especially facilitates the manipulation of the gathering member.

Of General Interest.

PROCESS OF TREATING STONE.—H. RYAN, Seattle, Wash. This invention relates more particularly to a process for treating building stone—such as granite, marble, sandstone, etc.—in order to remove stains therefrom and to change and improve the color thereof. It further relates to means for hardening the stone. Also, to a process for removing stains from various objects—such as stone, wood, and other building materials—and from fabrics, and more particularly stains caused by iron-rust.

TABLE.—E. MURRAY-AARON, Chicago, Ill. This invention pertains to improvements in tables of the adjustable and folding type, the object being to provide a table so constructed that by moving the top forward or rearward the height may be adjusted, maintaining the top in horizontal position, thus providing a table desirable for various purposes. It may be tilted and held at any angle to provide a drawing-board, book-rest, or the like.

WATER-TIGHT BUTT-JOINT.—F. C. KELSEY, Salt Lake City, Utah. Mr. Kelsey's invention relates to stave-pipes, his more particular object being to produce a type of butt-joint for connecting the ends of the staves together so as to prevent leakage and also to hold the adjacent abutting ends of the staves rigidly in predetermined positions relatively to each other.

STUFFING-BOX FOR HYDRAULIC CYLINDERS.—T. E. HOLMES, 63 Sheldon road, Sheffield, England. The object of the invention is to obviate the necessity of either withdrawing the ram or dismounting the cylinder in order to allow of the leather being renewed, the construction whereby this end is attained also permitting of the use of leather packing in situations wherein, owing to the impracticability of dismounting the cylinder, or withdrawing the ram, hemp or other readily renewable packing has been heretofore employed in place of leather packing, notwithstanding the fact of the latter being preferable in itself.

SCREW LIFTING-JACK.—E. H. GOODWIN, Olympia, Wash. In the present patent the object of the invention is to provide a new and improved screw lifting-jack arranged to reduce the friction between the members of the head to a minimum, to increase the lifting-power of the jack, and to prevent backing up of the screw-rod when the jack is under a load.

DEVICE FOR STRETCHING PAPER OR OTHER SUBSTANCES.—RACHEL GAUGUET, 6 Rue de Savoie, Paris, France. The invention relates to improvements in reglets designed to be engaged in connection with a stretcher-frame provided with channels or grooves to receive the reglets; and the object is to provide a reglet that will have a lateral spring-yielding tendency at its ends, the said spreading action being materially assisted by means of springs arranged in the reglets. The frame is designed for stretching sheets of paper, fabric, leather, and similar materials.

SPITTOON.—A. GARFEIN, New York, N. Y. In the present patent the object of the inventor is the provision of a new and improved spittoon which is sanitary, inoffensive to the eye, and arranged to completely conceal the accumulating sputum and to allow convenient cleaning whenever desired.

FRAUD-DETECTING BOTTLE.—S. E. BELL, Represa, Cal. In this instance the improvement relates to fraud-detecting bottles, the object being to provide a bottle of this class which is simple in construction and adapted to prevent effectually the fraudulent sale of liquors of all kinds. Openings having their outer edges in substantial alinement with the inner side of the cylindrical wall insure that the entire contents of the bottle may be removed. The bottle is constructed in a form so that no waste space occurs in packing.

DRESS-SUIT-CASE COVER.—S. BOTTEESE, Washington, D. C. In his improvement Mr. Botteese seeks to provide a protecting-cover for cases which can be secured snugly upon the case, does not interfere with the opening or closing of the case, and will afford means for carrying magazines, newspapers, or the like on one side and a pair of rubbers or the like on the other side.

CRATE.—H. H. CUMMER, Cadillac, Mich. The present invention refers to crates, and is an improvement on the crate formerly patented by Mr. Cummer. The improvements relate especially to the construction of the crate at the bottom and the cover. While the invention seems to be most applicable in connection with a folding crate or box, the parts may have substantially the same construction in a box which does not fold and so that the cover and bottom will be capable of connection and disconnection in a convenient manner.

BEDSTEAD FOR INVALIDS.—J. C. ANDERSON, Victoria, Canada. The purpose of Mr. Anderson's invention is the provision of a mattress attachment to the frame of bedsteads, which mattress is provided with a hinged head and foot section capable of being independently or simultaneously raised to stand at an angle to the body or central portion of the mattress and lowered to a horizontal alignment with the said body-section, so that either the head or the feet of the patient or both portions of the body may be given any desired inclination.

PROCESS OF REPAIRING PIPE-LINES.—J. Welsh, Jersey City, N. J. In repairing water-pipe lines it is impossible to close off the water perfectly on either side of the point where the break has occurred, as the valves in the main are apt to have grit or sediment collect on their seats and prevent the valve from closing tightly. Water passing valves in this way progresses to the point where repair is being made and interferes with making of permanent joints. This effect is materially increased when joints are made with lead, which is flowed into the collars. This invention affords means for disposing of this water so that it does not interfere with the repairing operation.

SUPPORT FOR FLOOR CONSTRUCTION.—L. Viezzi, New York, N. Y. In this patent the invention pertains to fire-proof floor construction; and its object is to provide a new and improved support for sustaining the filling between the beams while placing the filling in position, the support being very simple and durable in construction, easily set up, and readily taken down after the filling is in place.

SUBSTITUTE FOR WHALEBONE.—E. M. Bossuet, 49 Boulevard Haussman, Paris, France. This substitute is for use in connection with corsets, bodices, and other articles of apparel. It comprises small longitudinal strips of cork or cork composition, felt, leather, or other like material with intercalated strips of real whalebone, imitation whalebone, or other resistant and flexible material, these strips being secured together—for example, by means of a suitable adhesive—so as to constitute blades of pieces having the dimensions of the strips of whalebone usually employed in articles of dress.

HOSE-HOLDER.—A. G. Button, Denver, Col. The invention is an improvement in hose holders, especially designed for holding hose in use for sprinkling lawns and the like. Construction is simple and easily applied. By bending the points of the tripod so they extend parallel to each other and may be forced straight into the ground it is found in practice that but slight pressure is required to force the points into the ground and that the holder will not turn over, no matter how heavy the force of the water.

EVAPORATOR.—A. P. Geer, New London, Conn. This improvement relates to apparatus used on board marine vessels for evaporating salt water and condensing the vapors for the production of water fit for use in the boilers and for other purposes. The object is to provide an evaporator durable in construction, very effective in operation, and arranged to insure proper evaporation of the salt water without danger of clogging the apparatus or rendering the same ineffective.

SIGNALING APPARATUS FOR THEATERS, ETC.—T. E. Miller, Norman, Oklahoma. This invention is in the nature of a mechanical signaling device for theaters, etc., designed to reduce to a simple, quiet, and well-organized system the transmission and execution of the various orders incident to the dropping of curtains, the setting of scenes, orders to the orchestra, dressing-room, head usher, electricians, grippers, etc., instead of having to rely upon verbal orders and the dispatch of messengers. The apparatus comprehends an operator's transmitting-board, and intermediate mechanism whereby the above results are carried out.

MACHINE FOR MAKING CHEESE.—C. H. Southard, Smithville Flats, N. Y. The improvement pertains to a means for heating and circulating the material in cheese vats; and it consists, briefly stated, in the novel mechanism for performing this operation, in which mechanism an ejector is provided with a suction-port adapted to draw the whey therethrough, so that the steam passing through the ejector-nozzle will carry with it a quantity of whey, and the two will be admixed and discharged into the vat.

VETERINARY MOUTH-SPECULUM. — M. McNalley, St. Louis, Mo. The principal object in this case is the provision of a speculum so constructed that the jaws of the animal such as a horse, or mule, may be forcibly separated and securely held in open position, so as to permit the introduction of instruments into the animal's mouth and the convenient and effective manipulation of the instruments therein. Means are provided for holding the speculum in adjusted position with such security that the accidental release of the parts of the speculum by any movement of the animal is completely obviated.

Hardware.

WRENCH.—E. Enderes, Littleport, Iowa. The wrench is especially designed for the purpose of applying and removing what are generally known as the "never-slip" horseshoe-calks. When the jaws are fitted around the calk and the handle is moved in a certain direction the jaws will grip the calk and hold it until the handle is pulled back in reverse direction, when it will release the calk, so that the handle may be reciprocated to turn the calk one direction or the other, the cupped hook operating to tightly grip the calk and prevent any slipping of the same.

COMPOUND TOOL.—J. W. Quilling, Ursa, Ill. This tool is designed to be used as a can-opener, tack-puller, and corkscrew, having both fixed and movable jaws for opening cans, pulling tacks, nails, etc., and also for extracting stoppers from bottles, etc. The object of the invention is to provide an efficient device in a single unitary article for performing various functions of different parts of the tool.

Machines and Mechanical Devices.

CRUSHING-ROLLS.—R. Pick, Buffalo, N. Y. In this case the invention relates particularly to rolls for crushing sugar-cane and extracting the juice, the object being to provide crushing-rolls so formed as to crush or break the cane in uniform lengths without shocks and whereby the cane will pass lengthwise between the rolls at right angles to their axes.

ELEVATOR-ENGINE.—C. W. Hoffman, New York, N. Y. The object of this invention, which relates to elevators, is to provide improvements in elevator-engines whereby the engine is stopped in case of accident to the machinery by shutting off the motive agent from the engine and by applying the engine-brake by the same brake-lever which normally controls the brake on ordinarily stopping and starting the engine.

CHARGING APPARATUS.—T. F. Witherbee and J. G. Witherbee, Port Henry, N. Y. In this patent the invention has reference to a charging apparatus capable of many uses, but especially designed for blast-furnaces. The main object of the invention is to insure a better distributon of the materials charged into a blast-furnace—such as fuel, ores, and fluxes—than has hitherto been attained. These inventors have patented another charging apparatus which relates to a charging device which is capable of many uses, but is especially designed for use in blast-furnaces. The principal object of this invention is the provision of a bell and hopper which can be used in connection with a modern "skip-hoist," as well as with a hand-filled furnace. A further object is to provide a bell with a variable diameter, so as to allow a varied distribution of the charge within certain limits in the furnace.

WINDLASS WATER ELEVATOR.—L. Y. Randall, Gaffney, S. C. The invention is an improvement in the class of water elevators in which a bucket or receptacle is alternately lowered into the water to fill and raised therefrom to discharge its contents, the same being operated by a windlass or equivalent means and having a valve which serves for inlet and outlet of water, it being operated for the latter purpose by a swinging spout which is raised as the filled bucket or receptacle reaches the limit of its rise.

SHOE-SEWING MACHINE.—J. A. Rhoult, Haverhill, Mass. In the present patent the object of the invention, briefly stated, is the provision of a new and improved shoe-sewing machine more especially designed for sewing the outer sole on to the upper while both are in their natural positions, thus requiring no turning over of the shoe after being sewed.

TYPEWRITER COVER.—J. L. Ramsay, Lavaca, Ark. In this case the invention relates to covers for typewriters; and its object is to provide a device for this purpose which is of simple construction and which may be folded into small space. In the improvement, economy and ease of applying the device have been important considerations; for instance, the means for centering the typewriter easily with respect to the hood, which saves the metal material used in construction.

Prime Movers and Their Accessories.

LUBRICATOR.—E. A. Henry and O. A. Sneed, Joplin, Mo. In the present patent the invention has reference to lubricators and admits of general use, but it is of peculiar service upon steam-engines and analogous motors in which it is desired that the feed of the lubricant shall have a relation to the flow of steam or of some other aeriform body.

CURRENT-MOTOR.—F. M. Cummings, Lewiston, Idaho. This invention pertains to improvements in motors adapted to be operated by water-currents for driving pumps, dynamos, or other machinery, the object being to provide a current-motor of comparatively simple and inexpensive construction and in which the efficiency of power will be considerably increased over the normal power of the water-current.

Railways and Their Accessories.

BAGGAGE AND FREIGHT TRUCK.—L. Barnes, Oxford, Mich. The inventor's purpose is to provide a truck for conveying baggage to a baggage car or to receive it therefrom and which may also be used for freight and to provide the truck with one or more (usually four) elevating-sections, upon which baggage is placed, the sections being so arranged that they may be quickly and independently elevated to bring the upper portions of sections either flush with or above the floor of the car, enabling the baggage to be removed from the truck to the car or from the car to the truck with little exertion and without damage to articles.

SWITCH.—W. S. Jackson, Hoboken, N. J. This invention refers to switches for electrical work, it being particularly applicable to those employed in connection with the trolley-wire of electric-car systems. The device is simple and convenient. Though Mr. Jackson claims the operation of the switch by a trolley, it is to be understood that this does not necessarily apply to a contact-wheel only, but is intended to designate any portion of the supporting and conducting system which more directly co-operates with the source of current.

RAIL-TIE.—G. W. Schellenbach, Sedalia, Mo. In the present patent the invention pertains to improvements in metal railway-ties, the object being the provision of a metal tie the greater portion of which is incased in cement or concrete in a manner to relieve the strains and shocks, making the concrete subject generally to compression only.

VENTILATOR FOR CARS.—H. Kennell, New York, N. Y. One purpose of the invention is to provide means for ventilating cars or other vehicles by introducing a thorough circulation of air through the clearstory of the car, thus preventing occupants being subjected to draft, though the air is constantly replaced. The device is adapted for attachment at the ends of the clearstory which will open at the end of the latter facing the point from which the car travels and will close at the opposite end of the clearstory or that end which faces the point in direction of which the car is traveling, the two ventilators being independent in their operation, thus creating a suction to draw foul air out of the body of the car.

DUMPING-CAR.—McKinley Boyle, New York, N. Y. Mr. Boyle's invention refers to improvements in dumping-cars of that class in which the dumping is from the sides. It is the object of his invention to provide a simple and novel means to swing the door to a plane of the car-body and possibly above the top of the load, thus providing a wide opening through which the load may quickly discharge.

METAL CROSS-TIE AND RAIL-FASTENING.—C. D. Paxson, Cleveland, Ohio.—The aim of the inventor is to provide novel details of construction for a metal cross-tie that afford great strength for a tie of minimum weight, adapt the tie to resist strain in every direction, and give it a broad bearing upon the road-ballast; and a further object is to provide a novel rail-clamping device which releasably secures track-rails in position on the cross-tie, properly spiked apart.

CAR-FENDER.—E. C. Hall, New York, N. Y. The invention refers to car-fenders, and especially to the class carried by trolley-cars or street-cars. The object is to provide a fender of simple construction which will be normally disposed in an inoperative position well beneath the body of the car, but which can be instantly sprung into operative position, so as to catch an object lying upon the track before the car.

RAILROAD-TRACK-RAIL-GAGE HOLDER AND BRACE THEREFOR.—J. H. Crowley, Duluth, Minn.—The object here is to provide a transverse gage-bar of an essentially T-rail form to be clamped near each end thereof upon the base-flanges of two spaced track-rails between the cross-ties whereon the track-rails are seated, the bar being inverted and the base-flanges thereon secured in contact with the base-flanges on the track-rails on their lower surfaces by novel brace-clamps and abutment-flanges secured on the end portions of the bar, whereby the track-rails are held from lateral displacement and properly gaged and the outer sides of the track-rails braced to resist load strain and lateral sway of rolling-stock.

Pertaining to Recreation.

PORTABLE SWING.—C. U. Krieg, Sr., Nashville, Tenn. The invention is in the nature of an improved portable swing for use on lawns, parks, etc., which is designed for amusement, recreation, and advertising purposes and which shall also be protected as against the sun's rays and rain. Means are provided to lock the swing in many cases, as in playing games or sewing, and when elderly persons are getting in and out.

DUCK-CALL.—C. H. Ditto, Keithsburg, Ill. With a call of this kind the principal species of wild ducks—such as the mallard, pintail, widgeon, teal, etc.—may be readily called, the device being adjusted, so as to suit the species of duck being called and also so as to adapt the device to the peculiarities of the sportsman using the call.

Pertaining to Vehicles.

BICYCLE-SUPPORT.—E. H. Foster, Baker City, Ore. The device is simple and easily operated, holds the wheel against all possibility of movement when in use as a support, and when the wheel is being ridden is so securely fastened in place that none of the parts can become disengaged and cause accidents.

AUTOMOBILE ATTACHMENT. — H. C. Ucker, Fayetteville, Ark. The improvement refers to an auxiliary propelling means applied to motor-driven vehicles for carrying passengers or freight and adapted to be thrown into operation when the wheels of the vehicle slip or for other reasons fail to exert their proper propelling effect. The propelling device comprises a series of push-bars and means for mounting and driving them. It also comprises certain novel devices for moving the push-bars in and out of action.

WHIFFLETREE-HOOK.—W. R. Brueske, Wimbledon, N. D. The invention relates to a self-locking safety whiffletree-hook, but it is of such a nature that it can be applied to holding or fastening devices of any kind. The principal objects are the provision of a holding or fastening device which will be automatically and securely locked when the article to which it is intended to be attached is applied, which may be readily and quickly attached and removed, and which will be absolutely safe.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 7177.—For manufacturers of high-grade mirrors.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7178.—For manufacturers of springs wound by a key and run for 10 minutes.

2d-hand machinery. Walsh's Sons & Co., Newark, N.J.

Inquiry No. 7179.—For manufacturers of household goods, hardware, etc.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 7180.—For manufacturers of small coil steel springs, 1½ inches wide, 18 feet long.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 7181.—Wanted, name of material used in the small balls on hat pins.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 7182.—For manufacturers of thin steel razor blades of best quality.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 7183.—For manufacturers of bicycle parts for assembling bicycles; also manufacturers of light iron wheels for baby carriages and children's velocipedes.

Marketers of meritorious inventions and specialties throughout the world. Tatem Mfg. Co., Buffalo, N. Y.

Inquiry No. 7184.—Wanted, address of parties selling castings and drawings of water-jacketed gasoline engines for marine and automobile use.

I sell patents. To buy them on anything, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7185.—For parties selling Turkey boxwood.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 7186.—For manufacturers of machinery for fastening tips to shoe strings; also machinery for working button holes.

Wanted.—Information concerning manufacturers of vacuum pans for evaporation of liquids. Sligo Furnace Co., Sligo, Dent County, Mo.

Inquiry No. 7187.—For manufacturers of bending machines and plating apparatus, used in manufacture of gas and electric fixtures; also brass tubing, casing, etc.

Gut strings for Lawn Tennis, Musical Instruments, and other purposes made by P. F. Turner, 46th Street and Packers Avenue, Chicago, Ill.

Inquiry No. 7188.—For dealers in magnetic sand ore containing gold.

For Sale.—U. S. Patent No. 659,635. A household article of general necessity, light manufacture. Proven a good seller. Descriptive circular. Address Walter A. Arrowsmith, Urbana, O.

Inquiry No. 7189.—For importers or manufacturers of the "La Luciole" French electric sign, illuminated.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, wood fiber machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 7190.—For makers of small commutators.

Absolute privacy for inventors and experimenting. A well-equipped private laboratory can be rented on moderate terms from the Electrical Testing Laboratories, 548 East 80th St., New York. Write to-day.

Inquiry No. 7191.—For dealers in pure oils and ingredients for use in making flavoring extracts.

Manufacturers of all kinds sheet metal goods. Vending, gum and chocolate, matches, cigars and cigarettes, amusement machines, made of pressed steel. Send samples. N. Y. Die and Model Works, 508 Pearl St., N.Y.

Inquiry No. 7192.—Wanted, firms who underwrite stocks and bonds.

What Have You to Sell?—We are in touch with the best canvassers in Central New York. Act as manufacturers' agents and promoters of companies. Patents bought and sold. Manufacturers' and Inventors' Sales Company, 133 Leroy St., Binghamton, N. Y.

Inquiry No. 7193.—For manufacturers of certain Metropolitan lever handle loco. injector.

Patents on Dredges and Dredging Machinery for Sale.—By reason of the death of Ralph R. Osgood, valuable patents, having a long term to run, are offered for sale. For terms communicate with

The Albany Trust Company, Executor, Albany, N. Y.

Inquiry No. 7194.—For the manufacturers of the collapsible foil metal tubes.

For Sale.—Canada and all foreign rights. Flynn's Little Giant Controller. The New Theory in driving, and a guaranteed conqueror of hard pullers and runaway horses, or your money refunded. Fits all bridles; absolutely humane. Does not interfere with wind or gait. No overdraw or checkbit necessary. Lightest and neatest controller made. Price, $2.50 each. Address Dr. P. Harvey Flynn, Patentee and Sole Manufacturer, 73 Warren Street, New York City.

Inquiry No. 7195.—For parties in middle west to manufacture and sell, royalty basis, butter blocking machine for hotels, restaurants, etc.

Inquiry No. 7196.—For manufacturers of electrical tattooing outfit.

Inquiry No. 7197.—Wanted, address of parties selling lancewood.

Inquiry No. 7198.—For manufacturers of pressure tanks for residence water systems.

Inquiry No. 7199.—For manufacturers of advertising novelties.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9733) J. F. S. asks: Will you kindly explain how it is that makers of dry batteries rate their cells in amperes? Thus, they claim that a cell will show 14 or 16 amperes. I always supposed that an ammeter simply showed the *rate* at which current flows. This being the case, the reading on the ammeter would be dependent on the voltage and the resistance in circuit. Would it not be better practice to test cells with a voltmeter? A. You are correct in supposing that the amount of current registered on an ammeter connected in a circuit is dependent upon the voltage and resistance. In testing dry batteries, however, it is customary to short circuit each cell for an instant through an ammeter to see what is the maximum rate at which it will discharge. When new, this gives an indication of the capacity of the battery, and, as a cell becomes run down, the rate at which it will discharge when momentarily short-circuited decreases. When this falls to 5 amperes the cell is about used up for anything but very light, intermittent work. Cells in this condition will sometimes still spark a gasoline engine if the vibrator is properly adjusted to suit the weak current they will supply. The voltage also falls off slightly as a dry cell becomes run down, but this indication is not as definite as the amperes in the cell will show, while with a storage cell the voltage taken when the cell is discharging is a good criterion of the amount of charge still in the cell. A dry cell shows 1.5 volts when new and anywhere from 1 to 1.25 or possibly more when run down. A storage cell shows 2.1 or 2 volts under discharge when full, about 1.9 when half discharged, and 1.8 or 1.75 when fully discharged. It will, however, immediately return to 2 volts when on open circuit. In short-circuiting dry cells through an ammeter, but one cell at a time should be tested and care should be taken to have large enough wire to carry the current easily. The wires to the meter should be as short as possible and all connections should be well made. A whole battery of 4 or 6 cells can be short-circuited at once, but this gives an average discharge only and does not indicate the condition of each separate cell.

(9734) G. O. asks: Will you kindly state in your Notes and Queries if the dynamo described in the SUPPLEMENT No. 600, by George Hopkins, can be made into a 110-volt and 5-ampere machine, the size and amount of wire? A. The dynamo of SUPPLEMENT No. 600 can be rewound for 110 volts. We have published the mode of doing this in Answers to Queries: 9553, vol. 92, No. 11; 8316, vol. 85, No. 7; 8250, vol. 85, No. 1. We send these papers for ten cents each. The general rule for making such a change in the design of a machine is to double the number of turns on the armature and rewind the field with twice the number of turns, using wire of half the sectional area.

(9735) T. G. asks: I refer to your Notes and Queries column March 25, page 248 (No. 9565). You say: "Since the tank weighs 10 pounds an addition of 73 1-3 pounds in the tank will sink it." I suppose you did not intend to say will sink it to the *bottom* of the water? Would not the tank be kept swimming in submerged position at a certain distance under the surface of the water for the reason that the tank is closed air-tight and no water can enter the tank, and for the reason that 1 1-3 cubic feet of water at the surface of the water do not weigh as much as at the depth or bottom of the water, because for example the water at the bottom of the ocean is more compressed than at the surface and consequently 1 1-3 cubic feet of water weighs more and more the closer to the bottom of the ocean it is? For this reason the air-tight tank displacing 83 1-3 pounds of water at the surface of the water would not sink to the bottom, but be kept swimming in submerged position at a certain distance under the surface of the water. Would it be possible to put just enough weight in such a tank to make it stay in a submerged position say 4 or 5 inches under the surface of the water? A. We have treated the question of a submerged body many times in the query column, and would refer you to Queries 8307, 8440, 8935, 8959, 9500, in which different phases of the matter are discussed. But we have always said a body which will sink at all in water will go to the bottom. The reason is that water is less compressible than any metal or other substance which may sink in water. The references we have given above furnish you the figures of compressibility of water, etc. Water is not much denser at the bottom of the ocean than at its surface. Now, your question involves a somewhat different point. The container in this case is filled with water which is compressed as it descends in exactly the same degree as is the water in which it is sinking. There remains only the compression of the container. If, then, the box will sink at all the container will be compressed more than the water in which it is sinking and the whole will go to the bottom, if it sinks at all. It is not possible as a practical matter to make anything float just under the surface of water. We have tried to do this many times. The slightest change of buoyancy will bring such a body to the surface. The fatal point in this question is that the tank is to be filled with air and not with water; and air is readily compressible under all conditions. Hence, as the tank sank it would always grow smaller by compression and displace less water. Hence it would sink faster as it went deeper. There is no chance that the tank in the case proposed could ever rest except at the bottom of the water.

(9736) W. I. H. asks: 1. What is the heat conductivity of carbon such as the pencils used in arc lamps? What order does it have in the scale of conductors? A. The conductivity of carbon for heat is 0.000405, when copper is 1.0405 on the same scale. This is less than all the metals, stones, and many minerals, and more than most woods, wool, and animal substances generally. 2. What is its fusing point, or does it only fuse in the electric arc? A. Carbon has not been melted, though under sufficient pressure there seems to be no reason why it may not be melted. It turns or seems to turn directly into a vapor upon heating it sufficiently. It vaporizes in the electric arc at a temperature between 5,000 and 7,000 deg. F. The electric arc is the only source of heat hot enough to vaporize carbon. 3. What is its specific gravity? A. The specific gravity of carbon in the form of graphite is from 1.9 to 2.3. The porosity of electric light carbons would probably cause them to appear lighter than this. 4. How is it manufactured and of what is it composed? A. Carbon is manufactured from wood as charcoal; from coal in retorts as graphite. Carbon is carbon. It is an element, and so far as man is able to affect it, it is not made from any other substance, nor changed into any other substance. 5. What holds it together, that is, is it plastic when molded or molded under great pressure? A. Cohesion holds the particles of a lump of coal or other piece of carbon together. It is not plastic in its ordinary states. In the electric light carbons the particles are bound together by some sticky material, and the rod is then burned in a furnace. 6. Is it what would be considered an expensive product? Please give some idea of cost in molded shapes and in bulk. A. Carbon is not an expensive article. You know probably what a ton of coal or a cord of wood is worth at your place. In buying either you are buying carbon. 7. Could scraps of it be pulverized and again molded into shape? A. Pulverized gas carbon, or graphite, is molded, as we have said above. 8. Can you supply us with the addresses of firms making articles of carbon? A. The Dixon Crucible Company, Jersey City, N. J., make crucibles, lead pencils, and many other articles of graphite. All dealers in electrical goods have electric-light carbons, battery plates, and motor brushes for sale. They also may have granular carbon for use in the telephone transmitter. Jewelers deal in diamonds, which are crystallized carbon. 9. All authorities do not agree upon the melting point of gold. Please tell the melting point both in Fahrenheit and Centigrade. A. The melting point of gold ranges from 1,035 to 1,250 deg. C.; 1,080 deg. may be taken as an average value. This is from 1,900 to 2,250 deg. F.

(9737) L. F. S. asks: I believe that astronomers consider the planet Mars to be an old planet on account of there being very little water on it. Then, if this is the case, is the water gradually getting less on this world of ours, and if so, by what means, as when evaporation takes place on the ocean, this moisture falls again in rain. Does some moisture get carried into space? A. A vast amount of water exists in the rocks and other solids of the earth in a fixed form, and in the formation of rock, which is still going on, water disappears from the liquid state. This is not, however, the mode in which geologists believe the earth will grow old and die, but rather by becoming cold. As the earth cools the water can sink deeper below the surface. At present it is driven back as steam. The oceans can all go down below the solid surface into the porous solids of the depths of the earth and freeze there, or freeze on the surface in their beds, for that matter. It is not probable that water as water is carried out into space from the earth.

(9738) C. M. G. writes: Please give the solution and answer to the following problem in the SCIENTIFIC AMERICAN, also the rule to solve this class of problems: A siphon pipe 4 inches in diameter is laid in a small mountain stream to convey the water downstream (for a certain purpose) for a distance of 250 feet. A dam 5 feet high impounds the water, and the flow keeps the water stationary one foot from the top of the dam. In the 250 feet the pipe falls 4 feet, thus leaving the outlet of the siphon 8 feet below the surface of the water impounded. The distance from surface of the water to the paxe is one foot, altitude 4,500 feet. What is the pressure per square inch at the intake end of the siphon? A. We would say that if the water in the siphon were not flowing, the pressure at any point in the system could be readily found. It would be zero pounds above the pressure of the atmosphere at any point on a level with the surface of the water at the intake. For any point below the surface of the water, the pressure above that of the atmosphere would be equal to the distance below the level of the surface in feet multiplied by 0.433 in pounds per square inch. For any point in the siphon above the water line at the intake, the pressure would be less than the pressure of the atmosphere by an amount equal to the height of the point in question above the level of the intake in feet multiplied by 0.433, this result, as before, being in pounds per square inch. If the water is flowing through the siphon at a uniform velocity, the problem becomes very much more complicated, as the friction of the water in the pipe varies with the character of the pipe, its diameter and the velocity of flow. This makes accurate calculations very difficult. The pressure at any point in the system, however, would always be equal to the pressure found by the above rule, on the supposition that the water was at rest, minus the loss in pressure due to friction between the intake and the point in question, minus $0.433 \times \frac{v^2}{64.4}$ where v equals the velocity of the water in feet per second.

(9739) W. W. S. asks: Will you please explain why an incandescent light filament in circuit on an alternating current of about 125 volts swings back and forth when an ordinary horseshoe magnet is held with the north and south pole in a horizontal plane, while if these poles are held with their centers in a vertical one, no vibrations result? A. The vibration of the filament of an incandescent lamp under the influence of a magnet is due to the effort of the filament to turn in the magnetic field and place itself in the proper plane of rest with reference to the field of force of the magnet. The filament is a flexible conductor carrying a current of electricity and tends to rotate until the lines of its field are parallel and in the same direction with those of the magnet. In this respect it is just like a suspended coil of wire in Ampere's experiments, which may be found in any good text book. The filament may be ruptured if too strong a magnet is brought near it.

(9740) A. L. asks: Kindly oblige me by answering the following questions: 1. What is best material to make a magnet of? 2. What is the best means of making a magnet? 3. Does the north pole of a magnet repel the north pole of another magnet in practice the same as in theory—I mean on a large scale? A. Permanent magnets are made of steel, the best steel to be found. Tool steel is often used. Manganese steel is preferred by some; chrome steel, or tungsten steel also may used. Heat the bar to a cherry red, or if it is long, the ends of the bar, and plunge it endwise into water. It will then be glass hard. Draw the bar across the poles of a strong magnet, either another permanent magnet or, better, an electro-magnet. Do this ten to twenty times, pulling it off in the same direction from one pole, and then reverse the bar and pull the other end from the other pole in the same way. There is a repulsion between similar, and an attraction between opposite poles of two magnets. If the magnets be strong this will also be strong.

(9741) A. G. L. asks: What is the capacity of the condenser used in a Ruhmkorff coil with 2-inch spark? Is it possible to connect two condensers in multiple so as to make one of double capacity? How many volts would it take to run a 2-inch Ruhmkorff coil to its full capacity? Is there any possible way to find out how many vibrations a second an interrupter can make? A. A condenser for an induction coil giving a spark 2 inches long should contain about 15 square feet of tin foil. It is well to make the condenser so that it can be separated and the parts capable of being used separately, so that it may be adjusted to the strength of the battery. A condenser may have its capacity altered by dividing it into halves or any other fractional parts. Any number of condensers may be connected in multiple, and a greater capacity be secured. Three to six cells will be required for a 2-inch induction coil, according to the kind and condition of the cells. The number of vibrations of an interrupter may be approximately determined by the note given by it.

(9742) W. C. W. asks: 1. What metal or substance transfers electricity most quickly and easily by induction? A. There would not seem to be any considerable difference in the metals in the transfer of electrical induction, but electricity is not transferred by induction. 2. When we touch an electrical eel, what kind of electricity does he shock us with or project upon the person? A. Electricity is positive and negative, and a shock is always due to both. A shock is given by an electrical charge. This may be either of positive or negative electricity, and the shock is due to the sudden combination of an equal quantity of each. In a charge of electricity, the electromotive force may rise very high and the charge become very intense. The old name for this condition was static electricity, a name which has disappeared from the recent books. This is the condition of the electrical eel. These matters are well and fully treated in the new book just issued, "The Electrician's Handy Book," price $3.50.

NEW BOOKS, ETC.

THE REVELATIONS OF NATURE. By Leonidas Guillemet. San Francisco, 1905. Published by the author. 16mo; 258 pp. Price, $2.

This book contains a philosophic essay in three parts which treat of perpetual motion; forces of matter and celestial mechanism; and life and spirit, the infinite, and immortality. The author does not claim to be a man of science, although science undoubtedly has attracted him greatly and caused him to delve in and speculate upon some of the mysteries of nature which have been heretofore variously explained, or for which no suitable explanation has been found. Mr. Guillemet claims to have solved the problem of perpetual motion by means of liquid air. After stating that "all the cold imparted to a gas by abstraction from a liquified gas represents new energy," he goes on to say: "The question is to provide a machine that saves it and continues indefinitely to make more. That is easy enough when one way to do it is known." By his discovery (which is the subject of an application for a patent) the author has found out that the refrigeration and liquefaction of air will generate energy instead of spending it. The source of energy available to draw upon is the difference between the temperature of solid air and that of the atmosphere, he claims.

While people well informed on the subject in question may not agree with the author in some of his deductions, nevertheless they will find his book an interesting, clearly written little volume containing fresh ideas and speculations not only on perpetual motion, but also on the workings of nature in various directions and the operation of the universe as well.

PROPERTIES OF STEEL SECTIONS. By John C. Sample, C.E., M. Arch. New York: McGraw Publishing Company, 1905. 8vo.; pp. 121. Price, $3.

This is a reference book for structural engineers and architects. It includes many tables of moments of inertia, and radii of gyration of built sections, etc., besides examples of sections selected from monumental structures, unit stresses, safe loads for columns, plate-girder design, design in timber, and the like. The book consists chiefly of carefully calculated tables, which will save the designer much preliminary figuring in all standard designing. Only sufficient text to explain the application of the tables is included in the work. On account of its practical character, it should be a great help to all structural engineers and designers.

HYDRAULIC POWER ENGINEERING. By G. Croydon Marks. New York: D. Van Nostrand Company, 1905. 8vo.; pp. 388. Price $3.50.

This volume, which is a successor to a smaller book on Hydraulic Machinery published some four years ago by the author, is a practical manual on the concentration and transmission of power by hydraulic machinery. The author first gives an outline discussion and description of the main points and principles to be noted by engineers in designing or constructing apparatus for the utilization of water and the transmission of power. Subsequently, the author has given examples of special hydraulic machinery for various purposes. The second edition of the work contains examples of the latest developments in hydraulic pressing and lifting machines, these examples being illustrated by diagrams of typical valves, and machines for this purpose. Some forty illustrations have been added in the present edition, making a total of 240 in all. The book is divided into eight parts dealing with the Principles of Hydraulics; Hydraulic Pressures, Materials, and Test Loads; Joints; Valves; Pumps; Lifting Machinery; and Hydraulic Presses and Motors. Besides the table showing the water pressure in pounds per square inch for every foot in height up to 270 feet, the appendix contains a table giving the diameters, areas and displacements of pumps, and some thirteen other tables of use to hydraulic engineers are dispersed throughout the text. Besides diagrams of machinery the book contains a number of halftone photographs of hydraulic lifts, bridges, docks, cranes, etc.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending August 15, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid into stearic acid, converting oleic, A. de Hemptinne 797,112
Adding and printing machine, C. Wales.... 797,032
Addressing machine attachment, E. D. Belknap 797,092
Advertising curtain device, F. C. Chapman 797,097

ELECTRIC LAUNCH MOTOR. — THE design in this paper is for a motor of unusual simplicity of construction, which can easily be built by an amateur at small cost. It is intended for a boat of about 24 feet over all and 4 feet 6 inches beam, drawing 18 inches, and is capable of propelling such craft at a speed of 7 miles per hour. Illustrated with 21 cuts. See SCIENTIFIC AMERICAN SUPPLEMENT, No. **1202**. Price 10 cents by mail, from this office, and from all newsdealers.

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Metallizing plant, A. R. Pritchard	797,222
Mining apparatus, A. McDougall	797,068
Mining sluice, P. Bouery	797,168
Mirror, glass reflecting, Parsons & Stoney	797,455
Mitten, R. B. McMasters	797,212
Motion transmitting, regulating, and reversing apparatus, E. D. Ackerman	797,543
Mower, lawn, J. Bruk	796,986
Mowers, grass catcher for lawn, C. K. Hann	796,999
Musical instruments, tone expression controlling device for mechanical, T. Danquard	797,182
Musical wind instrument, J. Schwarz	797,232
Numbering machine, W. A. Porter	797,370
Numbering machine, Smith & Dill	797,381
Nut cracking machine, S. M. Brown	797,260
Oil burner, crude, J. C. Ziegler	797,249
Oil cup, J. L. Hecht	797,429, 797,430
Ordnance, breech-loading, W. R. Smith	797,237
Ordnance loading device, C. P. E. Schneider	797,330
Ore briquets, agglomerating iron waste, etc., for the manufacture of, Rouse & Cohn	797,150
Ore roasting furnace, H. C. Holthoff	797,003
Oven, baking, J. F. Lorentz	797,299
Packing, L. W. J. Marsden	797,066
Paper carton, H. G. Eckstein	797,504
Paper hanging machine, A. C. Redman	797,224
Paper jardiniere or package for flower pots, H. E. & E. Collenburg	797,175
Paper writing sheet, compound, L. E. Meacham	797,302
Pastry knife, combination, F. A. Tobler	797,088
Pavement, G. W. & W. T. S. Crichfield	797,408
Pen, J. W. Thompson	797,087
Pencil holder, pocket, W. H. Vance	797,158
Phenol esters. making, F. Sparre	797,024
Phonograph, E. J. Rector	797,020
Photographic emulsions, producing, F. Rompler	797,458
Photographic plate developing aparatus, J. D. Lyon	797,445
Piano pedal, G. Merritt	797,009
Piano pedal, self-playing, J. Wieser	797,390
Piano, self-playing, J. Wieser	797,389
Picture hanger, C. Schultz	797,076
Picture hanger, F. E. Lehman	797,208
Pins and the like, catch device for, Guidone & De Cristofaro	797,199
Pins of brooches, etc., fastener for the, C. Singleton	797,463
Pipe joint, H. J. Everson	797,418
Pistol, magazine, O. F. Mossberg	797,306
Pitman connection, A. Grieves	796,997
Planter, corn, W. L. Beall	797,488
Plaster, etc., apparatus for the manufacture of slabs or blocks of, B. C. Simpson	797,153
Plow attachment, disk, W. S. Cook	797,177
Plow truck attachment, L. Pore	797,534
Plug, attachment, H. T. Paiste	797,454
Plug, attachment, G. B. Thomas	797,472
Plug, drift, R. D. Gould	797,196
Pneumatic despatch tube apparatus, E. A. Fordyce	797,053
Pneumatic motor and speed governor, T. Danquard	797,181
Pneumatic service system carrier, H. Burl	797,044
Pole attachment, neck yoke, M. Dunham	797,414
Polishing wheels, machine for bending metal scrolls for, V. W. Jewett	797,287
Portable house, J. A. Walker	797,474
Post cap, F. L. Heughes	797,432
Potato digger, G. A. Troxler	797,385
Powder saluting charge, smokeless, F. I. Du Pont	797,218
Power transmitting mechanism, T. L. & T. J. Sturtevant	797,383
Press. See Baling press.	
Pressing machine, hydraulic, W. H. Fisher, reissue	12,380
Pressure controlling device, W. F. Krichbaum	797,440
Pressure regulating device, Westinghouse & Clark	797,162
Printing and auditing device, E. J. Brandt	796,984
Printing machine, blue, W. O. Wakefield	797,388
Printing press, G. F. Read	797,319
Printing press, W. Scott	797,536
Printing press, rotary web, H. A. Wood	797,039
Projectile, E. Gathmann	796,993
Projectile, H. B. Beale	797,042
Pulley belt-shifter, step, E. Kottusch	797,126
Pulley, wood, J. E. Swineford	797,155
Pulp, machine for pressing water from wood, C. W. Roberts	797,374
Pump lining, centrifugal, P. J. Hedlund	797,058
Pump motor cooling means, P. J. Hedlund	797,059
Pumping rig, oil well, S. F. Field	797,421
Puncture closure, A. T. Vigneron	797,387
Rack, J. O'Hare	797,528
Rail guard, third, M. Zugermayer	797,394
Rail joint, C. Bush	797,045
Rail joint, F. Hachmann	797,426
Rail joint, W. Sutherland	797,470
Rail joint closer, Rockwell & Smith	797,456
Railway block signal system, electric, McBerty & Launbranch	797,141
Railway carriage lock, J. Haag	797,425
Railway gate and signal, automatic, Johnson & McCollum	797,062
Railway gate, automatic, Mickley & Gise	797,210
Railway paving plant, F. A. Hetherington	797,356
Railway rail joint, E. A. Weil	797,033
Railway rail joint, Walsh & Thompson	797,475
Railway rail stay, E. C. Tecktonius	797,085
Railway switch, R. H. Scheibert	797,021
Railway tie, metal, J. A. Lippert	797,296
Railway train signal, S. E. Foreman	797,191
Railways, electrical safety apparatus for signaling on, H. Cousin	797,180
Railways, means for transmitting electricity to vehicles on electric, A. Beer	797,254
Razor and hair-cutter, combined safety, E. J. Deneen	797,184
Recorder, G. N. Engert	797,051
Renovator, pneumatic, J. S. Thurman	797,241
Reverbatory furnace, A. M. Gaylord	797,352
Revolver extension grip, G. A. Baribeault	796,982
Revolving chair, G. J. Adam	797,040
Rheostat, water, W. D. Pomeroy	797,369
Ribbon roll controlling device, M. Schubert	797,378
Rock drill or rock drilling machine, Hellman & Bayles	797,111
Rolling metal, helical rolls for, F. L. & W. L. Price	797,221
Rotary engine, L. S. Bellah	797,093
Rotary engine, P. C. Dahl	797,501
Rubber body to another body, attaching a, R. Whitaker, Jr.	797,035
Rule holder, mechanic's, J. P. Whitby	797,036
Sad iron heater, B. Bryan	797,261
Safety pin, H. F. Stowell	797,026
Salt holder, D. H. Beyea	797,167
Sash cord clamp, J. W. Finfrock	796,991
Sash hanger, storm, J. Diehl	797,185
Sash lock, ventilating, W. A. Nichols	797,213
Sash operating device, Smith & Stilling	797,382
Sash, window, P. A. Sheley	797,023
Sash, window, O. M. Otte	797,147
Saw guide, band, D. C. Prescott	797,018
Saw, hand, R. W. Hawkins	797,428
Saw handle, O. C. Hanson	797,108
Saw machine, band, B. Rishebarger	797,321
Sawmill dog, W. H. Trout	797,028
Scale, spring, M. H. Wilson	797,091
Scorifiers, tool for handling, E. Keller	797,121
Scraper, wheeled, M. Dunn	797,503
Screw driver, G. Shelton	797,078
Screw key, ratchet, C. Contal, reissue	12,379
Separator, A. F. Hoffecker	797,357
Setting out, scouring, and stuffing machine, J. W. Deckert	797,268
Sewing machine, overedge, G. Keyser	797,291
Sewing machine shuttle, C. H. Chittum	797,047
Sewing machine smocking attachment, A. Laubscher	797,207
Sewing spangles on fabrics, machine for, M. P. Nassberg	797,308
Shade attachment, J. K. Putnam	797,019
Shaft, flexible, A. C. Kadlowec	797,360
Sheaf carrier attachment, D. W. Smith	797,236
Shears. See Sheep shears.	
Sheep shears, W. Seedhouse	797,233
Sheet metal can, F. M. Assmann	797,395
Ship, war, J. Slonka	797,235
Shipping system, Fisher & Raymond	796,992
Shoe stretcher, Walker & Smith	797,541
Sieve cleaner, grain, J. B. Cornwall	797,499
Sifter, ash, H. Hofgren	797,115
Sign, illuminated, S. I. Butters	797,492
Signal system, block, F. B. Corey	797,498

Siphons, apparatus for charging gas domes for, A. Klienfeldt 797,124
Slack adjuster and pulley alining device, J. R. Fordyce 797,104
Sled, S. L. Allen 797,165
Sled runner, S. L. Allen 797,338
Slide, W. C. Howard 797,118
Smoking pipe draft regulating device, C. A. Couch 797,178
Socket washer, C. G. Ette 797,545
Sound reproducer, A. L. Irish 797,516
Speed indicating or governing apparatus, L. E. Cowey 797,500
Spinning machine driving cylinder, J. W. Anderson 797,166
Spraying apparatus, C. Gibson 796,996
Spring-making machine, helical, F. M. Stambaugh 797,331
Square, H. W. Nagel 797,453
Square, folding, A. Johnson 797,120
Square, T-, J. A. Robinson 797,228
Stamp mill, C. J. Hodge 797,202
Stamp pad inking device, rubber, J. S. Trimble 797,089
Starching machine, P. M. Cave 797,344
Stay making machine, dress, C. A. Kelly 797,005
Steam boiler, J. E. Haarmann 797,107
Steam generator, C. B. Scherrer 797,329
Steam generator, H. R. Stickney 797,333
Steering and braking mechanism, J. D. Metcalf 797,448
Stereotype casting boxes, means for cooling, W. Scott 797,022
Storage battery, G. K. Hartung 797,110
Stove, self-feeding coal, Lehmann & Ohnemus 797,295
Stovepipe, adjustable, C. Nelson et al 797,069
Strainer, M. A. Conklin 797,266
Stroke mechanism, full, J. F. Ohmer 797,070
Superheater boiler, J. E. Bell 797,256
Surgical bandage, C. Fuhrhans 797,510
Surgical bandage plaster, J. Benario 797,094
Swimming apparatus, C. P. Randolph 797,223
Switch, F. R. McBerty 797,526
Switch operating mechanism, Stephens & Holland 797,467
Switch rod, W. K. Bryce 797,262
Switching mechanism, electrofluid pressure, W. J. Bell 797,398
Tank heater, H. L. Ferris 797,507
Tank support, P. P. Sturdevant 797,334
Telegraphy, space, F. Braun 797,169, 797,544
Thill coupling, R. E. Stenzel 797,025
Thill coupling, W. M. Jenkins 797,119
Threshing machine band cutter and feeder, Harrison & Stuckel 797,000
Ticket clip, railway wagon, B. F. Cocker 797,264
Tile mold, J. H. Chidester 797,173
Time recording apparatus, R. Burk 797,491
Tins, means and appliance for cutting off the lids of square, Langley & Smith 797,128
Tire fabric, pneumatic, C. L. Marshall 797,138
Tire inflating connection, rotating, A. L. Olson 797,367
Tire, pneumatic, J. O. Haas 797,200
Tool, combination, McKinney & Henderson 797,211
Tool, combination, H. C. Willilams 797,484
Tool dressing jack, G. E. R. Hughes 797,282
Tool, drifting, R. D. Gould 797,195
Tooth, artificial, H. P. Osborn 797,312
Tooth, metallic backed, W. G. Hughes 797,515
Toothpick, R. R. Freeman 797,423
Transplanting implement, T. J. Peters 797,531
Traversing mechanism, W. E. Magie 797,301
Trolley mounting, G. E. Henry 797,355
Trolley wheel, F. E. Bryan 797,342
Trousers stretcher and creaser, H. C. Warfel 797,476
Trunks, etc., corner piece for, J. P. Clark 797,495
Tub lifter, J. Dowlen 797,186
Tubular boiler, W. H. A. Robertson 797,227
Tunnel, subaqueous, D. D. McBean 797,524, 797,525
Turbine, M. H. P. R. Sankey 797,460
Turbine, elastic fluid, T. G. E. Lindmark 797,064
Turbine, multiple impact, H. Lentz 797,130
Tywer iron and fire pot, combined, L. Silcott 797,462
Type distributing apparatus, A. A. Low 797,008
Typewriter cabinet and copy holder, combination, E. E. Chesney 796,988
Typewriting machine attachment, H. A. Briggs 797,043
Union, reducer, and expansion joint, combined, W. R. Sheckler 797,152
Valve, compound locomotive, F. J. Cole 797,496
Valve, cylinder drain, Kennedy-McGregor & Wren 797,288
Valve, flush, Goodfellow & Ramsay 797,353
Valve for pneumatic instruments, bellows, G. W. Bemis 796,983
Valve gear, steam engine, P. Miller 797,523
Valve lubricating mechanism, fluid pressure, T. R. Brown 796,985
Valve, steam engine, Needham & Smith 797,309
Vehicle body, T. Lotherington 797,444
Vehicles, steering, driving, and braking device for wheels of motor, C. H. Atkin 797,251
Vending perfumes and other liquids, coin-controlled apparatus for, L. L. Martin 797,520
Vessel-coaling apparatus, L. A. de Mayo 797,364
Vessels, closure for containing, C. Schroeder 797,377
Vise, J. P. Schneider, Sr 797,376
Wagon, dump, R. E. H. Wurdisch 797,164
Washer. See Fruit washer.
Watch, W. E. Porter 797,219
Watch protector, N. E. Landin 797,294
Water heater, Smith & Dausch 797,380
Water heater, L. H. Meres 797,522
Water purifier, C. L. Kennicott 797,290
Water supplying apparatus, C. H. Godfrey 797,513
Wells, treating oil, Oliphant & Lyddon 797,529
Wind wheel, A. Gran 797,197
Windmill, W. F. Miller 797,140
Wire applying device, stay, H. Prouty 797,535
Wire finish nail, A. J. Chase 797,494
Wire stretcher, F. W. Hahn 796,998
Wire stretcher, W. M. Sanders 797,151
Wrench, E. T. Foster 797,274
Wrench, R. A. Brooks 797,340
Wrench, E. L. Bellman 797,489
Wrench, C. F. Spery 797,538

DESIGNS.

Book cover, W. M. Rhoads 37,511
Comb, F. W. Grell 37,510

TRADE MARKS.

Beer, Chr. Heurich Brewing Co 45,364
Boots and shoes, children's leather, A. E. Little & Co 45,384
Boots and shoes, leather, B. A. Corbin & Son Company 45,378, 45,379
Boots and shoes, leather, J. M. Whitcomb 45,387
Boots, shoes, and slippers, leather and canvas, J. W. Carter Shoe Co 45,385
Boots, shoes, and slippers, leather and leather and cloth, G. F. Daniels & Co. 45,380
Brushes, solid back, Ames Bonner Co 45,377
Candy confections, butter chocolate and other, C. Repetti 45,350
Canned fruits and vegetables, Bloomington Canning Co 45,347
Canned tomato paste, P. Roncoroni 45,349
Canned vegetables and fruits, H. C. Baxter & Bro 45,345, 45,346
Canned vegetables and fruits, W. T. Reynolds & Co 45,348
Carbons for electrical purposes, H. Reisinger 45,416, 45,417
Clasps and fasteners for personal wear, American Ring Co 45,323, 45,324
Cocks, tank, siphon, and gage valves, ball and basin, Boston Brass Co 45,414
Cocktails, Thomas H. Handy & Co 45,355
Coffee, W. T. Reynolds & Co 45,315
Coffee, roasted and roasted and ground, Enterprise Coffee Co. of Baltimore City 45,313
Cold and cough cure, J. V. Quick 45,374
Collars and cuffs, Reversible Collar Co 45,317
Dermal and respiratory renovant, Dad Chemical Co 45,367
Dust collectors, centrifugal, Knickerbocker Co 45,418
Emmenagogue, Norwich Pharmacal Co 45,372
Face and skin cream, Herpicide Co 45,375
Flavoring extracts, Puryear-Miller Mfg. Co. 45,311
Flour, wheat, Northwestern Consolidated Milling Co 45,338 to 45,340
Flour, wheat, Waggoner-Gates Milling Co. 45,341
Foods, breakfast cereal, Topeka Milling Co. 45,344

Gas, machines for manufacturing illuminating and fuel, S. P. Sanders 45,419
Guns and parts thereof, Hunter Arms Co.. 45,336
Hair pins, De Long Hook & Eye Co....... 45,327
Hoes, D. & H. Scovil.......... 45,415
Hydraulic jacks, P. S. Justice & Co........ 45,330
Insulating and sheathing paper and cloth, J. A. & W. Bird & Co.............. 45,395
Insulating varnishes and compounds for insulating purposes, Standard Varnish Works 45,435
Italian paste, Maull Bros. 45,310, 45,343
Jelly powder, R. B. Beaumont............ 45,342
Knitted underwear for men and boys, Utica Knitting Co. 45,325
Lard, Siegel, Cooper & Co............... 45,316
Leather, kid, F. Blumenthal & Co.......... 45,430
Medicine for inflammatory diseases, C. S. Moore 45,370
Medicines for disorders of the stomach and bowels, headaches, constipation, rheumatism, neuralgia, and dyspepsia, H. L. Dinkelspiel 45,368
Metal polishes, H. Perine.............. 45,432
Metal polishing compound, A. O. Bettes Mfg. Co. 45,431
Oil, antiseptic healing, Paris Medicine Co.. 45,373
Oil, sewing machine and bicycle, W. F. Nye 45,424
Ointment, wafer, cone, pessary, pencil, crayon, or bougie for intra-orificial applications, Norwich Pharmacal Co..... 45,371
Organs, combination attachments for playing pianos or organs, and parts thereof, Wilcox & White Co.............. 45,412
Organs, reed, Mason & Hamlin Co......... 45,410
Overcoats, ready-made suits, custom-made suits, and trousers, A. J. Strauss & Co. 45,326
Paint, liquid, A. Burdsal Co............. 45,433
Paint, metallic, Prince's Metallic Paint Co. 45,434
Paints and colors, C. A. Willey.....45,439, 45,440
Pens, writing, E. L. Horney............. 45,397
Pianos, Steinway & Sons............... 45,411
Pianos and piano players, self-playing, Autopiano Co. 45,409
Piano players and self-playing pianos, automatic, Autopiano Co. 45,408
Plows of all sorts and plow parts, Oliver Chilled Plow Works.......... 45,337
Powder, Miami Powder Co.............. 45,420
Remedies, malarial, L. E. Cash........... 45,366
Rock drills, E. A. Rix.................. 45,332
Roofing felt and paper, J. A. & W. Bird & Co. ....45,390 to 45,393
Roofing slate, Provident Slate Co. 45,396
Rugs and carpets of oriental design and texture, C. M. Cleveland............ 45,441
Seed, timothy, D. I. Bushnell & Co........ 45,421
Shoes, ladies' leather, Rose Shoe Mfg. Co.. 45,423
Shoes, leather, Hamilton Brown Shoe Co... 45,382
Shoes, leather, Sidney Shoe Co........... 45,386
Shoes, leather, Hamilton Brown Shoe Co... 45,422
Shoes, men's and boys' high and low cut leather, Hamilton Brown Shoe Co..... 45,381
Shoes, women's, misses', and children's high and low cut leather, Hamilton Brown Shoe Co. 45,383
Soap, laundry, A. Conkling.............. 45,426
Soap, laundry, J. G. Haas Soap Co........ 45,427
Soap, toilet, Mulhens & Kropff............ 45,428
Soap, toilet, National Toilet Co........... 45,429
Syrups, molasses, and sorghum, M. H. Alexander Co. 45,312
Tacks, carpet, H. C. Tack Co............. 45,413
Targets in the air, machinery for throwing or hurling, Chamberlin Cartridge & Target Co. 45,328
Teas, pure green and black mixed, Enterprise Coffee Co. of Baltimore City..... 45,314
Tiles and ceramic ware, American Encaustic Tiling Co. 45,389, 45,425
Tire bolts, Russell, Burdsall & Ward Bolt & Nut Co. 45,385
Tobacco, plug, Monarch Tobacco Works... 45,376
Tonic and female regulator, restorative, Fritts & Wiehl 45,369
Tonic, malt, McAvoy Brewing Co......... 45,365
Upholstery fabrics, Philadelphia Tapestry Mills 45,319
Varnishes, japans and wood stains, Standard Varnish Works 45,438
Varnishes, paints, japans, enamels, furniture polishes, renewers, and stains, Standard Varnish Works 45,437
Varnishes, paints, lacquers, japans, enamels, and oils used in connection with same, Standard Varnish Works........ 45,436
Vehicle irons, dropped forged, H. D. Smith & Co. 45,334
Vises, bench, Prentiss Vise Co............ 45,331
Washing machines, E. H. Huenefeld...... 45,442
Watchcases, Fahys Watch Case Co........ 45,398
Watches and watch parts, Hampden Watch Co. 45,399
Watches, watchcases, and watch movements, New York Standard Watch Co.. 45,400
Watches, watchcases, and watch movements, Philadelphia Watch Case Co.... 45,401 to 45,407
Water purifying and softening machinery, Wm. B. Scalfe & Sons Co............ 45,333
Water wheels, James Leffel & Co. 45,329
Waterproof felt, paper, and cloth used for damp-proofing, J. A. & W. Bird & Co.. 45,394
Whips, carriage, H. M. Van Deusen Whip Co. 45,388
Whisky, S. Binswanger & Bro. 45,351
Whisky, Bluthenthal & Bickart.....45,352, 45,353
Whisky, Fritz Thies Mercantile Co........ 45,354
Whisky, D. Holzman & Co.............. 45,356
Whisky, R. E. Wathen & Co.......45,357, 45,358
Whisky, D. Wise....................... 45,359
Wine, Maryland Distilling Co............ 45,360
Wine, claret, J. M. Vergnole............. 45,362
Wine, port, C. Xander.................. 45,363
Wines, Sweet Valley Wine Co............ 45,361
Wool, fine and crossbred grades of, D. S. Pratt ....45,320 to 45,322
Woolen cloths, light and heavy, Middlesex Co. 45,318

LABELS.

"Firena," for cigars, H. Sommer Co...... 12,317
"Gold Mark," for cigars, A. C. Henschel & Co. 12,319
"Kern's Korn Kure," for a corn cure, L. G. B. Erb.......... 12,324
"La Brilliante," for polish for metals, La Brilliante Silver Polish Co............ 12,326
"La Flor de Fowler," for cigars, W. E. Fowler 12,318
"La Saolo," for cigars, Cole Lithographing Co. 12,316
"Lee's Hazel Antiseptic Cones," for medicine, L. D. Perkins 12,322
"Palmer's Netting," for open mesh fabric for protection against insects, I. E. Palmer 12,325
"Purity," for canned fruits, Lewin-Meyer Co. 12,321
"The 5 Oil Skin Food," for skin food, S. Johnston 12,323
"20th Century," for beer, American Brewing Co. 12,320

PRINTS.

"A Good Judge," for grape tobacco, R. A. Patterson Tobacco Co.................. 1,398
"A Kiss and a Bachelor," for cigars, Victor Thorsch Co. 1,397
"Dermophile," for underwear, H. Jaquin & Co. 1,399
"The Eleven O'Clock Toast," for Montebello Champagne, W. C. Dunn............... 1,396

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.