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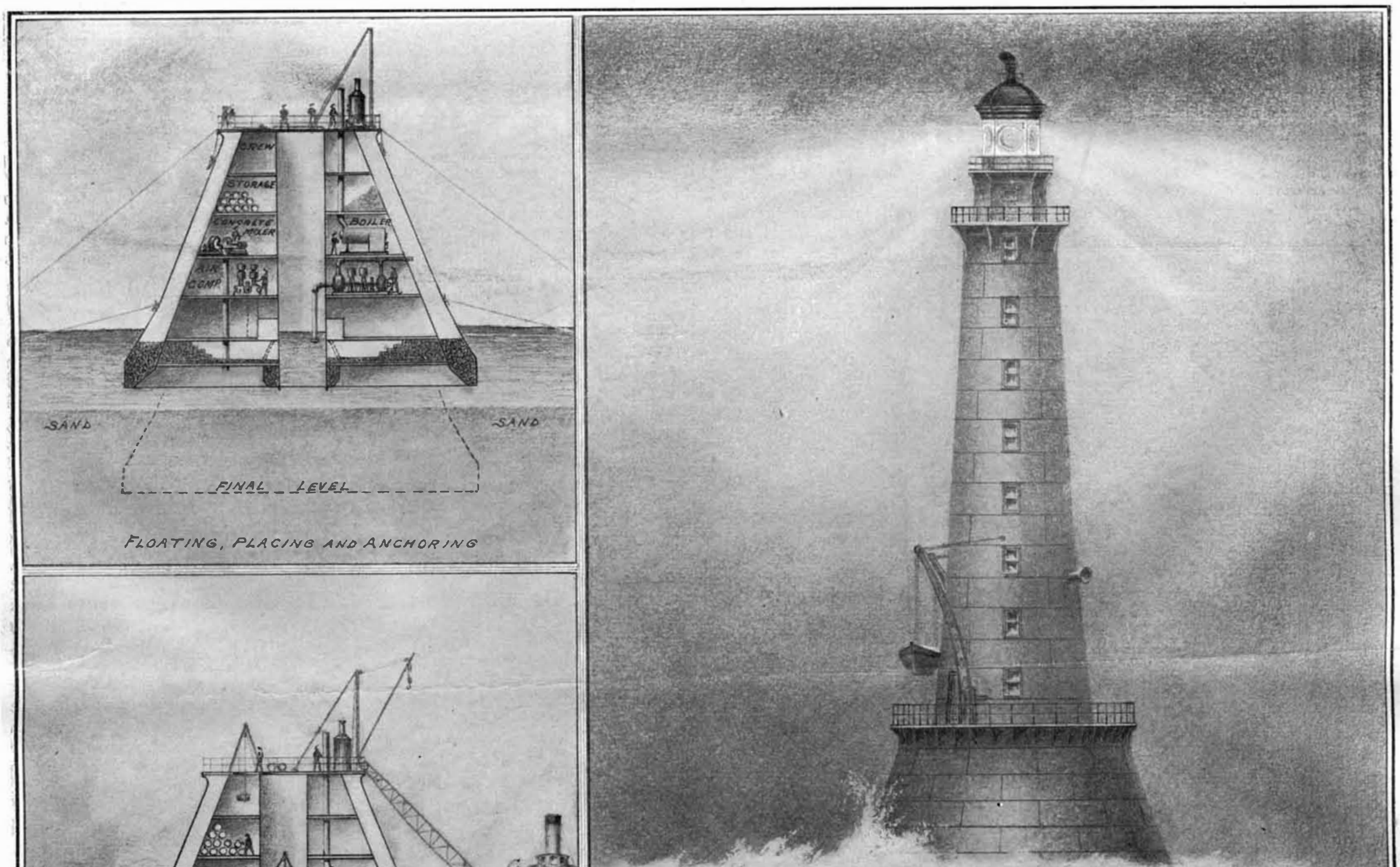

THE ERECTION OF THE DIAMOND SHOALS LIGHTHOUSE OFF CAPE HATTERAS.—[See page 251.]

Steel and Concrete Will Be Used in the Construction. The Caisson of Steel Which Forms the Base Will Be Built in a Shipyard, Towed to the Shoals, and Scuttled.

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MARCH 24, 1906.

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 receive special attention. Accepted articles will be paid for at regular space rates.

"WHAT'S IN A NAME?"

We note in the columns of the daily press that the Cunard Company are proposing to bestow upon the two 25-knot turbine steamers, the time of whose launching is not far removed, the names "Lusitania" and "Mauritania." As we stand in meditative contemplation of these most interesting products of the art of nomenclature, we are askng, like one of old, "What's in a name?" Saving and except that they end in the characteristic last two syllables favored by the company, they fail to call up any familiar associations either of people or country. "Umbria" we know and "Etruria" we know; but who are these?

A reference to the encyclopedia discloses the fact that "Mauritania" and "Lusitania" were the ancient names, respectively, of Morocco and Spain—two of the countries which are playing a leading part in the present diplomatic amenities at Algeciras; from which it is evident that the Cunard Company, forecasting a peaceful outcome, have decided to perpetuate the conference by an appropriate christening.

One member of our staff has suggested that because the two new ships are the longest in the world, search was made among the names of countries living and dead for names that bear a similar distinction; while a contemporary has discovered that the ships will never need to take in water ballast, their names being heavy enough to keep them on an even keel in any weather.

But in all seriousness we do think it would be a thousand pities if these two noble ships, representing the highest effort of the shipbuilder's art, should be dispatched to this country carrying names which have no appropriate significance whatever. Surely the Cunard Company possess, among the names of the earlier ships, some that might fittingly be perpetuated in these, their latest vessels. The SCIENTIFIC AMERICAN, therefore, offers the friendly suggestion that the company revive the names "Britannia," and "Hibernia"; the one being the name of the first ship to carry the Cunard flag across the Atlantic, and the other the name of one of the "Britannia's" three sisters. There would be a peculiar fitness in the choice, inasmuch as the "Britannia" and "Hibernia" of 1907, like their namesakes of sixty years before, will mark the opening of a new era in the wonderful story of the navigation of the Atlantic.

NEW WATER SUPPLY LEGISLATION.

The legislature of the State of New York has seldom been called upon to discuss a bill of greater importance and urgency than the one now being pressed upon its attention for increasing immediately the water supply of the city of New York. It is gratifying to know that this whole question is in the hands of a Board of Water Supply, whose members are strictly non-partisan, and all men of sterling worth. Its engineers have formulated a plan, the broad outlines of which are discussed elsewhere in this issue, which embodies the results of investigations extending over many years, and carried on by the very best engineering talent of the day. If favorable legislation is secured, and active construction at once begun, it will be possible to complete in a few years' time a sufficient section of the new system to ward off the threatened risk of a water famine. That such a famine is possible if immediate steps are not taken to prevent it, will be evident from the following considerations:

The water supply of New York is at present confined almost exclusively to the Croton watershed, with which it is connected by two aqueducts, the "old," and the "new." The new Croton aqueduct, completed fifteen years ago, in its present condition, when running at its full capacity, can deliver 295 million gallons of water per day to the distribution reservoirs in Manhattan. The old Croton aqueduct, as now being repaired, can be relied on to convey about 80 million gallons per day. New York city, therefore, has aqueduct connections with the Croton watershed which are sufficient to bring in a maximum of 375 million gallons per day. In years of extreme drought, however, the Croton watershed, even if every reservoir within it should be drawn down until it was empty, can be prudently relied upon to yield, in years of extreme drought, not more than 300 million gallons per day. Nevertheless the consumption of Croton water has already averaged for an entire month as high as 318 million gallons per day, and for a whole year 292 million gallons per day. Now for ten years past the consumption of water in New York city has increased at the average rate of 14 million gallons per day, a rate of increase which renders it certain that unless a new supply is soon provided New York city must face the untold inconvenience and danger of a water famine.

STEEL MANUFACTURERS AND THE CHAIN BRIDGE.

The Merchants' Association of this city is determined to leave no stone unturned in its efforts to expose the daily increasing scandal of the delay in building the Manhattan Bridge; and they have recently addressed a strong letter to the Hon. Herman A. Metz, comptroller of the City of New York, which has received a favorable answer.

In the campaign carried on in the daily press by the engineers who were anxious to discredit the accepted design for a chain bridge, it was repeatedly stated that the chain bridge would cost more to build than a wire bridge, and that the steel manufacturers would be unable to manufacture eye-bars of the great size required, that would come up to the requirements of the specifications. These statements were merely part of a cloud of pseudo-technical dust with which an effort has been made to confuse the issue.

Now the Merchants' Association has effectually disposed of this contention by writing to several of the leading steel manufacturers, firms who would be possible bidders for the construction of the chain cable bridge, and asking them whether such a bridge could be built, and whether it would cost more in time and money than a wire bridge. In every case the association was assured by these firms that they were prepared to submit bids and undertake the construction of the bridge according to the plans. They further stated in their replies that the Manhattan Bridge, if built on the eye-bar plan, will require less time for its construction than it would if built on the wire cable plan.

We do not make any comments upon the breach of professional etiquette involved in the starting and keeping alive of a daily-press agitation of this character by engineers of more or less standing—that is a question for the Society of Civil Engineers or for the papers devoted exclusively to civil engineering interests to pass upon—but we do consider it to be a strange anomaly that, although the engineers who are opponents of the chain bridge have been feverishly anxious to discuss, or prompt the discussion of, this bridge question in the daily press, or before non-technical bodies, they absolutely refuse to allow it to be brought up for discussion and decision before a qualified board of engineering experts. It is not the fault of the public if it is driven to believe that the refusal to submit the plans for the two bridges to a tribunal of expert engineers, is due to the fact that the advocates of the wire bridge are well aware that the decision would be in favor of the more modern, more scientific, cheaper, and more quickly constructed chain-cable design.

A TIMELY WARNING.

In our issue of December 9 of last year, commenting on the need for providing some form of horizontal guide or fender rails on the supporting columns of the Subway on all curves, we said "the SCIENTIFIC AMERICAN is of the opinion that on such curves as those at the Grand Central Station and Times Square; and at all turnouts such as that at Spring Street which are liable to be taken by express trains at high speed, it would be advisable to attach some form of guard rail to the lines of posts on the outer side of the curve." That the warning was timely was shown on the morning of March 15 last, when the third car of a heavily-crowded express train jumped the track at the Spring Street turnout, and was only saved from collision with the columns by the strength of its couplings, which fortunately proved sufficient to hold it in the general line of the train and fairly close to the rails, until the emergency brakes had brought the train to a stop.

We regard the situation at Spring Street as being particularly dangerous for two reasons: First, that whereas at the Grand Central Station and Times Square the curves are both sharp and long, and therefore, must always be conspicuous in the minds of the motorman, the curve at Spring Street being only what might be called a jog in the line, to enable the tracks to swing out sufficiently to admit of an additional track at that point, does not appear to be as formidable a curve as the two above mentioned. When a motorman is running at full speed, and particularly should he be behind time in the rush hours, there is a strong temptation for him to take the turnout at a higher speed than he would if the turnout were merely the commencement of a long and formidable-looking curve. And yet it is a fact that such short curves as are found at turnouts or where the tracks spread to pass on either side of an island platform, are very much sharper than the longer and more important curves. Furthermore, in the Subway, the important curves are "spiraled," or "eased," that is to say they are parabolic in curve, and the centrifugal thrust of the train against the outer rail is so gradually developed as not to be perceptible to the ordinary passenger. On turnouts and jogs the change of direction of the track is so abrupt that if, as happens every day on the Subway, the motormen on the express trains fail to make the proper reduction of speed, there is a jolt and lurch to the train which tells very plainly what a terrific strain is being thrown upon the guard rail and upon the flanges of the car wheels.

A personal inspection of the track at Spring Street after the accident showed very clearly the point at which the centrifugal thrust of the flange of the wheel against the guard rail became great enough to enable the flange to get a sufficient "bite" on the metal to enable it to lift itself and its load over the rail and so cause the derailment. The general manager of the company has issued an official statement, which assigns the derailment to the fact that the wheel had slipped on the axle and that this widened the gage between the wheel flanges and caused the trucks to jump the track. This may be perfectly true; but it simply proves what a terrific lateral thrust is being exercised on the Subway cars if the guard rail reaction is sufficient to shift a wheel on its axle; for these wheels are thrust onto their axles by a hydraulic pressure, which amounts, we believe, to as high as 15 or 20 tons.

Another fact that makes the situation at Spring Street one that calls for great care in running the trains is, that the turnout necessitates a break in the continuity of the line of columns, and that as a train swings over to the right and crosses this line diagonally, it is in a position in which, if the leading car of a train that was running too fast were derailed, it would run end-on into the first of the columns, beyond the turnout, with one or two results: Either a number of the columns would be carried away and the street above crash into the Subway, or, should they be able to resist the impact of the 300-ton train, the columns would shear their way through the first car, splitting it in two.

We do not wish to be alarmists. The Subway and its equipment are absolutely first class; and there is not the slightest risk at Spring Street, or elsewhere *provided the trains are slowed down to the proper speed for which the curves at this point were laid out by the engineers who built the road.* The rules of the company as to reduction of speed on curves should be of the most stringent character, and accompanied with the severest penalties in case the lawful speed is exceeded. There can be no doubt that at present motormen are running over portions of the line, where they are expected to slow down, at a higher speed than is consistent with a prudent and safe operation of the road; and the most flagrant instance of this, especially during the past six months, has been the particular spot at which the recent derailment occurred.

THE DURATION OF LIGHTNING FLASHES.

Faraday made observations which to him proved that lightning flashes lasted as long as one second, whereas Dove, by his observations on tops, illuminated by a flash of lightning, was led to infer that the duration of lightning must be exceedingly short.

L. Dufour has suggested using rapidly-rotating devices, such as employed by Wheatstone in measuring the duration of electric sparks, for determining the duration of lightning flashes. He thus distinguished "instantaneous" and "rapidly succeeding" flashes of lightning and those of a "certain duration."

The oscillating character of lightning flashes has been proved by B. Walter from photographic records, which showed a wave-shaped fluctuation in luminosity.

In a recent issue of the Elektrotechnische Zeitschrift Mr. K. E. F. Schmidt records some experiments made on a rapidly-rotating disk, 10 centimeters in diameter, on which a white cross on a black background had been drawn, the members of the cross being 2 millimeters in breadth. This disk being driven by clockwork, performed 50 to 60 revolutions per second, and the following observations were made by its means on heavy evening thunderstorms:

1. In connection with many flashes, the cross would appear once brilliantly and sharply.

2. The cross would more frequently appear two, three, or even more times as a well-defined image, either in so rapid a succession as to give the impres-

sion of an instantaneous occurrence, or else at appreciable intervals. Whereas one cross was very luminous, the second as a rule was weaker, and so on with diminishing intensity. The relative position of the various bright crosses as well as their succession showed the greatest variability. The impression was frequently produced of the disk rotating in the direction of the hands of a clock, while it really rotated in the opposite direction; or it would appear pendulating.

3. In connection with an extremely sharp powerful cloud lightning, an eightfold cross would appear brilliantly for a moment, all the arms lying at the same distance, while one of the crosses had a somewhat greater intensity than the remaining.

From the above it is inferred that Walter's statement of the extreme variability in the discharge phenomena of lightning flashes is correct.

The time which actually elapses between the partial discharges can be computed only if the images appear for a moment, as according to physiological investigation on the duration of "after-images" (Nachbilder), the duration of the phenomenon cannot be upward of 1-50 of a second, i.e., the duration of one rotation. From other observations it is inferred that the duration of a discharge is about 1-1000 of a second, whereas the lightning referred to under No. 3 evidences a discharge phenomenon including at least eight partial discharges of equal intensity and succeeding each other at regular intervals of about 1-1000 second each.

In connection with the lightning referred to under No. 1, the visible discharge must have come to an end after less than 1-35000 to 1-40000 second, and the partial discharges mentioned under No. 2 must have been of the same short duration.

A determination of the duration of lightning is the more important, as it will give a means of ascertaining the time of oscillation, provided the lightning really constitutes an oscillating phenomenon. The period of discharge would thus be less than 1-30000 second.

THE IMPENDING EXHAUSTION OF THE WORLD'S IRON SUPPLY.

Several months ago the chief of the Swedish geological survey, in pursuance of a resolution adopted by the Swedish parliament, prepared a report showing the extent of the known deposits of iron in the world, and the rate at which such deposits are being consumed. While there has been some dissention as to the exactness of certain details contained in the report, it may be accepted as a substantially accurate investigation of a subject of vital importance to the world. Most disquieting in this report is the conclusion that we are likely to run short of iron within a single century if the present rate of consumption is maintained.

The world has only 10,000,000,000 tons of iron ore available. Of these Germany has twice as many tons as the United States. Russia and France each have 400,000,000 tons more than this country. Our annual consumption of iron is placed at 35,000,000 tons, which is more than a third of the world's total consumption. Commenting on the known and generally-accepted facts of the situation, the Iron and Coal Trades Review in one of its recent issues stated: "We would seem to be within a little more than half a century of an absolute iron famine. This fact raises problems of serious consequence to the world's iron industry and to the outlook of civilization itself."

The efficient consul-general of the United States at Paris, Mr. F. Mason, has analyzed with considerable astuteness the problems involved in this threatened industrial catastrophe. From an elaborate report of his we abstract the following facts:

It is well known that the high-class ores of the lake district in America will, at the present rate of consumption, be exhausted within less than fifty years. The Mesaba deposits, with the present annual output of 12,000,000 tons or thereabouts, will not outlast twenty-five years, and it requires only a simple calculation to demonstrate that a continued yearly consumption of 35,000,000 tons of ore by the iron and steel industries of the United States will, within the lifetime of many persons now living, eat away entirely the 1,100,000,000 tons which, according to the Swedish report cited, constitute our country's entire workable supply as at present known. Inasmuch, therefore, as the United States possess but about one-ninth of the world's ore deposit and yet consumes more than one-third of the total annual output from all countries, the conclusion is direct and unavoidable that the future economic policy of American iron masters should be to secure by all practical means, the largest possible ore supply from the mines of other countries. How can this be most economically and effectively accomplished?

The problem is largely one of transportation, in which the item of marine freight rates plays a dominant part. An economic long-distance ocean rate for heavy, low-class merchandise, involves necessarily two conditions, viz., vessels specially adapted to the trade, and return freights that will bear an equal or higher charge for transportation. The ship that brings ore from Spain, Sweden, and other European countries to the United States, must have each trip an east-ward-bound cargo that will be more than ballast and yield a regular and definite profit. There is but one material which will meet the requirements of the case, and that is coal.

It is in respect of quantity and quality of coal supply that the advantage of North America over European countries is decisive and overwhelming. Whatever may be the facts concerning ores, the known coal measures of the United States render their fuel supply secure, abundant, and of excellent quality for centuries to come. There are hundreds of thousands of acres of gas and coking coals of high quality in the Appalachian region—to say nothing of other fields —which have as yet been hardly scratched by the pick and drill of the miner. New coal deposits of greater or less extent and value are being discovered from year to year. With what is now known the present enormous annual output of 280,000,000 tons of bituminous coal can be maintained for hundreds of years without exhausting the available supply. In Europe, on the contrary, the years of adequate coal provision are definitely numbered. In England experts estimate the duration of the workable coal measures to be from sixty to one hundred years. Germany has a somewhat longer lease of industrial life dependent on coal supply, but already the subject is so acute that a heavy contract for the delivery of German coal to France, for iron and steel works, is understood to have been canceled recently at heavy loss to the sellers, because, it is definitely understood, the imperial government objected to the depletion of the national coal supply for the benefit of neighboring countries. France has native coal for a generation or more, but the mines are deepening, the cost of production is gradually increasing, and economists are looking with growing apprehension to the future. Twenty-five or at most thirty years hence, the question of an adequate fuel supply will be a serious problem for France.

In 1903 France consumed 42,694,100 tons of coal, of which 34,217,661 tons were the product of French mines, while the remaining 8,476,459 tons were imported. Cardiff and Belgium coals are delivered at Havre at prices varying, in ordinary seasons, from $4.63 to $5.21 per ton. This is the competition which American coal would have to meet, since from that port of debarkation, common to all imported coals, the costs of duty and freightage to the interior would be the same.

The railway freight rate on coal from Havre to Paris is 70 francs per carload of 10 tons, or $1.35 per ton for a haul of 143 miles. The rate by the River Seine, which is open to navigation practically the entire year, is from $1.05 to $1.10 per ton. Add to this the import duty of 26 cents and it will be seen that the Belgian and Welsh coals can be landed in ordinary times at the docks outside the walls of Paris for about $6.36 to $6.50 per ton. The wholesale price charged by importers to local dealers for bituminous coal is at present, slightly more than $10 per ton. Is there not in the margin of $3.50 and $3.64 between these figures an opportunity for American coal, provided the whole transaction, including mining, railway and ocean transportation, and transshipment at seaports, is so organized and managed as to develop a large trade and reduce expenses per ton to a minimum? In other words, can American bituminous coals of the grades adapted to gas manufacture, domestic use, and general industrial purposes, be delivered in large quantities at Havre for a cost not exceeding $5 per ton.

It remains to consider the correlation between these conditions and the future ore supply of the United States and certain European countries, as described in the first section of the present report. Coal imported into France pays a duty of 26 cents per metric ton. In respect to duty, freight up the Seine to Paris, and other charges American coal would be on the same basis as Belgian and British coals, which come into France principally by that route.

The demand for foreign coal will increase with the gradual exhaustion of the French mines, and the consumption will be augumented in proportion to whatever reduction can in future be made in the present high cost of fuel. There are millions of tons of good coking and gas coals in the Allegheny and Cumberland districts of the United States which can be produced with profit at the mouth of the mine for an average price of $1 to $1.25 per ton. When the railroads now projected or under construction are finished and in operation it should be possible to carry such coals to tide water for a freight rate not much, if anything, in excess of $1 per ton.

When in 1902 the project of exporting American coal to Europe was actively discussed, it was the consensus of expert opinion that the successful development of such a trade would require the construction of a special class of vessels which would do for the ocean-going coal traffic what they had done for the ore and coal trade of the Great Lakes, namely, steel barges of 10,000 tons burden, stanchly built, with quarters for a crew of ten to fifteen men, and engine power sufficient for a speed of 8 or 10 knots per hour, which would give steerageway sufficient for safe handling in all weathers. Given a fleet of vessels, with loading docks for coal along the Chesapeake Bay or Atlantic coast, and a reliable return freight, and the problem of a large and expanding coal export to Europe, which depends primarily on an ocean freight rate not exceeding $1.25 to $1.50 per ton, would be practically solved.

As return freights, the potash minerals of Germany have been suggested, but they are limited in quantity and restricted by various conditions, so that there remains but one available resource, and that is iron ores of Spain, Finland, and the Scandinavian Peninsula, three countries which, together, now mine about 14,000,000 tons per annum, but which, for want of cheap and abundant fuel, smelt not more than one-third or one-fourth of that amount. The time will doubtless come when most, if not all, European countries will prohibit the export of native coal, except to their own colonies. The imported fuel supplies of France, Italy, Spain, and Scandinavia will then have to come mainly from beyond the Atlantic. It will be strange indeed if American foresight shall fail to recognize the opportunity which time will ripen and the laws of demand and supply will offer to American enterprise.

THE EFFICIENCY OF THE GAS ENGINE.

What becomes of the heat in the fuel which goes into a gas-engine cylinder? Part of it, usually about 25 per cent, is converted into work, about 40 per cent is absorbed by the water jacket, and about 35 per cent is lost by radiation and through the exhaust pipe. If we can reduce the amount which is wasted, the percentage turned into work will obviously be increased. Other things being equal, the amount which is absorbed by the water jacket depends upon the amount of surface exposed during inflammation. The higher the compression the less the surface surrounding the unit of compressed charge. Hence, more heat goes into the work. The Lenoir engine, firing at atmospheric pressure, requires nearly 100 cubic feet of gas per B. H. P. hour, while with a compression of five atmospheres an engine of the same horse-power will do the same work on 20 cubic feet of gas.

In a paper read before the Western Society of Engineers, Mr. C. E. Sargent presents a keen analysis of these losses, which it seems well worth summarizing in the following paragraphs:

The higher the compression within the limits of the pressure necessary for premature ignition, the greater will be the efficiency, but the kind of fuel governs the degree, and the compression necessary to ignite kerosene vapor, while not so volatile as gasoline, will not cause ignition. Natural gases can be compressed to 150 pounds absolute, alcohol to 190 pounds, and blast furnace gas to 210 pounds, and still require an electric spark for inflammation.

In considering the heat which is lost by way of the exhaust, it must be remembered that, when a cylinder full of gas and air is compressed and ignited, the reactions during combustion raise the temperature of the gases enormously, and that for every degree F. of rise in temperature, there is a corresponding increase of 1/490 of the volume of the gases even though with a proper mixture the combustion is not instantaneous.

If a full cylinder of combustible mixture is compressed from atmospheric pressure and temperature and heated further by chemical action, then, when the volume is constant, the pressure is increased. When the exhaust valve opens this pressure causes the familiar "sea-lion" bark apparently inseparable from the gas-engine. This is the second loss of the internal combustion engine, and when we consider that from 35 to 40 per cent of the heat is wasted in this way, is it any wonder that engineers have tried to minimize the loss? We all know the efficiency of the direct-acting steam pump and the gain by a more complete expansion even though we obtain a lower mean effective pressure, and consequently less power from the same cylinders. To utilize the heat and pressure in the exhaust, compound gas engines have been suggested, tried, and in a few cases with some success.

The working fluid of the internal combustion engine, unlike steam, is practically a perfect gas, so that the efficiency of the gas engine may be increased if we can expand the burnt gases to a greater volume than before compression. As in a steam engine there is a limit to the degree of expansion desirable. When the pressure equals the power required to overcome the friction, a further expansion reduces the efficiency of the engine. Hence the decrease in efficiency as the load is lightened.

In a single-expansion steam engine it has been found that a terminal pressure of about four pounds above the atmosphere is the most efficient pressure of release, while on account of the lower mechanical efficiency of the gas engine a terminal pressure of from 6 to 8 pounds seems to give the greatest economy.

ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—III.

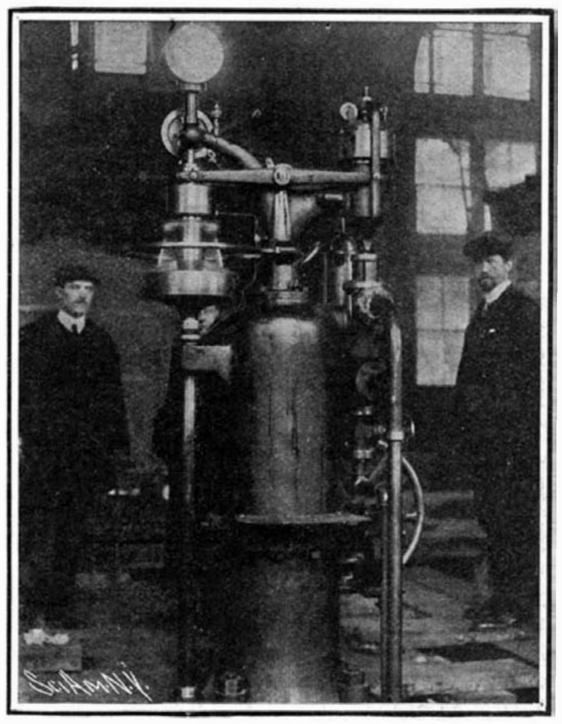
110,000 HORSE-POWER PLANT OF THE CANADIAN NIAGARA POWER COMPANY.

The history of the great electric power developments at Niagara Falls divides itself into two important periods, the first embracing the pioneer work that was done upon the American side of the Falls, and the second dealing with the more recent and far more extensive operations on the Canadian side. If we exclude some minor and scattered water-power plants, the credit for the first development of electrical energy from the Falls, on a scale of any considerable magnitude, is due, perhaps, to the company now known as the Niagara Falls Hydraulic Power and Manufacturing Company, who cut a canal on the American side from the upper rapids to a forebay on the edge of the cliff below the steel arch bridge, and utilized its energy in a power house at the foot of the cliffs. The first installation was modest; but the plant is to have an ultimate capacity of about 40,000 horse-power.

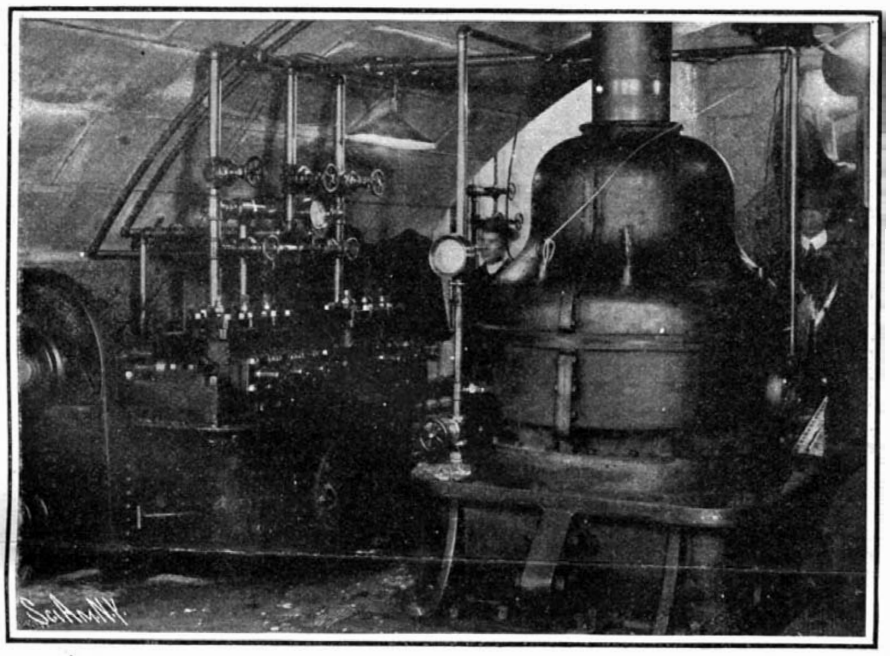
The first development of the power of the Falls on a scale that commanded world-wide attention, was made by the Niagara Falls Power Company, when they built a 50,000-horse-power house, and installed in it ten hydraulic electric units, each of 5,000 horse-power. The success of this plant was so encouraging that, not long after its completion, the company built on the opposite side of their intake canal a second power house, containing eleven units of 5,000 horse-power. This brought up the total capacity of the plant of this company on the American side to a grand total of 105,000 horse-power.

It was inevitable that, in the process of utilizing the energy of the Falls, the superior advantages offered on the Canadian side should raise the question of establishing power plants on the Canadian shore line. The greater volume of water that flows over the Horseshoe Falls, and the fact that the concave form of the shore line tends to place the deepest and swiftest currents within easy reach of wing dams and sluiceways, renders the Canadian side particularly attractive to the hydraulic engineer. Hence it was that the next power plant to be built by this company was located on Canadian soil; and being the first in the field, it was enabled to select the most favorable site for its intake. By reference to the bird's-eye view of Niagara Falls published in our issue of August 12, last year, it will be seen that, of the three power plants on the Canadian side, that of the Canadian Niagara Power Company is the most advantageously located as regards the simplicity and economy of construction of its intake; for while the other two companies have been under the necessity of building large and expensive wing-dams for the purpose of backing up the water and securing a sufficient depth of flow at the intake, the intake of the Canadian Niagara Power Company is built right on the shore line of the river, whose depth at this point is sufficient to insure, at all times, the requisite supply of water.

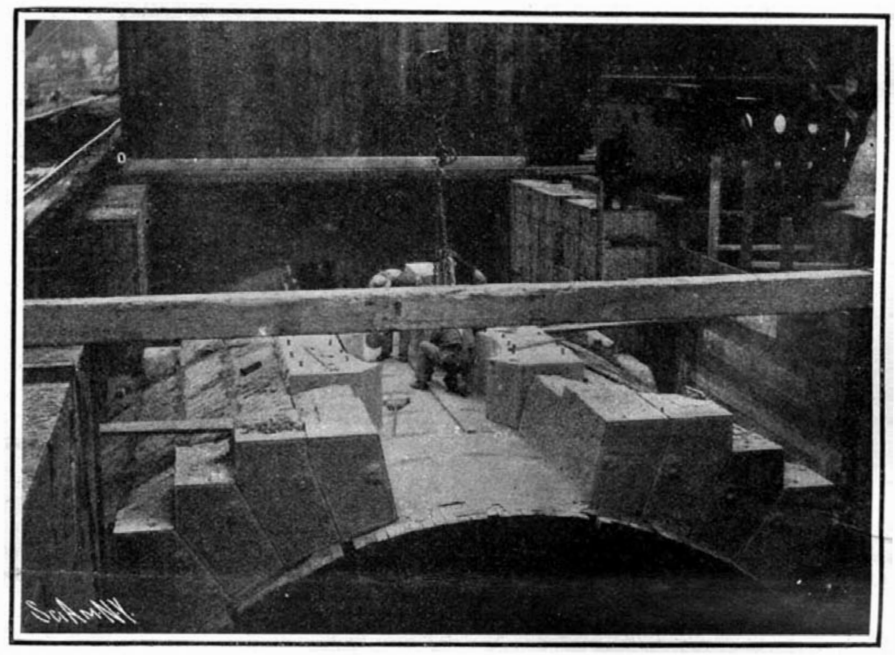
It may be well, by way of recapitulation, to mention the salient features of the other two plants on the Canadian side. The largest of these is that which is under construction by the Ontario Power Company. Its intake is located near the head of the upper rapids, and when the scheme has been completed in its entirety there will be three 18-foot tubes, the first of which is now in place, leading the water from the intake to the top of the bluffs below the Canadian Falls. From these conduits a series of 9-foot penstocks carry the water down to a vast building 1,000 feet in length, located at the foot of the bluffs, in which, ultimately, there will be installed twenty-two units of 10,000 horse-power each. A little more than a third of the mile down the rapids from the Ontario Power Company's intake is located the power station of the Electrical Development Company, whose ultimate capacity will be 125,000 horse-power. The water is deflected by a wing-dam through screens and gates into penstocks which lead to eleven turbines, each of which has a capacity of 13,000 horse-power at three-quarter gate. The turbines discharge into a tailrace tunnel, which leads in a straight line from the bottom of the wheel pit to the Falls, where the water is discharged near the bottom of the cliff and behind the great cur-



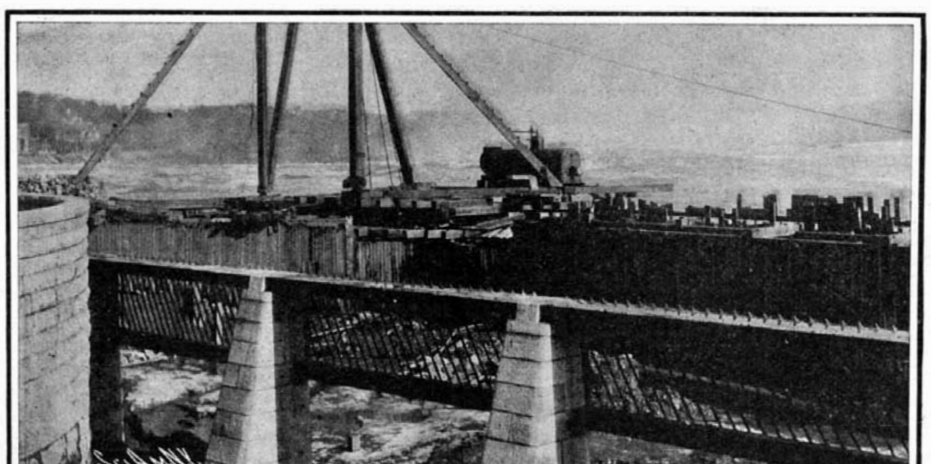
Governor for Controlling the Speed of the Turbines.



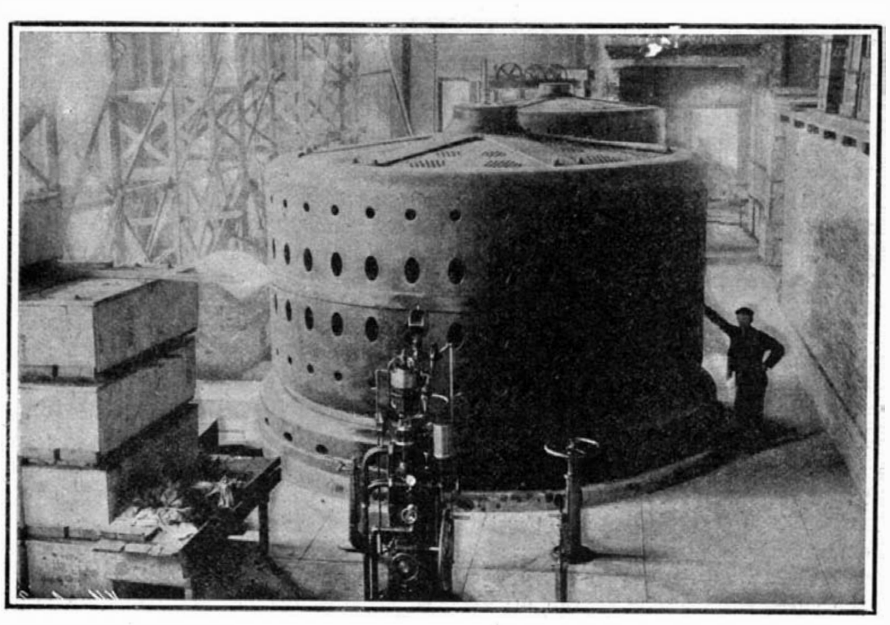
A Thrust Bearing on One of the Vertical Turbine Shafts in the Wheelpit.



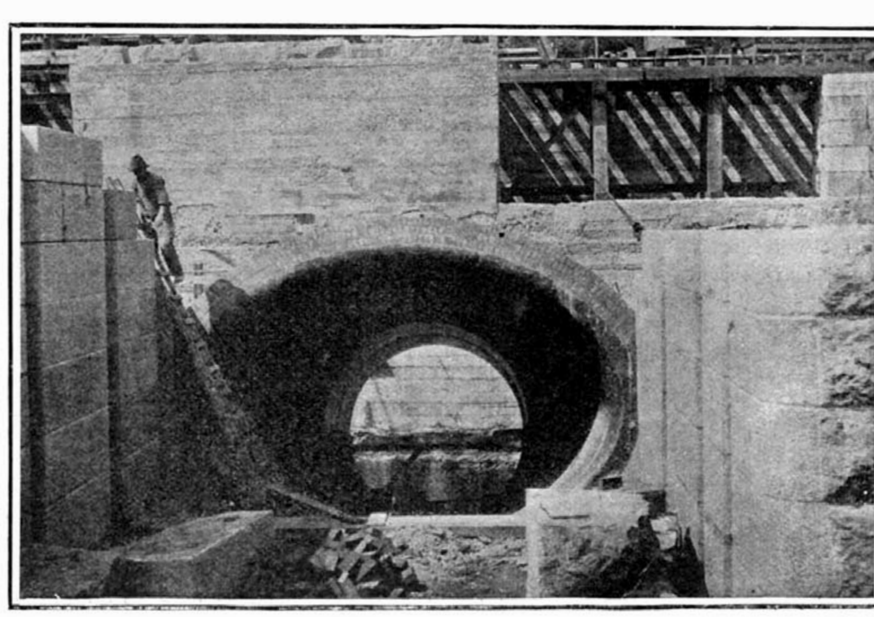
Constructing One of the Massive Arches Which Carry the Generators.



Screen, at Entrance to Forebay, for Preventing Entrance of Driftwood and Ice.



One of the Eleven 10,000-Horse-Power Generating Units.



View Showing Brick Ring Around a Penstock Mouthpiece, with the Wheelpit Seen Through the Opening.

ELECTRIC POWER DEVELOPMENT AT NIAGARA FALLS.—III.

tain and between the water and the face of falling water. The total capacity of this plant is 125,000 horse-power.

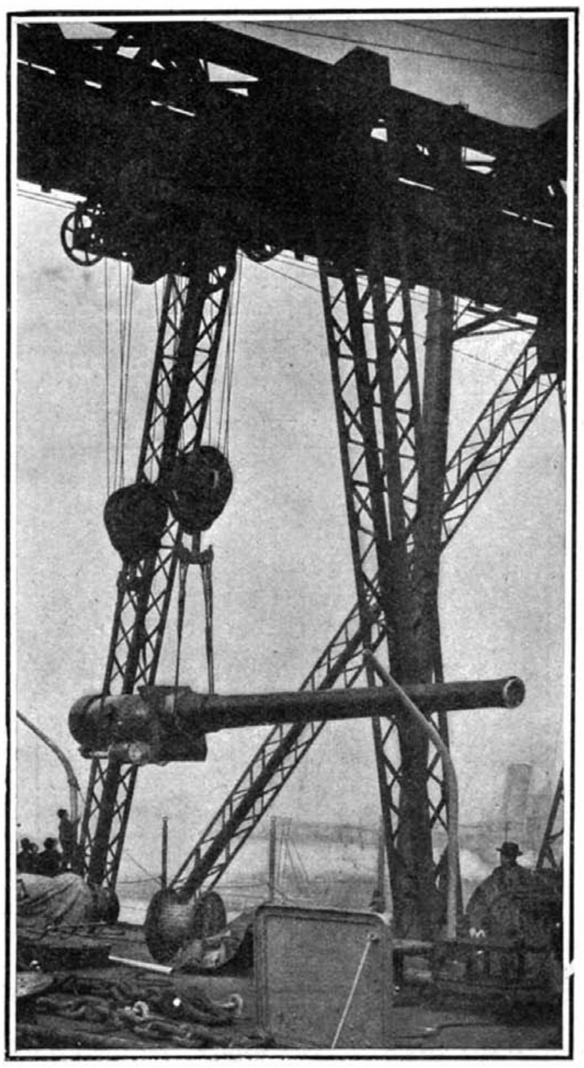
The great work which forms the subject of our illustrations has been built by the Canadian Niagara Power Company, a Canadian corporation which is controlled by the parent enterprise, the Niagara Falls Power Company. At its completion it will have a capacity of 110,000 horse-power. In the general arrangement of its wheel pit, turbines, power station, and tail-race tunnel, it resembles the company's plants upon the opposite side of the river; but in the details of its design it marks the progress which has been made during the decade which has intervened since the first plant was built upon the American side. The power station is located approximately parallel with the shore line of the river, and at a point about a mile from the point where the upper rapids commence. The entrance to the forebay is closed by a strongly-constructed iron screen, carried upon a line of masonry piers, which serves to prevent the entrance of ice and driftwood. Just inside the screen the entrance is crossed by a handsome masonry arch bridge, which has been built to carry one of the driveways of the park. Beyond the bridge the channel widens out into a broad basin 626 x 150 feet in extent, across whose waters one sees the dignified and impressive mass of the great power station. The water flows from the forebay to the penstocks through a series of arched openings, whence it is conducted by eleven great penstocks 10 feet 2¼ inches in diameter to as many turbines located in one long line on the floor of the wheel pit. The effective head of water is 133 feet. From the turbines the water is discharged through draft tubes into a discharge tunnel which measures 25 feet in height by 18 feet 10 inches in width. The tunnel extends from the wheel pit to the face of the gorge, a distance of about 1,700 feet, just below the Horseshoe Falls, where it discharges at the level of the river.

The distinctive feature of this power station is the unusual size of the turbines and the generating units, each of which is of a capacity of 10,000 horse-power, or exactly double that of the units established in the first power plant of the Niagara Falls Power Company on the American side. It was a notable step on the part of the company to increase the size of its units by 100 per cent, and no little credit is due to them for being the first to make so bold a move at Niagara. The advantages of the larger units are many and valuable. In the first place they occupy but little more space than units of 5,000 horse-power, and, consequently, for a given total capacity of plant, there is a great reduction in the length of the wheel pit and the power house. Moreover, 10,000 horse-power generators cost considerably less per horse-power than generators of 5,000 horse-power capacity. The turbines, which were designed and built by Escher, Wyss & Co., are of the vertical type and the power is transmitted by massive vertical shafting, 3 feet 4 inches diameter in the hollow portion and 14 inches in the solid portion, to eleven generators located on the floor of the power house at ground level. The generators are wound for three-phase, 25-cycle current of 11,000 volts potential, the speed of revolution being 250 per minute. This high voltage was selected because of the economy that it secured in local distribution of the power, the cost of underground distribution of three-phase, 11,000-volt current being about one-fifth of that of distribution of a two-phase 2,200-volt current.

The cable connections are so arranged that the Canadian power house can operate in connection with one or both of the American plants. The cables are carried across the Niagara River over the upper steel arch bridge, the total distance between the two plants being about three and one-half miles. The three-phase, 11,000-volt current is changed to two-phase, 2,200-volt current for paralleling, by means of step-down transformers; or, if desired, it is delivered direct to the various manufacturing concerns on the lands of the Niagara Falls Power Company. The output of this great plant will be available for Canadian industries in the Province of Ontario, so far as they lie within transmission distance, and subject to the Canadian demand for power it will be available for American consumers on the American side according as the demands may come in. Our thanks are due to Mr. W. D. Robbins, assistant engineer for the company, for courtesies extended during the preparation of this article.

MOUNTING THE 12-INCH GUNS OF THE "CONNECTICUT."

If it were not for the delay in the furnishing of



12-Inch Gun Being Transferred from Floating Crane to the Ship.

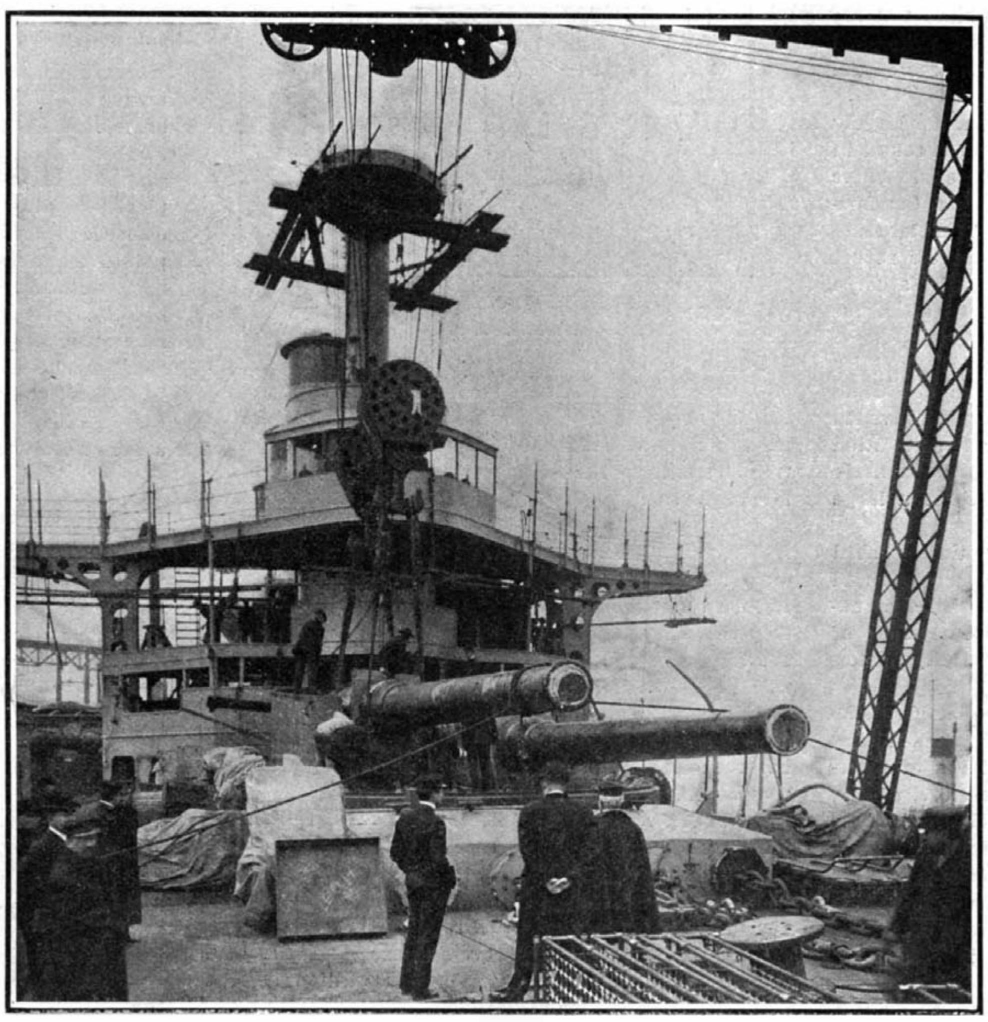
the armor for her turrets, the United States battleship "Connecticut," which, as our readers are aware, has been constructed at the Brooklyn navy yard, would to-day be a completed ship. As it is, about three or four per cent of the work remains to be done and practically the whole of this relates to the mounting of the guns and the bolting on of the turret armor. The four 12-inch guns and the eight 8-inch are in place, and as soon as the twelve 7-inch pieces are delivered from the gun factory, the work of placing them on their central pivot mounts in the broadside battery will be quickly accomplished. With the exception of these last-named guns, everything below the upper deck is completed.

Pending the final determination and announcement of the plans for our new battleships "South Carolina" and "Michigan" (ships which will be of the same broad type as the "Britannia," carrying only 12-inch guns in the main battery), the "Connecticut" represents the highest development of warship construction in the United States navy. Furthermore, if the naval designers of the world have been too precipitate in the sweeping changes which they have made in their new designs, changes based on the so-called lessons of the Japanese war—if future engagements will not be the long-range affairs that is commonly supposed, and the opposing fleets, keen for the delivery of a crushing and conclusive attack, draw into closer range where the secondary armament can play on the enemy with telling effect—in such event the "Connecticut," with her eight 8-inch and twelve 7-inch guns in effective range, might well prove to be a match for one of the new type carrying a few very powerful, but slow-firing guns.

The "Connecticut" is 450 feet by 76 feet 10 inches, by 24 feet 6 inches, and displaces 16,000 tons. With 16,500 horse-power she is designed to make 18 knots an hour. Her full bunker capacity is 2,200 tons of coal. She carries a continuous belt, 11 inches thick amidships. Her 12-inch guns are protected by 12-inch armor; her 8-inch guns by 8-inch armor, and her 7-inch guns are mounted behind armor 7 inches thick. Her complete armament is four 12's, eight 8's, twelve 7's, twenty 3's, twelve 3-pounders, and fourteen small guns. She also carries four submerged torpedo tubes.

Our illustrations represent the emplacing of one of the four heavy, long-caliber, 12-inch guns, each of which with its saddle and attached port-shield weighs 75 tons. The guns were lifted and lowered into position by the large floating gantry crane which was built three years ago specially for the Brooklyn navy yard for doing this kind of work. The gun is lifted by means of two wire cable slings attached to the lower sheaves of two separate hoisting cables. These hoisting cables lead up to and over a traveling car, which runs upon tracks laid on the lower chords of the cantilever boom. The gun is lifted from the deck of the crane until it is high enough to clear the top of the turret. The carriage is then hauled out by means of cables that run in a sheave at the outer end of the boom, until it is in the correct position over the turret, and the gun is then lowered into position. A new feature in these pieces is the provision of a massive port-shield with parallel, vertical edges, the width of the shield being such that when the gun is in position, the clearance between the shield and the gun port is only about sufficient to allow the insertion of a lead pencil. The shield gives a perfect protection to the gun detachment inside the turret against fragments of bursting shell, and incidentally, it serves to prevent the entrance of gases from the 8-inch guns which are mounted a pair on each beam, astern of the 12-inch turret. The 12-inch gun is an exceedingly handsome piece, and its great length of 45 calibers, or nearly 50 feet over all, gives it an appearance of perfect proportion that is not possessed by the earlier pieces of shorter length. The initial service velocity is 2,700 feet a second, and its 850-pound shell leaves the muzzle with an energy of about 44,000 foot tons—sufficient for the penetration of 16½ inches of Krupp steel at a distance of 5,000 yards, providing, of course, that the projectile carries the usual soft cap.

Through the courtesy of Capt. William J. Baxter, chief naval constructor at the yard, we were given an opportunity to make an inspection of the great battleship, which has left a strong impression of the skill with which the interior arrangements have been planned, and of the absolutely first-class character of the work. The great size of the ship has enabled the designers to provide accommodations for the officers and crew which are exceedingly liberal and comfortable, and marked by careful attention to the latest sanitary requirements. Particularly interesting is the care with which this provision has been car-



These guns with their attached shields weigh, each, 75 tons. They are hoisted and moved into place by the floating gantry crane shown in the illustrations.

MOUNTING THE 12-INCH GUNS IN THE FORWARD TURRET OF THE BATTLESHIP "CONNECTICUT."

ried out as far as it affects the living quarters of the crew. Immediately above the boiler room is to be found a long line of shower baths for the use of the firemen; steam-heated drying racks, for their working clothes; a plentiful supply of wash basins and other essentials to cleanliness and decency. The same provision is made further forward for the crew; and mention should be made of a lofty, well-ventilated hospital and of a special room for patients having infectious diseases, while is tiled throughout, ceiling, floor, and walls, so that it can be subjected to thorough washing and disinfection after the patient has been removed.

As regards the working of the guns, all of which, by the way, are electrically-controlled, the most interesting features are those having to do with the speedy and safe delivery of the ammunition supply to its proper destination. This contains many new features which are of such a character that it is not advisable that they should be made public. Suffice it to say that the ammunition hoists, and the methods adopted for the transportation and distribution of the ammunition from the various magazines to these hoists, have been so skillfully designed and placed, that the mechanism is practically secure against shell fire. As long as any gun is in action, the gun captain need have no anxiety on the score of a failure of the supply of powder and projectiles.

Finally, as regards the very interesting competition in the construction of the "Connecticut" and the "Louisiana" (a competition, by the way, which the parties concerned in the construction of the two ships deny as having any existence), it may be said that at the present time the two ships stand about level. When the proposition was made to have the "Connecticut" built at a government yard, those who objected to such an arrangement declared that if the government built the ship she would cost from anywhere from 30 to 40 per cent more and take far longer to build, than if she were constructed at a private yard. As a matter of fact she has been built in the same time, and has cost only about 15 per cent more than her sister ship "Louisiana"; and this in spite of the fact that the government employees have shorter hours and receive higher pay than the employes in private yards.

THE NEW WATER SUPPLY FOR NEW YORK CITY.

In the choice of a new source of water supply for New York city, the engineers of the present Board of Water Supply have been obliged to exclude from their investigations certain desirable water sheds and rivers that had been shut out by prohibitory legislation. The sources of supply in the Catskill Mountains recommended by the Board have been chosen as presenting the most quickly available and the best and cheapest large sources that can be obtained under present conditions. The Housatonic River is ruled out because of its location in the State of Connecticut. Ten Mile River, a tributary of the Housatonic flowing into Connecticut, is ruled out by the uncertainty of the law governing the diversion of interstate waters; and the watersheds adjoining the Croton watershed on the north are ruled out by the prohibitions of the Legislature in 1903-04.

The choice of the Catskill sources was made largely as the result of a study of the very full data found in the report of the Commission on Additional Water Supply (the so-called Burr-Hering-Freeman Commission) appointed by Mayor Low in 1902. The elaborate studies of that commission, included in their report and published by the city, were carried on by a corps of engineers and assistants comprising in all about two hundred men, who spent an entire working season in the field, and very carefully examined the quality and feasibility of all available sources in the State of New York. This same commission was reconvened by Mayor McClellan and after further investigation recommended, without reserve, the Catskill Mountain sources as being now the most available for a large future supply.

In other independent investigations the Catskill Mountain sources have been repeatedly considered and proposed, notably as the result of a study of the subject under the chief engineer of the Department of Water Supply, Gas and Electricity of this city during years 1902 and 1904.

Catskill Sources to be Appropriated.—The Commission on Additional Water Supply recommended that steps be taken at once toward the building of reservoirs, aqueducts, and filters, sufficient to store, purify, and convey to New York city 500,000,000 gallons of water daily from various new sources; and the report of the present chief engineer of the Board of Water Supply, Mr. J. Waldo Smith, recommends that the following sources be appropriated for New York city, these being those for which authority is now being sought in a bill before the legislature: 1. Esopus Creek, to be taken at a point near Olive Bridge; 2. Rondout Creek, to be taken at a point near Napanoch; three small streams tributary to the Rondout, to be taken as shown on the map; 3. Schoharie Creek, to be taken at a point near Prattsville; 4. Catskill Creek, to be taken at a point about one mile north of East Durham, and also six small streams tributary to aqueduct from Catskill Creek to Ashokan reservoir. The total available yield of these Catskill sources, exclusive of interstate tributaries, is 660 million gallons daily, and 511 million gallons if we exclude the Catskill supply of 149 million gallons. Although there is no immediate call for the total amount, the present rate of growth of the demand in this city renders it certain that New York city will, within twenty-five years, need substantially all the waters that these sources can supply *in years of extremely low rainfall.*

The Great Ashokan Reservoir.—The scheme of construction proposed is to build at once that portion of the system which will give the city, in the near future, a sufficient additional supply, to safeguard it against any danger of a water famine. The first section that it is proposed to construct in accordance with this principle is the great Ashokan reservoir with a capacity of 250 million gallons daily, and an aqueduct of 500 million gallons daily capacity, to extend from the reservoir to a crossing beneath the Hudson River at New Hamburg, from which place it will be carried to New York by way of the new Croton reservoir. The

MAP OF NEW YORK CITY'S PROPOSED NEW WATER SUPPLY.

Ashokan reservoir will carry its full water line at an elevation of 600 feet above mean sea level.

Rye and Kensico Reservoirs.—From the Croton reservoir the 500-million-gallon aqueduct will be continued south to Kensico reservoir, which will be enlarged to include Rye Pond and form an emergency storage reservoir at an elevation of 355 feet above mean tide containing 25 billion gallons, or fifty days' supply at 500 million gallons daily. Continuing south for about four miles, the reservoir will lead to a large filtering plant at Scarsdale, and six miles to the south of this there will be another storage reservoir at Hill View. The advantage of these two reservoirs is that should any mishap occur anywhere along the 69 miles of aqueduct to the north, ample time would be given to make repairs without interfering with the regular city supply.

Brooklyn and Staten Island Connection.—For the supply of Brooklyn and Staten Island a tunnel of 200 million gallons daily capacity will be driven below the East River, with connections suitable for delivering 100 million gallons daily to Brooklyn, this connection terminating in a large reservoir in Forest Park. Another line, capable of delivering 20 million gallons daily, will be built by way of Brooklyn, its course being indicated on the accompanying map. In view of the fact that it will be from five to eight years before the first water can be brought in from the Catskill region, it is recommended that immediate relief, which is even more necessary in the case of Brooklyn than Manhattan Island, be sought in the more easterly sources of Long Island, which have been as yet undeveloped. The connection to Staten Island will probably consist of a 48-inch main leading to a terminal emergency reservoir built on high ground on Staten Island.

The estimated cost of constructing the Ashokan reservoir and aqueducts, emergency reservoirs, etc., but not the filter beds, as above outlined, is $112,092,000, and the time for its completion from five to eight years. The total cost of completing the whole system, including the Scarsdale filtration plant (estimated to cost $17,525,000) and the Rondout and Schoharie developments, is $161,857,000.

Artificial Albumen.—A New Condensed Food to Supplant Meat.

Consul Pike, of Zittau, reports that an interesting discovery is being discussed by the German press, which refers to the result of a recent investigation by Prof. Emil Fischer, of Berlin. He writes:

"It is contended that the principal nourishment required by the human body for its maintenance is alubpmen, according to the renowned professor of physiology, Pfeiffer, the source of all muscular strength. For this reason it has at all times been the endeavor of our learned men to obtain more knowledge of this important ingredient of our daily food. Up till now all such efforts have been in vain, but it was recognized that were it possible to make artificial albumen, a complete change in the present system of nourishing the human body would be brought about and would render the now so necessary meat foods to a great extent dispensable.

"Prof. Emil Fischer, director of the leading chemical institution, the Berlin University, has gained the credit of having accomplished the first analysis of natural albumen. He has established the composition of the various ingredients, some of which he has succeeded in producing artificially. The substance thus obtained he has called 'polypeptide,' and it is said to possess a large number of the properties characteristic of natural albumen. The vast importance of this discovery will be better comprehended when we realize that the introduction of this artificial food will reduce the disastrous effects of bad harvests, pestilence, etc., to a minimum, and cause famine to become a thing of the past."

The Current Supplement.

The current Supplement, No. 1577, opens with the first installment of a good article on Torpedo-Boat Destroyers. Clarence M. Barber writes instructively on fuel briquetting in America. The excellent article on "Cement Mortar and Concrete: Their Preparation and Use for Farm Purposes," is concluded. Recent advances in wireless telegraphy are reviewed by J. Erskine Murray. Of interest to the army of pilgrims who each summer return to New England to enjoy the beautiful excursions for which Boston offers a natural geographical and historical center, will specially wish to include in their itinerary a day at the Harvard Botanical Gardens, inasmuch as the centenary of this institution's conception has been celebrated. M. C. Crawford gives a comprehensive description of the garden, and illustrates it with many photographs. The scientific treatment of high-pressure explosives, both solid and gaseous, has left much to be desired. For that reason Mr. J. E. Petaval's treatise, published in the Supplement, may be regarded as the most valuable contribution to our knowledge of the subject. Among the minor articles which may be mentioned are those entitled "Starting the Engine," "The Brake Shoe Problem," "Water Power at High Pressure," "A Simple Camera Shutter," "Hybridization of Plants," "Star-Streaming," "Cost of Running a Motor Delivery Tricycle."

American Homes and Gardens for April.

The April number of American Homes and Gardens is one of the handsomest and most diversified issues of the periodical which has thus far been published. The "notable American home" which Mr. Barr Ferree picturesquely describes is the Long Island residence of Mr. W. K. Vanderbilt, Jr., at Great Neck. Beautiful photographic illustrations accompany the text. Other residences, not quite so large, although distinguished by architectural taste, are described and illustrated. Most interesting to the great majority of readers will be the account of some successful houses costing from $3,000 to $6,000. Photographs and plans of these dwellings are published. Instructive, too, as well as helpful are excellently illustrated contributions on "Weaving as an Occupation for Women," by Mabel Tuke Priestman; "Old-Fashioned Clocks in American Homes," by Mary H. Northend; "Modern Theory and the Bedroom," by Jay Wheeler Dow; "Construction and Care of the Hotbed," by Ida Bennett; "Garden Work for April," by Eben Rexford, as well as many other articles both timely and entertaining.

Correspondence.

Cement Tiles Once More.

To the Editor of the SCIENTIFIC AMERICAN:

In your article of March 3 I notice an article by C. E. Bartlett in regard to cement tile for farm drainage.

I have no doubt Mr. Bartlett is conscientious in his opinion but I am afraid he will carry an erroneous idea to some one interested in farm drainage.

The fact is: no water to speak of goes through the wall of the tile, but at the joint.

For proof take a soft tile, cement the bottom, fill with water and cover so that none of the water will be lost by evaporation. If the tile is an unusually soft one you will find at the end of twenty-four hours that the water has lowered about ½ inch.

In this section of the country the farmers are putting in *thousands* of tile every year, and the simple fact that the glazed tile are meeting a ready sale and giving universal satisfaction, against scarcely no sale for soft tile, is in itself proof of the error of Mr. Bartlett's statement. W. M. SNYDER.

Renwick, Iowa, March 7, 1906.

To Prevent Obnoxious Odors in the Subway.

To the Editor of the SCIENTIFIC AMERICAN:

I have read in your valuable paper, from time to time, various suggestions as to the best means of doing away with the obnoxious odors in the New York Subway, and having traveled in the Subway myself during the past summer, I therefore make these suggestions:

(1) I would have suspended from each truck a casing (made of some thin metal), same to inclose wheels, brake, shoes and boxes, and having of course an opening at the bottom for the wheels, said opening to be almost airtight, so as not to allow too great an inflow of the outside air while the aim pump is running.

(2) Have one car in each train fitted with an electric pump, also a tank (for the storage of foul air), connecting each casing to a running pipe under the car, same to empty into storage tank.

By having the wheels, brake shoes, and boxes incased, as above stated, the casing would catch any waste oil that might otherwise fall to the roadbed (and in time cause obnoxious odors); also the heat generated from the application of the air brakes, which as we know is very disagreeable.

(3) When the motorman applies the air brakes, the air pump could be automatically started and run as long as he may deem necessary in order that the foul air which has arisen during the application of the air brake and already in the casings, with any other odor that may have arisen from the oil, be forced into the storage tank.

(4) When the train has come out into the open air, or has arrived at the yards, a release valve in the storage tank could be opened, thus allowing the inclosed air to escape.

(5) Have the casings made similar to the present boxes, allowing for the injection of oil, also space for the cleaning out of the casings when necessary.

It seems to me that this would be a partial solution of the present annoyance. JOSEPH J. PARMENTER.

Chicago, February 27, 1906.

THE DIAMOND SHOALS LIGHTHOUSE.

Ever since American shipping amounted to anything the Diamond Shoals, extending for eighteen miles out into the Atlantic, off the point of Cape Hatteras, on the North Carolina coast, has been the worst menace to shipping known to mariners.

A properly placed beacon light at that point is an imperative necessity; for the lighthouse located on the outer bar is too far inward from the Diamond Shoals, while the lightship is too distant seaward, but is far enough out to insure sufficient depth for all vessels. In rough weather the light is not easily discernible. A permanent structure located at the edge of the outer shoal, and high enough to be seen in all kinds of weather, has become a necessity. An attempt was made not very long ago to build a lighthouse on this shoal, but was unsuccessful. For four or five years past Capt. Albert F. Eells, of Boston, Mass., has given the subject much study, and has recently been successful in persuading Congress to give him an opportunity to build a lighthouse at his own expense. Under the terms of the bill he is authorized to construct a substantial, sufficient lighthouse and fog signal of the most improved construction, together with auxiliary works.

The act specifies that Capt. Eells and his associates shall build the light station at their own cost, maintain the structure and operate the light in accordance with the regulations of the lighthouse board for one year, also at their own cost, after which it shall be placed under the control of the lighthouse board, who shall operate it for four years more at the cost of the United States. Eells and his associates shall then be entitled from the United States to the sum of $750,000, provided the structure is in a substantial and satisfactory condition.

In their report of 1888 the lighthouse board stated that the erection of a permanent lighthouse off Cape Hatteras would be an engineering task of great magnitude.

In 1902 O. L. Spaulding, acting Secretary of the Treasury, stated that the probable cost of erecting such a permanent light on Diamond Shoals according to the best plans then proposed would be $1,588,000.

The ship-owning and seafaring people throughout the country clearly realize the importance to their property and their lives of the work intrusted to Capt. Eells and his associates. The petition to Congress for the passage of the act contained the names of fifteen marine insurance companies, fifteen national banks doing the business of marine men, and 209 steamship lines and miscellaneous marine organizations.

Through the courtesy of Harriman Brothers, the engineers who have been intrusted with the designing and the erection of the lighthouse, we are enabled to present the following description of the proposed structure.

The foundation for the lighthouse will be a massive steel caisson in the form of a truncated cone with a cylindrical base. Upon this will be erected a tower comprising essentially a plate-steel cylinder with a slight batter from base to top, which tower will support a lantern at a height of 150 feet above sea level.

The foundation caisson will be 108 feet in diameter at the bottom, 80 feet high and 50 feet in diameter at the top. It will have a double shell of steel plates parallel to each other, spaced 6 feet apart and attached to twenty-four upright inclined plate girders, which will divide the space between the shells into twenty-four watertight compartments. It will have a double bottom, which is about 7 feet higher than the outer bottom edge of the caisson. The space between the two floors of the bottom, about 7 feet apart, is divided into twenty-four sections by twenty-four frames or trusses, extending radially from near the bottom of the twenty-four outer inclined girders, horizontally, to within 8 feet of the center of the caisson.

The central part of the caisson will be in the form of an open vertical shaft, 16 feet in diameter, extending from top to bottom, inclosed by steel plates riveted together and riveted to the steel girders, extending horizontally from this shaft to the inner edge of the twenty-four inclined girders mentioned. These horizontal girders, being about 13 feet one above the other, act as temporary floor beams that will divide the caisson into five large circular rooms.

The estimated weight of the entire structure, including the lighthouse and contents, is to be 27,000 tons. The displacement of water will be about 10,000 tons, which will leave an effective weight resting on the sands of the Diamond Shoals of about 17,000 tons, covering an effective area on the base of 8,960 square feet. This will give a pressure on the base from a vertical weight of 1.9 tons per square foot. The resultant pressure on the base from wind and wave is about 0.9 of a ton per square foot, added to the vertical weight of 1.9 tons per square foot, gives the maximum pressure on the leeward side of the caisson of 2.8 tons per square foot, while the pressure on the windward side of the base would be 1.9 tons per square foot, minus 0.9 ton wind and wave pressure. This would still leave a downward pressure on the windward side of the base of one ton per square foot, which gives this entire structure as here designed a stability never before submitted for the construction of such a lighthouse. The caisson is to be built at some shipyard and towed to its destination.

The central tube in the caisson, which extends from top to bottom, is made of curved rolled steel plates, attached to the ends of the horizontal floor girders and to the bracings, all of which when riveted together will form a vessel-like caisson of circular shape, built sufficiently strong to stand its sea voyage and the wind and wave pressure, after its final settlement into the sands of the Diamond Shoals.

All the inside horizontal girders are covered at the different elevations to make temporary floors and rooms in the caisson. It is proposed to place in these rooms, at the time of towing, the boiler, engines, pumps, derricks, dredging apparatus, concrete-mixing machinery, water, sand and cement, and the different materials necessary for sinking and filling, as well as supplies and equipment for the workmen.

A portion of the space between the two outer shells, and part of the bottom will be filled with concrete before leaving the shipyard, so that the caisson will draw about 21 feet of water.

After reaching its destination the caisson will be held in place by suitable anchors and cables. It will be scuttled by pumping water into the interior compartments until it rests on the sands in about 24 feet of water, leaving the top or deck about 56 feet above the surface of the ocean.

The lighthouse will be located some distance back from the outer edge of the shoals, so that it will be protected from the unbroken force of the ocean waves in time of storm. The shoals below the four-fathom contour extend over an area of about six miles by two miles, and the location selected, as shown by studies of the government maps made during the last fifty years, has suffered but slight alterations in depth.

After the caisson has been scuttled water ballast will be pumped into the twenty-four side compartments above the sea level. It is then proposed to sink the foundation caisson as quickly as possible, by a combined dredging and compressed air process, the dredging being done in and through the central well or shaft, and the caisson being sunk as far as practicable by open dredging through this well. This work will be preferably done in the spring of the year, as at that time the prevailing winds are from the shore, and therefore, the seas do not run so high.

After the caisson has been sunk as far as practicable by open dredging and the added weight of water and concrete, the lower air chambers will be filled with compressed air to force out the water. Laborers will enter these chambers and assist the hydraulic dredging machinery in excavating with powerful water jets, shovels and special tools to force the sand toward the central tube, whence it will be pumped upward and discharged through the outer shell.

While the dredging is being done the work will be be carried on as fast as possible in filling the different chambers with concrete. The material—cement, crushed stone, granite blocks, boulders, supplies, etc.—will be brought to the caisson in lighters, and hoisted aboard and stored in the different rooms to be used when required. A balance in weight will be preserved between the increasing weight of the structure and the increasing buoyancy of the surrounding water as the caisson sinks to its final depth. The caisson may thus be temporarily held at about the same level, to facilitate certain details of the excavation, or it may be made to sink more rapidly in the sand.

It has been estimated by a competent engineer, who has made an investigation of this location, that the sand is capable of supporting a weight as high as from eight to ten tons per square foot, but at no place, with this structure, will the pressure be greater than 3.6 tons, after deducting the amount of buoyancy or the pressure of the water displaced by the caisson.

As soon as the caisson has been sunk to its proper depth, about 26 feet below the surface of the sand, the bottom being about 50 feet below the surface of the water, the work of filling will begin. A rip-rap apron of oval shape, composed of irregular granite blocks or boulders, will be deposited on the surface of the sand entirely around the foundation, extending outward about 75 feet from the edge of the caisson in the direction of the greatest exposure.

After this caisson has been scuttled and sunk a few feet into the sand it is claimed that it will withstand any storm that may come up at that season of the year, and by the time it has reached its total depth of 26 feet in the sand and been partially filled with granite and cement and surrounded with rip-rap, it will withstand as great a storm as has ever been recorded off these shoals.

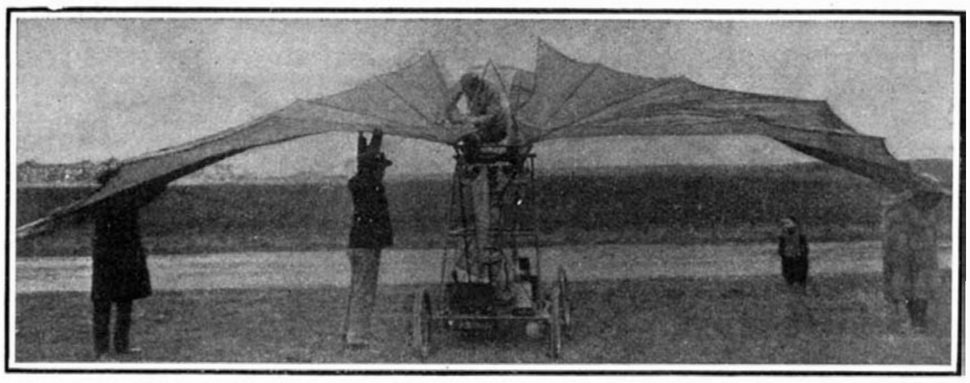
The entire shell of the caisson having been filled with concrete, and the central tube having been loaded with sand, except a space of about 12 feet deep, for a cistern that will hold 15,000 gallons of fresh water, and for rooms 14 feet high for storing the oil, water, and hoisting engine for the lighthouse, the foundation will be complete. The erection of the lighthouse or superstructure will thereupon begin. The lighthouse is of steel construction, and consists of an outside circular steel shell with an inner central steel tube, which contains a spiral stairway, chimneys, and ventilators, all of which are well braced by steel girders, frames, and partitions, and which has eight different floors besides the lantern gallery and watchroom. The outer shell of this structure is to be lined with a layer of concrete or plaster placed upon wire mesh or expanded metal, about 4 inches thick.

The first floor will be equipped with three lifeboats, with a crane for hoisting or lowering on the outside. The second floor will be divided into four rooms and will contain the fog-signaling apparatus and two oil engines. The third floor will contain the hoisting engine for operating the crane, and two large provision rooms and a bedroom. The fourth floor will have two bedrooms, a writing room and a bathroom. The fifth floor will have two bedrooms, a writing room, and a bathroom. One half of the sixth floor will be devoted to the dining room, and will have a well-equipped kitchen, pantry and refrigerator. The seventh floor will have a double sitting room and a laundry, and on this floor will be placed a tank that will hold 1,600 gallons of fresh water. The eighth floor will be properly equipped for the Lighthouse Service room. The ninth floor will contain the watch room and will have a gallery extending all the way around it, where those connected with the life-saving service as well as the light service may keep constant watch and records, during calm or storm. The floor above this will contain the light, for the installation of which the government has separately appropriated $30,000. The light will be of the first order and will be seen at a distance of 15 miles.

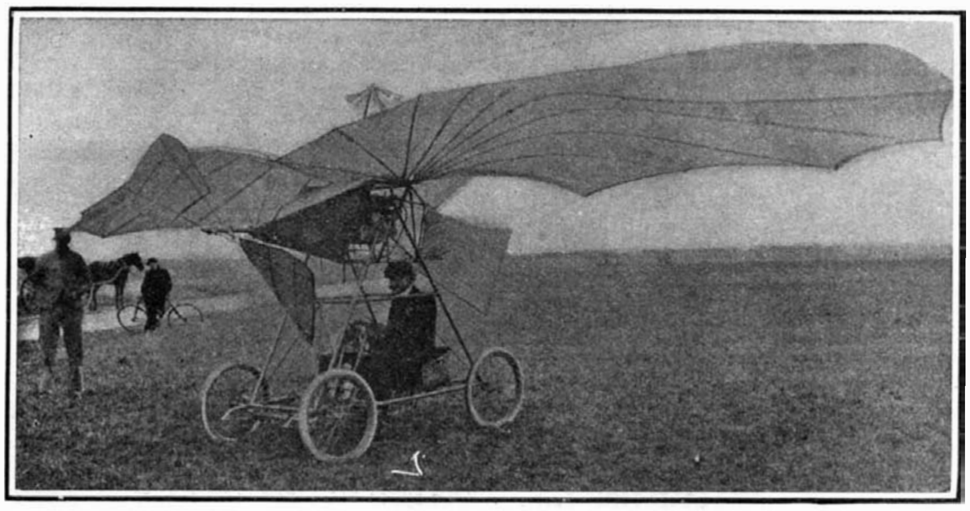
SOME RECENT FOREIGN FLYING MACHINES.

The present year bids fair to see the solution of the problem of the "heavier than air" flying machine, judging from the number of aeroplanes now being experimented with by inventors the world over. The following descriptions will give an idea of some of the latest attempts at solving the problem of flight with a machine of this kind.

Four of our illustrations show the recently invented aeroplane of M. Vuia. This machine consists of a pair of wings covered with varnished silk which, when unfolded, have the appearance of a gigantic bat, as can be seen from two of the annexed illustrations. The aeroplane is mounted on a framework of steel tubing carried on four pneumatic-tired wire wheels, the front pair of which can be steered after the manner of an automobile. In the upper part of the framework is a carbonic acid motor, capable of giving 25 horse-power when operated at high pressure. The motor drives the propeller placed in front of the wings, and thus draws the machine along the road. When sufficient speed is attained the machine is expected to rise in the air. The speed necessary for this is estimated to be about 36 miles an hour. As soon as the machine is in the air, it can be steered to the right or left by means of a vertical rudder, while its inclination is varied by means of varying the angle of the wings, which are made to turn about their horizontal axis. The total weight of the complete machine is 195 kilogrammes (639.76 pounds), to which must be added the weight of M. Vuia, which is 50 kilogrammes (164.04 pounds). The length of the wings from front to back is 2.40 meters (7.87 feet). Their breadth is 8.70 meters (28.54 feet). The propeller is 2.20 meters (7.21 feet) in diameter and has a pitch of 2.35 meters (7.71 feet). In the initial experiments made some weeks ago with this machine, the wind blew so hard that it was impossible to extend the enormous wings of the aeroplane. Consequently, the inventor confined himself to experimenting with the propeller, while causing it to draw the machine along the road with the wings folded. The road was muddy and rutty, and there was a slight up-grade. Notwithstanding this, when the propeller turned the machine started and attained a speed of 12 miles an hour. The wind blew from the side. On the return trip, which was slightly downgrade, a little higher speed was attained. M. Vuia, accompanied by his mechanic, rode back and forth several times with the same success.

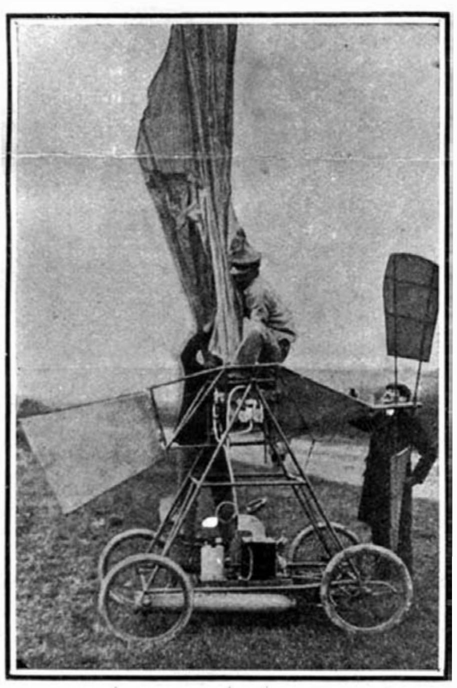


Front View of Vuia Aeroplane.



The Vuia Aeroplane Ready to Rise.

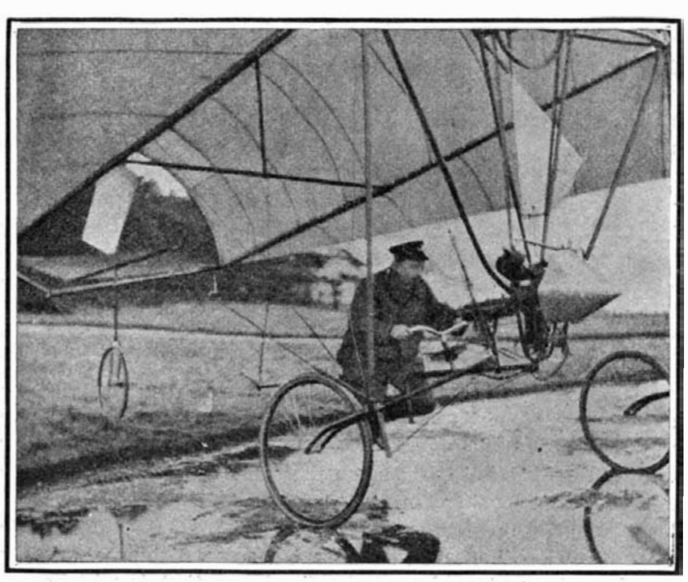
The aeroplane is mounted on a light quadricycle so that it can be drawn along the ground by its propeller until sufficient speed is attained to enable it to rise in the air.



The Aeroplane with Wings Folded, As It Ran Along the Road.

There is, of course, considerable difference between 12 miles and 36 miles an hour, the estimated speed at which the machine is supposed to leave the ground; but the first experiments were sufficiently successful to encourage the inventor and those who witnessed them. Moreover, this quadricycle, if run on a smooth, flat track, can be used for studying with great ease and in a practical manner the best form to give the propellers which it is intended to use for aerial propulsion, and the variations in their efficiency according to the speed with which they are revolved. It would be worth while to fit such a machine with a 100-horse-power Buchet motor, weighing 2.2 pounds to the horse-power, in order to see what could be accomplished. The experiments made thus far were certainly very interesting, and all those having the conquest of the air at heart will follow any future ones the inventor may make, with the greatest attention.

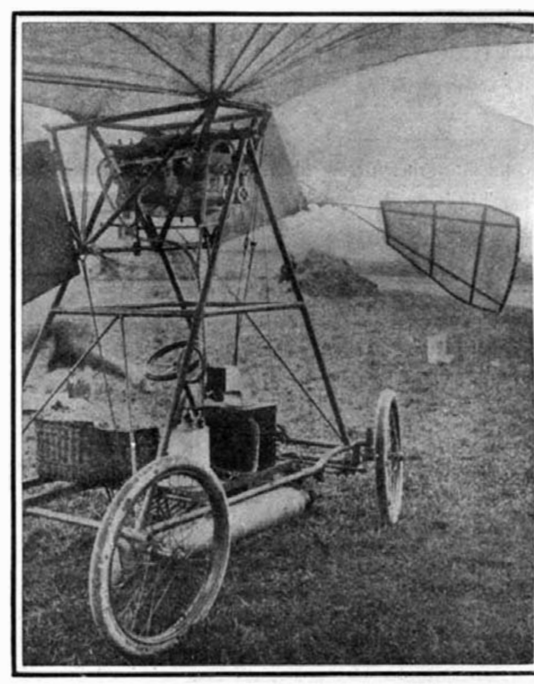
Four other illustrations, shown herewith, depict a new aeroplane of somewhat similar construction, which is the invention of Mr. J. C. H. Ellekammer, a Dane who has made a name for himself in connection with the motor bicycle which he invented, and the chief features of which are a patent starting valve and "turbine" carbureter. Mr. Ellekammer began work about a year ago upon this aeroplane and in its trial so far it has been altogether successful. The novel feature about this machine is the long semi-circular body within the front end of which is mounted a propeller. The latter produces a powerful draft beneath this curved body and draws the machine forward through the air. The propeller is driven by a belt from a three-cylinder motor placed directly beneath it, and the cylinders of which set at an angle of 120 degrees, and work upon a single crank. The motor is air-cooled, as usual. Two large triangular wings serve to steady the machine and help support it. The operator sits upon a saddle just back of the motor. Three bicycle wheels are used to support the machine when it is upon terra firma. The machine is constructed of light steel tubing and canvas. Its length is 28 feet, and its width across the wings, 32 feet. It is fitted with an 8-foot propeller, and its width complete, is 287 pounds. The most important feature of the whole machine is said to be that the operator can maintain it at any desired angle to the horizontal. The machine is said to have flown when tethered to a pole and run around a wide circular track surrounding it. At present the inventor is constructing a motor of larger horse-power. As soon as this is completed he plans to give a demonstration before Prince Waldemar of Denmark, who is greatly interested in aeronautical matters.



The Danish Aeroplane Running Along on the Ground Before Rising.

VIEWS OF NEW FOREIGN AEROPLANES.

A distinctly novel type of flying machine is what may be called a revolving aeroplane apparatus. This is shown at the bottom of the next page. It consists, as may be seen, of two triangular wings inclined somewhat with the horizontal, and suitably mounted on rollers on a circular track. The track is supported upon a framework of steel tubing, within which the operator is supposed to sit. Mounted upon the wings are two propellers which are driven by belts from a motor placed at the base of the wings and also mounted on the same frame with them, the idea being that the wings, driven by the propellers, will revolve rapidly and lift the machine in a vertical direction. After it has attained the desired height, the operator can tilt it by moving his body toward the rudder, and thus can cause it to move forward as well as rise. A parachute can be carried within the circular frame and opened in case the machine falls. The photograph is of a model constructed of oak, bamboo, canvas, and steel tubing for the purpose of showing that the machine could be built on a large scale. The wings are 30 feet across and they have a periphery of 27 feet. The rudder was about 7 feet long and the propellers about 10 feet in diameter. The total weight of the machine was in the neighborhood of 300 pounds, and it was fitted with a light air-cooled gasoline motor of 3¾ horse-power, weighing some 50 pounds. This machine is the invention of an Englishman, Mr. George Clout, whose present address is 234 West 14th Street, this city. He has spent some fifteen years working out this idea and is desirous of interesting capital for the purpose of building a practical machine along these lines.



Near View of 25-Horse-Power, 4-Cylinder Compressed-Air Motor.

An engineer living in Monaco, Mons. M. Léger, has recently tried to find a satisfactory solution of the problem of flight by a combination of a hélicoptère and aeroplane. His invention is based on the following considerations:

If helicopeters have failed to give the desired results, this is due to the fact that separate screws were used for support and for propulsion. Now a vertical air screw in a horizontal air current (and likewise a horizontal screw in a vertical current) will never work satisfactorily. One of the blades of the screw will in fact possess with regard to the air an absolute speed equivalent to the sum of the tangential speed and the speed of propulsion, while only the difference of these two will be operative on the other side of the screw. One of the blades will accordingly tend to rise more rapidly than will the other, with the result that the equilibrium of the whole machine is upset. Léger accordingly uses two screws, which serve simultaneously for supporting and propelling the machine. These screws are arranged at an oblique angle, their common axis being placed in a vertical direction for rising and descending, and in an oblique position for horizontal movement. These screws, rotating in opposite directions round their common axis, mutually deal with the resulting recoil. If now the machine be given supporting surfaces, the axis of the screws being inclined as far as the horizontal position, it will work as an aeroplane and have the advantage of this type of airship, viz., the requirement of much less power for propulsion, or the attainment of a far higher speed with a given amount of power.

Léger has recently carried out experiments with a helicopter of half the dimensions required for lifting a man (see annexed cut) in the presence of the Prince of Monaco, who takes an active interest in this work and who has repeatedly presented reports on the same to the French Academy of Sciences. The screws of this apparatus were 6.25 meters (20.5 feet) in diameter and 1.75 meters (5.74 feet) in breadth. They were made of highly resistant reinforced aluminium sheets, and were each 21 kilogrammes (46.29 pounds) in weight, while the complete apparatus without the motor weighed 85 kilogrammes (187.39 pounds). It was operated by an electric motor placed on the ground and driving the screws through a shaft and universal joints.

The experimental machine carried 25 kilogrammes (55.11 pounds) dead weight, the total amount to be lifted thus being 110 kilogrammes (242.5 pounds), which was actually raised by the expenditure of 6 horse-power. Now motors of a maximum weight of 2 kilogrammes (4.4 pounds) per horse-power, inclusive of the amount of fuel required for one hour's operation, are at present constructed. Fifteen kilogrammes (33.06 pounds) of the load above referred to will accordingly correspond to a motor of 7.5 horse power and 30 kilogrammes (66.13 pounds) to the weight of a man of half size. Now 110 kilogrammes (242.5 pounds) were lifted by 6-horse-power, i. e., 18.3 kilogrammes (40.4) pounds) by each horse-power. Consequently 7.5 horse-power may be expected to produce an ascensional force of $7.5 \times 18.3 = 137.25$ kilogrammes, or 313.08 pounds. As the machine, motor, and half-size man weigh respectively 85, 15, and 30 kilogrammes, there is a total weight to be lifted of 130 kilogrammes (286.59 pounds). Therefore there should be 7.25 kilogrammes, or 26.49 pounds surplus lifting power, which is ample.

The inventor intends shortly to construct and to test a helicopter of larger size. This flying machine is to be provided with screws of 12.50 meters (40.02 feet) in diameter. The output of its motor will be 100 horse-power. It is intended to transport a man and carry an amount of fuel sufficient for six hours' operation. According to M. Léger, its dimensions as compared with those of other flying machines will be rather moderate.

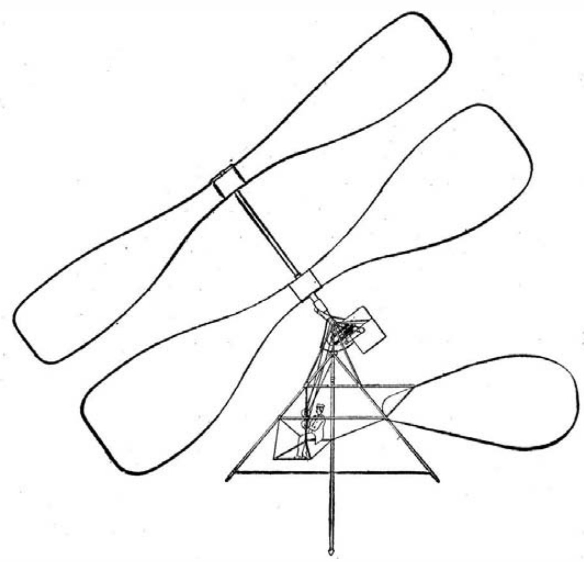
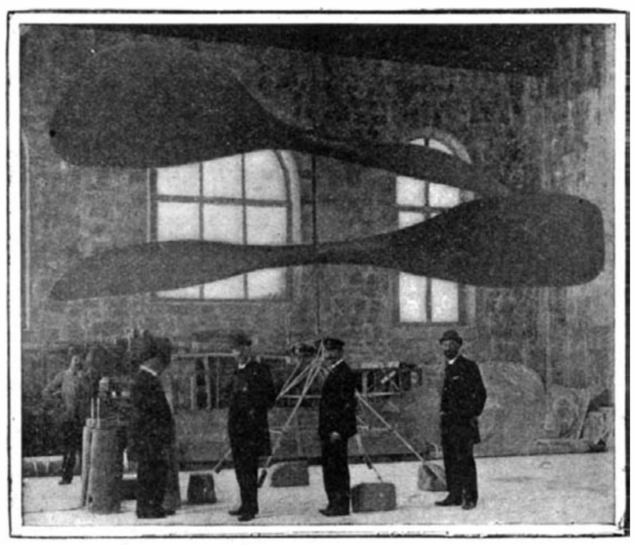
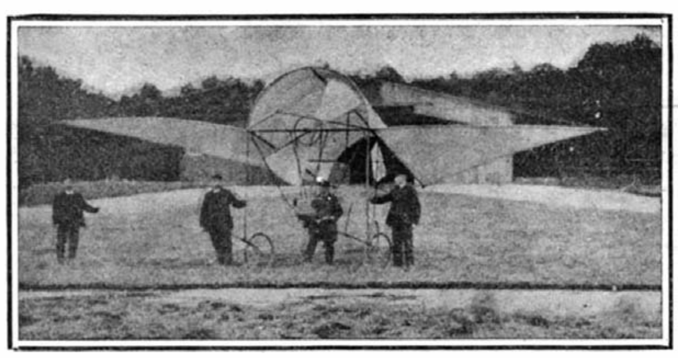


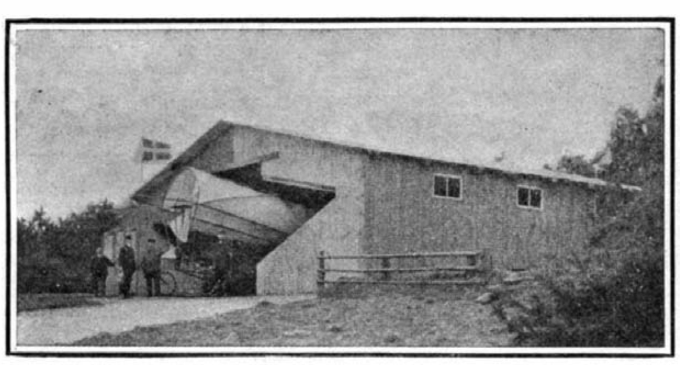
Diagram of Leger's Helicopter.



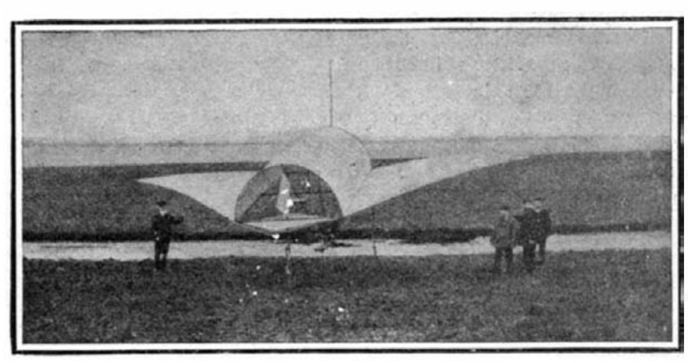
The Oppositely-Revolving Propellers of the Helicopter.



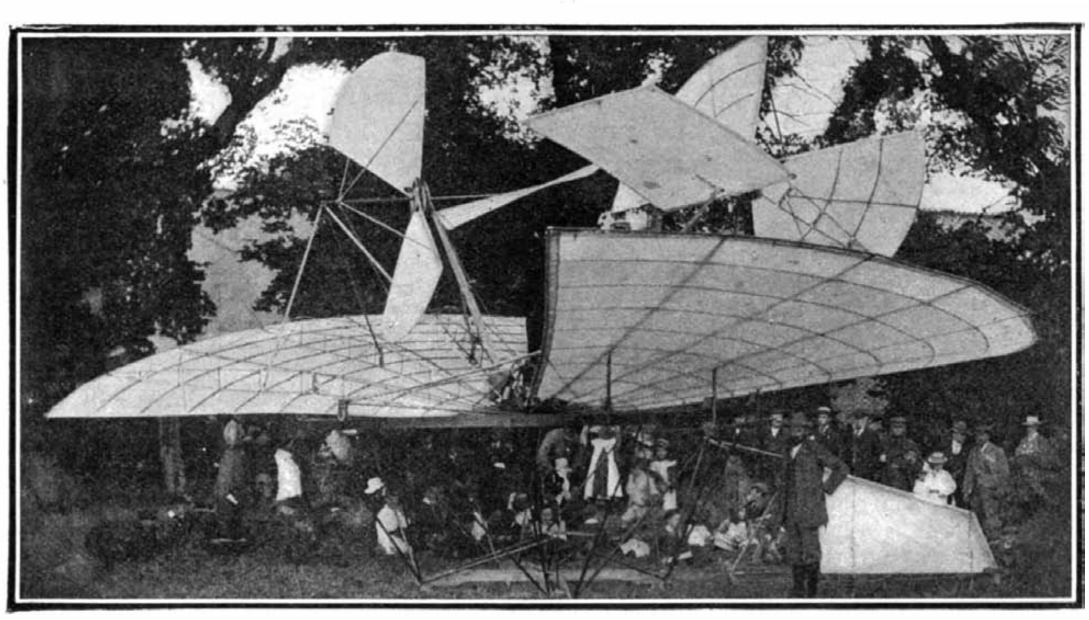
Front View of a Danish Aeroplane.



The Aeroplane Leaving Its Shed.



Rear of Aeroplane, Showing Rudders.



An English Machine Consisting of Revolving Wings Driven by Propellers.

RECENT FLYING MACHINES OF THE HEAVIER-THAN-AIR TYPE.

Trade of the United States with Europe.

Europe takes two-thirds of the exports of the United States and supplies practically one-half of the imports. This statement summarizes the facts which have been developed by a series of discussions of the trade of the United States with the countries of Europe recently presented by the Department of Commerce and Labor through its Bureau of Statistics. These discussions have presented an analysis of the trade with each country of Europe by principal articles, and when summarized show that Europe takes more than a billion dollars' worth of the exports from the United States, while all other parts of the world take a little less than a half billion dollars' worth. In no year since 1899 has the value of exports to Europe fallen below one billion dollars, while that to all other countries has never touched the 500 million dollar mark. Prior to 1900 the exports to Europe had never been as much as one billion dollars in value; in that year they crossed the billion dollar line, being 1,040 millions, and have since that time averaged about 1,050 millions per annum. In 1900 the exports to all sections of the world other than Europe were 354 million dollars in value, but have grown year by year until in 1905 they were 498 millions, the growth since 1900 in exports to the non-European countries having been proportionately greater than that to Europe.

On the import side, Europe supplies, as already indicated, about one-half of the merchandise brought into the United States. Prior to 1890 the share of the imports drawn from Europe averaged about 55 per cent; after 1890 the average was a little more than 50 per cent; in 1905 it was 48.4 per cent. This reduction in the percentage of the imports drawn from Europe is apparently accounted for by the growing demand in the United States for tropical and subtropical products which are supplied almost exclusively by the other grand divisions of the world. The value of tropical and subtropical products brought into the United States in 1905 was 508 million dollars, against 303 millions in 1895 and 218 millions in 1885. Most of this class of imports comes, of course, from the non-European sections of the world; much of it from South America, especially coffee and India rubber; much of it from the southern part of North America, especially sugar, sisal, and tropical fruits; a considerable part from Asia, including tea, raw silk, and spices, while Oceania contributes sugar, spices, cocoa, and other products of this character, and Africa Egyptian cotton, India rubber, hides and skins, and a small supply of sugar.

The trade of the United States with Europe is composed on the import side chiefly of manufactures and materials for use in manufacturing; on the export side of food stuffs, manufacturers' materials, and manufactures. The manufactures imported from Europe are chiefly the higher grades of cotton, silk, and wool fabrics into which labor, and in many cases hand labor, largely enters; while chemicals, certain grades of iron and steel manufactures, toys, wines, china and porcelains, cut and plate glass, and other articles of this kind contribute largely to the grand total. In addition to this, however, there are imported from the European countries certain articles the product of their respective colonial possessions, including India rubber, fibers, tobacco, hides and skins, wool, tin, raw silk, diamonds, and various tropical and subtropical productions. The articles exported to Europe are chiefly breadstuffs, meats and live cattle, and fruits, for food; raw cotton for use in manufacturing, and a variety of manufactures, including copper in pigs, bars, and ingots, mineral oil, agricultural implements, boots and shoes, manufactures of wood, oil cake, cotton-seed oil, vegetable oils, naval stores, and various manufactures of iron and steel.

Of the 1,021 million dollars' worth of merchandise sent to Europe in 1905, 239 millions was manufactures, the other 782 million dollars' worth being largely food stuffs and manufacturers' materials. With the growing tendency of our steadily increasing population to consume at home a larger share of the food stuffs produced in the United States, and to increase the consumption by our own factories, the supply which can be spared for Europe is decreasing rather than increasing, and as a consequence the percentage of exports sent to Europe is slowly decreasing.

Prior to 1887 the share of our total exports sent to Europe was over 80 per cent; since that time the percentage has gradually fallen until it reached 72 per cent in 1902, and in 1905 was but 67.23 per cent of the total, while the share of the exports taken by those grand divisions to which the exports are chiefly manufactures shows an increased percentage in 1905 compared with 1904.

A NEW FRENCH COMPOUND LOCOMOTIVE.

BY FRANK C. PERKINS.

The powerful tank locomotive herewith illustrated has recently been constructed and placed in operation by the Compagnie du Chemin de Fer du Nord. It has two sets of six-coupled driving wheels, one set in front and the other at the rear, with two bogie wheels connected with each truck, one pair following the six forward drivers and the other pair on the rear truck leading the six rear drivers. Each set of eight wheels is carried in its own separate swiveling truck. There are two separate sets of tanks for water and fuel, one located over the forward driving wheels, and the other over the rear drivers and inclosed with a cab as noted in the illustration.

This locomotive is of considerable length, measuring 16.186 meters over all and including the bumpers. The total heighth of the locomotive is 4.22 meters and the total width 2.874 meters. The following interesting data as well as the drawing and photograph was furnished by G. Du Bousquet, l'ingenieur en chef du materiel et de la traction of the La Chapelle works of the Chemin de Fer du Nord.

This locomotive has a boiler with 130 tubes, each 4.75 meters in length and of an external diameter of 70 millimeters. The total heating surface of the boiler is 244.55 square meters, of which 234.56 square meters represents the heating surface of the tubes.

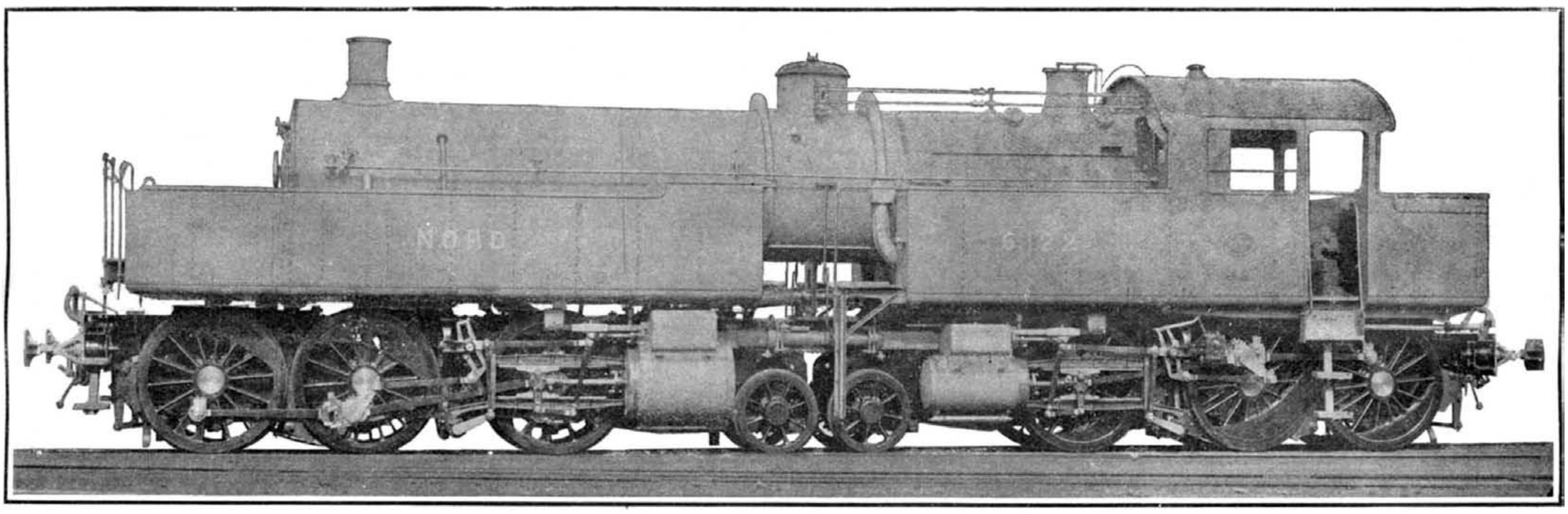
The grate is 2.54 meters in length and 1.186 meters in width, giving a total grate area of about 3 square meters. The steam pressure is said to be 16 kilogrammes per square centimeter for this boiler, with a maximum steam pressure of 6.5 kilogrammes per square centimeter for the low-pressure cylinders. The boiler shell has a diameter of 1.456 meters and is constructed of steel plate 17 millimeters in thickness. It is mounted 2.8 meters above the rail. The steel frames are more than 12 meters long and are spaced 1.142 meters apart.

The high-pressure cylinders are 400 millimeters in diameter and the low-pressure cylinders are 630 millimeters in diameter, the piston stroke in each case being 680 millimeters. The diameter of the six driving wheels is 1.455 meters, while 0.850 meter represents the diameter of the four bogie wheels. The total wheel base of each truck or the distance from the center of the bogie wheel axle to the last driving wheel axle is 5.795 meters, while the total wheel base of this tank engine is 12.59 meters.

The total weight of this French engine empty is 81.482 tons, while its weight complete with water and fuel ready for operation is 105.43 tons. The total adhesive weight of the locomotive complete is 88.93 tons and it has a maximum effort when working as a compound engine of 18,607 kilogrammes with an increased tractive effort of 24,064 kilogrammes with a direct admission of steam at high pressure in the large or low-pressure cylinders. The coal bunkers are capable of holding five tons of fuel, and the capacity of the water tank is 12.8 tons of water.

The method of carrying the steam from the boiler to the cylinders on the swiveling trucks and from the trucks back to the smoke box is as follows: The steam pipe runs from the steam dome down to a swivel joint arranged vertically over the king-pin of the truck with its axle in line with the king-pin. Thence it is led to the high-pressure cylinders, from which it passes to the low-pressure cylinders through a length of flexible coupling. The exhaust is led to the smoke box through a swivel joint in the center of the low-pressure cylinder truck.

Provision is made for supplying both the high-pressure cylinders and also the low-pressure cylinders with high-pressure steam when found necessary, in starting heavy loads or on heavy grades when increased power is found desirable. In this case the engine operates as a simple locomotive with four cylinders.



A NEW FRENCH MALLET COMPOUND LOCOMOTIVE.

Total heating surface, 2,361 square feet. Steam pressure, 228 pounds. Cylinders: High-pressure, 16 inches, low-pressure, 25 inches diameter, by 27 inches stroke. Weight, 105.4 tons.

Opening of Broadway Extension to Harlem River.

The final section of the new subway at the extreme north end of Manhattan Island to the south bank of the improved Harlem River or ship canal was completed and put into operation on March 12, with the exception of two deep underground stations located at 168th and 181st Streets. These are 100 and 125 feet below the surface at Washington Heights, and are connected by electric elevators in shafts sunk through solid rock; no stops will be made there until they are finished, which is promised at an early date. The shafts are 15 feet by 32 feet in size. The size of the stations cut in the rock are 320 feet long, by 73 feet wide at the shafts, but narrower at each side sufficient for platform space. Trains are now run from the Battery at the extreme south end of the island to the 157th Street station, there a transfer is made to the train running over the extension to Harlem River and King's Bridge every eleven minutes. When all the stations are completed it is expected trains will be run through without transfer. A person is now able to have quick transit from one end of the island to the other for the moderate fare of five cents, a certainty which but a very few years ago seemed like a visionary dream.

The first elevated structure of the Broadway section of the subway is in the neighborhood of West 125th Street, over what is known as Manhattan Valley. The road then runs underground under Broadway or King's Bridge Road to 169th Street thence north in a straight line under St. Nicholas Avenue and Washington Heights to 199th Street, where it emerges from the hill on to the second elevated structure, comprising three tracks over what is known as the Inwood Valley to 218th Street station located on the south bank of the Harlem River and opposite the south end of the drawbridge over the river at this point.

It is expected a new double-decked drawbridge will supplant the present one by which the road can be carried over the Harlem and the tracks of the New York Central and Hudson River Railroad now running along its northern bank, up under Broadway to Yonkers. It has taken five and a half years to complete this section.

A most charming and desirable residential section of the city will thus have convenient and frequent transit to all other business sections.

Rush Paper.

Very little paper has been made of late years from rags. Vegetable substances are employed, as alfa, wood, and straw; the idea has not prevailed that the wild or cultivated rush can be employed for this purpose. But an inventor has ascertained that, when suitably treated, the plant will produce a very white and consistent paper pulp by means of the following treatment: 1,000 kilogrammes of the green rush, cut up as fine as possible, is mingled with a caustic lye of 30 deg. B., and boiled in an autoclave for five or six hours under a pressure of 6 kilogrammes at 170 deg. C. The pulp is washed with water, sulphuric acid in suitable quantity added, then bleached with chloride of lime and washed energetically. It is then suitable for employment in the manufacture of paper.—Le Papier.

HOW SHINGLES ARE MADE.

BY DAY ALLEN WILLEY.

Although over $20,000,000 worth of shingles are manufactured in the United States yearly, this portion of the timber industry is perhaps least known of the several divisions into which the products of the forest enter, partly for the reason that the making of shingles, especially in the eastern part of the country, is usually carried on in connection with the ordinary sawmill. In fact, the making of shingles is classed as a part of the sawmill industry, but in the States which produce the greater proportion of the shingles, one finds very large plants devoted to shingle making entirely.

As everyone knows, hemlock, cypress, and white pine are used extensively for roofing purposes. Cedar, however, is employed to such an extent that over half of the shingles annually cut in the United States are of this wood, the output of white pine shingles representing about $3,500,000 in value and the cypress $3,000,000, nearly all of the remainder being contributed by hemlock, which is used widely in the East. As cedar forms such a large proportion of the forest growth of Oregon and Washington, we find in these States the majority of the mills devoted entirely to making shingles. They secure the raw material usually in the form of "bolts"—logs which have been cut to the exact length of the shingles desired, so that it is only necessary to split the bolt into the requisite thicknesses and finish the sections for commercial purposes. As a rule, the mills are located in the vicinity of woodland which has been stripped of the first growth.

As is well known, the custom prevails in the Northwest in cutting large trees of making the necessary incision anywhere from 6 feet to 10 feet above the ground, as the felling can be done with more safety and less difficulty. Consequently, a single stump of a tree 5 feet or 6 feet in diameter will cut into a surprisingly large number of shingles if it is sound in the heart. The bolts are made with cross-cut saws operated by hand, or portable saws driven by engines mounted on trucks belted to mechanism especially designed for this class of work. As the lengths into which the stumps or trunks are cut make them of a size which can be readily handled, the use of a tramway or skidway is unnecessary, and frequently advantage is taken of some watercourse to construct a flume of suitable dimensions. This consists merely of a conduit of planks supported at various distances from the surface according to the grades to be overcome. The water may be secured from a spring or creek on the hillside, although at times it is diverted from a larger stream by damming the latter, the fall of water in the flume being sufficient to carry the bolts to the mill.

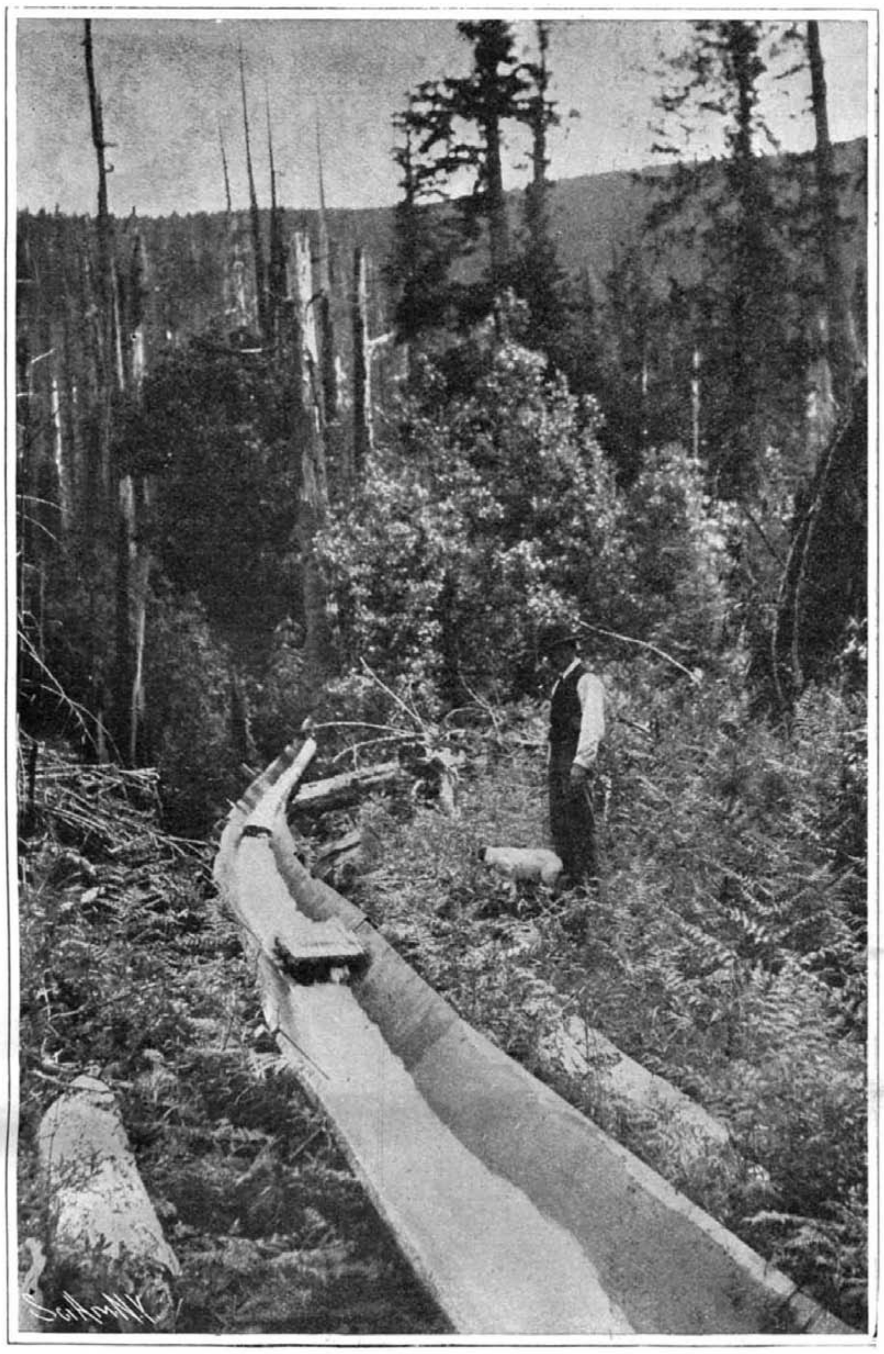
Some of the flumes in Washington are ten and twelve miles in length. As fast as the timber is removed they are extended through the tracts where the bolt cutters are operating, since it is only necessary to place the bolts in the flume and thus transport them directly to the mill pond. The cost of building the flume is so small, that this novel method of transportation is generally the most economical by far. But a small amount of water is required, as the cedar is so light that it will float in a very shallow depth. At the mill end of the conduit it enters a pond, where it is kept in a boom like the ordinary sawlogs until required.

The shingle mill, like the sawmill, is provided with an inclined way leading into the water. This is fitted with an endless conveyer, upon which the bolts are guided by the "bolt puncher," as he is termed. Leaving the conveyer, they are taken by hand or by another conveyer to the cutting machinery, and there reduced to shingles. In the shingle mill itself this mechanism is of two kinds. In one the bolt is sawed, while in the other the bolt is riven by means of a special cutter. Some of the larger shingle-riving machines are provided with a series of knives which will split up ten bolts at once. They are nearly circular in form, and are fed by hand from the top. Before the bolt is placed in the flume, as already stated, it is sawed to the proper length, just as logs are usually cut before leaving the woods, so that it is only necessary to run them through the band saw or circular saw to turn them into beams, planking, or other forms desired. The bolts from the larger trees are split to a size which will allow them to be placed in the bolt cutter before being taken to the mill, so that the shingle-making machinery can be operated continually if desired.

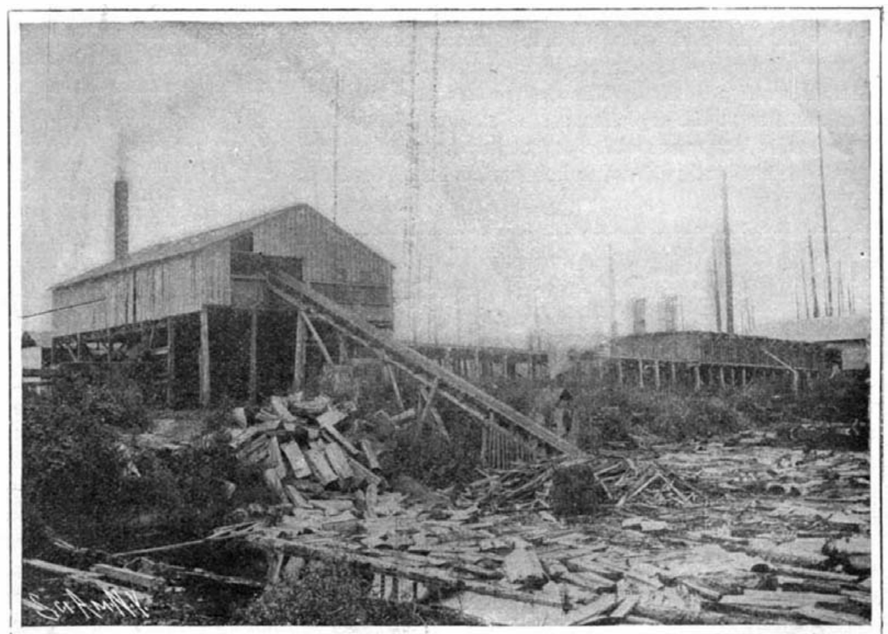
The standard size shingle used in the United States is 6 inches in width by about 18 inches in length. Consequently, the majority of the riving machines are designed to turn out shingles of these dimensions, but in addition a shingle jointer, as it is termed, is frequently used to trim off the rough edges when it is necessary to perform this work.

The most important centers of the shingle industry of America are the towns of Ballard, on Puget Sound, and Vancouver, on the lower Columbia River, as each is located adjacent to an enormous supply of raw material. At Tacoma as well as Seattle large mills are also in operation, devoted to the production of this form of lumber, working on cedar almost entirely. A better idea of the magnitude of this industry in the State of Washington can be gained, when it is known that the State produces fully forty per cent of the material manufactured in the United States. Frequently entire shiploads of cedar shingles are exported from Puget Sound, owing to the very extensive foreign demand, not only for roofing, but for other purposes.

The shingle industry is of great importance from the standpoint of forestry, as it has prevented the loss of a very large quantity of valuable timber. It is calculated that actually less than one-half of the timber value of the average tree in Washington and Oregon is converted into planking and commercial lumber, owing to the wasteful methods which are employed in felling the forest. The development of the shingle industry has utilized much of the material which would otherwise decay, but the area which has been stripped of first-growth trees is so extensive, that twice the present number of shingle mills could be located in this section of the Northwest, and find ample material for their needs. In addition to the stumps, however, small trunks are also cut into bolts, where the diameter of the tree is of a size which will allow it to be split without too much waste. Therefore considerable timber which is considered too small for planking and logs is utilized for shingles.



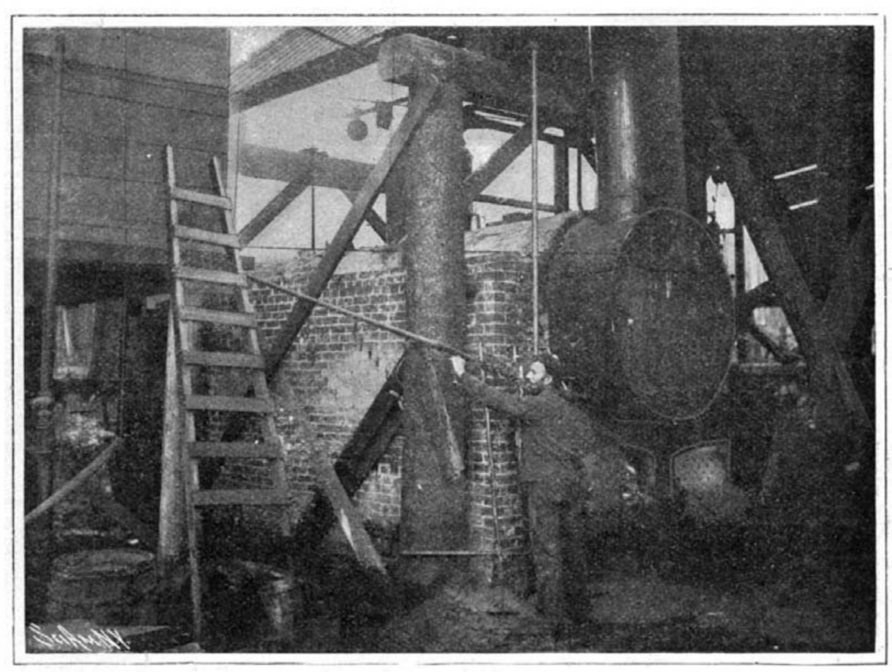
Shooting Bolts Down a Flume to the Mill.



Shingle Mill and Pond.

Hauling Out Logs to be Cut into Shingle Lengths.

A Shingle Cutter Which Works on Ten Bolts at Once.



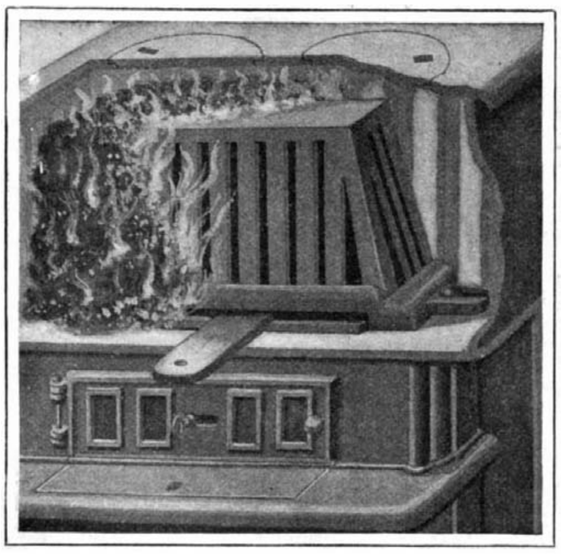
Shingle-Mill Boiler Fired Entirely with Sawdust from the Bolt Cutters.

HOW SHINGLES ARE MADE.

The Canadian Pacific Railroad Company has obtained authorization from the Dominion government to build another line through to Georgian Bay from Peterboro. This will give the company another terminal on the upper Canadian lakes.

AIR BOX FOR STOVES.

In the accompanying engraving we illustrate a novel device which is applicable to ranges, stoves, and open grates, and which aims to provide a better control of the draft than has heretofore been possible, thus effecting a saving in fuel. The device has the form of a box, smaller at the top than at the bottom. The rear of the box is left open, while the other three sides are formed of inclined walls provided with long vertical

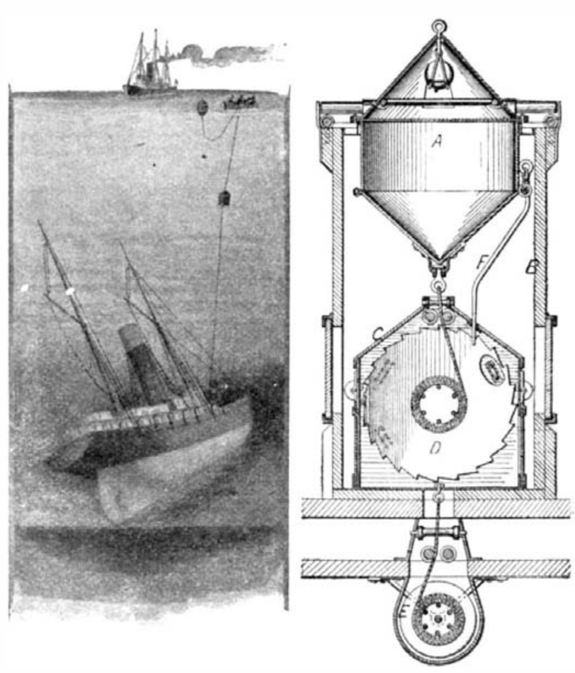


AIR BOX FOR STOVES.

apertures. The bottom of the box is provided with a sliding plate, the purpose of which will be presently explained. The air box, as the device is termed, is placed on the grate of a stove, to which it is secured by means of bolts. It thus takes up most of the space usually occupied by the fuel. The rear of the air box fits closely against the rear wall of the firebox, but a narrow space is left on the other three sides to receive the fuel. By this means the area of the fire is greatly increased, while the depth is reduced. Air passes up from the grate into the box and thence through the apertures to the fire. The plate at the bottom of the air box serves as a damper which can be moved in or out to control the amount of air fed to the fire. Owing to the shallowness of the fire and the general distribution of air, a perfect combustion of the fuel is assured. In proof of the value of the air box it is pointed out that there is a material reduction in the amount of smoke from a stove supplied with this device. The inventor of the air box is Miss B. J. Mouat, P. O. South Dunedin, New Zealand.

APPARATUS FOR MARKING SUNKEN VESSELS.

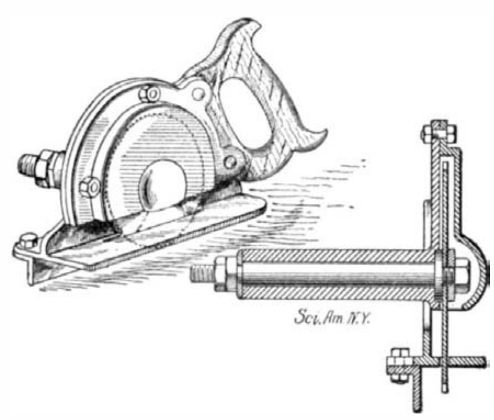
An apparatus for marking sunken vessels and enabling the immediate recovery of the principal valuables of a ship, has just been invented by Mr. Frederick W. Johnson, of 418 Jefferson Street, Seattle, Washington. The apparatus comprises a buoy connected with the vessel and adapted to rise to the surface as the vessel sinks. The buoy is provided with a bell which is adapted to ring as the buoy works in a seaway. The buoy is connected by a line to the strong-box of a ship and this box is, in turn, connected by a reel to the ship. Should the ship sink, the buoy would immediately rise to the surface to mark the spot and the bell in the buoy would be sounded by the waves. Then by hauling up on the buoy line the strong-box would be raised to the surface and the ship's papers, specie, invoices, accounts, etc., would be immediately recovered. The line connecting the box with the ship can now be detached and secured to the buoy to mark the spot for further salvage operations. In the accompanying engraving one of the views is a section through the buoy and the strong-box. The buoy, which is indicated at *A*, rests on top of a housing, *B*, built on that part of the deck house occupied as the purser's office. The strong-box, which is indicated at *C*, is connected by a line with the buoy. Rollers are mounted at the top of the housing to prevent the line from catching when the vessel sinks. The reel carrying this line is provided with a ratchet wheel, *D*, the teeth of which are engaged by a rod, *F*, depending from the buoy, and which prevent uncoiling of the reel while the buoy rests in the housing. The strong-box is also provided with anti-friction rollers at all sides to permit easy removal from the housing. The line connecting the box with the ship is wound on the reel, *E*. The bell in the buoy consists of a ring which is adapted to be struck by a ball. Clips projecting from the annular bell serve to throw off the ball and prevent it from rolling noiselessly around the ring. This ball is normally suspended in a sling at the top of the buoy, but is released by a cord when the buoy rises from the housing. In order to hold the buoy level in a seaway and prevent it from toppling over a short piece of cable may be tied to the swivel ring at the top of the buoy and be secured to the main cable about three feet below the buoy.



APPARATUS FOR MARKING SUNKEN VESSELS.

ODDITIES IN INVENTIONS.

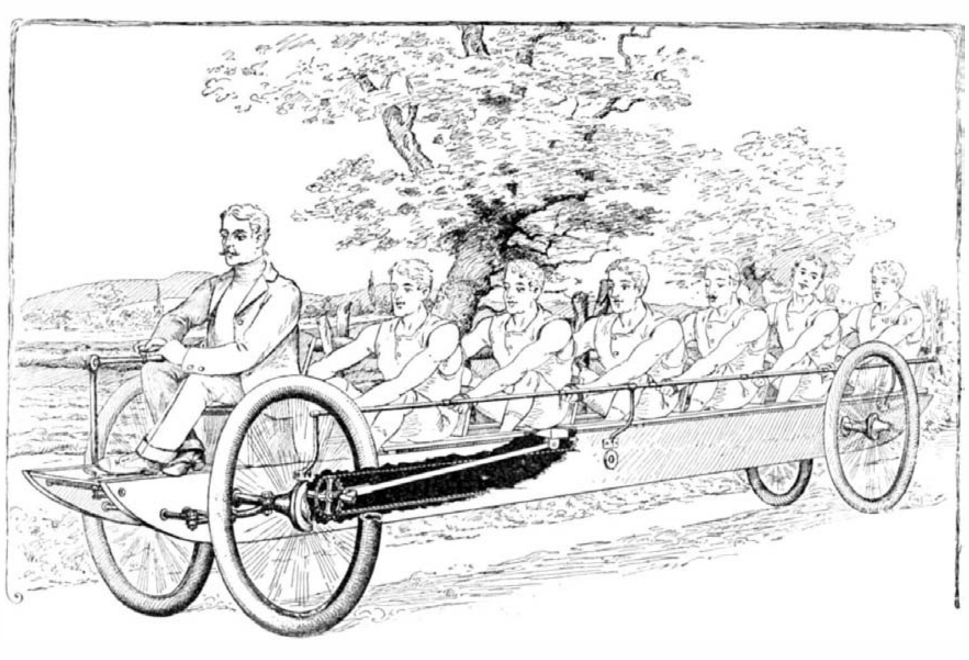
A Portable Rotary Hand-Saw.—A patent has re-



A PORTABLE ROTARY HAND-SAW.

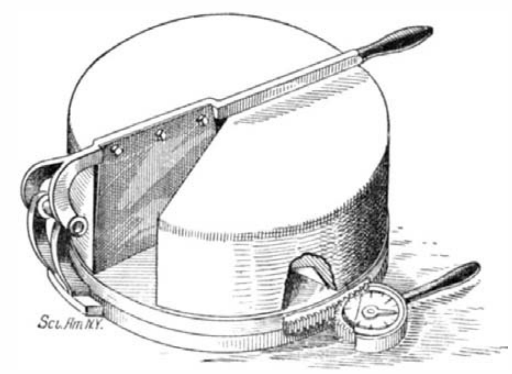
cently been secured on a portable hand-saw with revolving blade. This saw may be used for cutting grooves of any desired depth in places where an ordinary saw cannot be conveniently used, for example, in cutting grooves in window sills for various kinds of weather strips or for cutting grooves in floors at the lower end of a partition. The saw is secured by a nut to the end of an axle which is mounted to turn in a suitable hub. Secured to the hub is a guard which covers the saw. To this guard a handle is attached. The guard is adjustably mounted on a bracket by means of bolts engaging slots therein and thus permitting the saw to be set for the desired depth of cut. As a means for revolving the saw the inventor proposes to use a small electric motor mounted on the device and coupled to the axle.

An Overland Rowing Shell.—Boat racing, while a very interesting and exciting sport, is limited to a few schools and colleges, which are favorably located near large bodies of water. For the benefit of unfortunately-situated institutions, an inventor has designed the rowing vehicle, which we illustrate herewith. On it a crew may develop rowing muscles, and learn to keep stroke without going near the water. A rail extends along each side of the vehicle, to which straps are attached. By alternately pulling on these straps and pushing back against foot braces, the movable seats are given a reciprocating motion, which is employed to operate the driving mechanism and propel the vehicle. Although this vehicle is not of much value as a training for rowing on water, as it does not teach a man how to handle an oar, yet it might, with advantage, be used for land boat races between competing colleges.



AN OVERLAND ROWING SHELL.

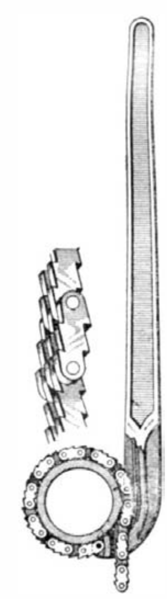
Computing Cheese Cutter.—A novel device for cutting cheese has recently been invented. The device comprises a simple computing mechanism whereby it is possible to gage the exact size of slice that should be cut for a certain price. The cutter is journaled



COMPUTING CHEESE CUTTER.

to a fixed base on which a revolving table is mounted. The cheese is carried on this table and is revolved by means of a pinion engaging teeth formed on the periphery of the table. The pinion is provided with a pointer which moves therewith over a graduated disk and indicates the length of the arc through which the cheese is turned. Different disks are provided for cheeses of different price or weight and these disks can be readily placed on the indicator. Each disk is graduated for five-cent slices, thus for a $3 cheese in which there would be sixty five-cent pieces, a disk would be selected which would indicate arcs of six degrees of the revolving table. Owing to the gearing the pinion would have to be turned through thirty degrees to effect a six-degree movement of the table, thus insuring great accuracy in cutting the pieces to the proper size.

Chain Wrench.—A resident of Milwaukee has invented a chain wrench which is an improvement on previous inventions along this line. In the ordinary type of chain wrench the fixed head is formed with teeth and thus only one or two teeth actively engage the pipe or cylinder on which the wrench is used. In another common type of wrench the head is bifurcated, each furcate member being formed with gripping teeth and the chain being pivoted between them. This makes the head too wide for use on short pipe-fittings, flanges, elbows, and the like. In the present invention the head is not serrated but the chain used is provided with teeth; thus the number of teeth gripping a pipe is proportional to the surface of the pipe. At the bottom of the recess in which the chain is received a strip of rubber is placed and this is protected by a thin metal covering. The purpose of this resilient lining of the recess is to avoid too great a pressure on the links of the chain and permit the sides of the recess to take a portion of the strain.



IMPROVED CHAIN WRENCH.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HAT-FASTENER.—S. M. JOHNSTONE, New York, N. Y. The principal object of the invention is to provide simple and effective means for attaching a hat-fastener to a hat in such a way that it always remains upon the hat and does not have to be removed each time the hat is taken off, but at the same time can be removed, if desired, in order to secure it to another hat.

TROUSERS-HANGER.—A. CHELBERG, New York, N. Y. Hangers as heretofore constructed have been either too complicated for general use or have failed to provide means for supporting the garments in a proper manner. The principal objects of the invention are to construct a hanger in such a manner that although the trousers can be held in natural and proper position, yet the construction will be simple and there will be few parts liable to get out of order.

Electrical Devices.

PANEL-BOARD.—E. R. LEMANQUAIS, New York, N. Y. Each section of the sectional panel-board may be used independently, if desired, and the sections may be combined in any number, so as to make up a panel-board of any desired size. The devices for holding the fuses are improved so that the latter may be securely held with proper electrical contact and yet removable at will without danger to the operator. The board minimizes the danger of shocking persons operating or adjusting the same.

Of General Interest.

BALANCED SUCTION AND FORCE PUMP.—P. H. J. PAINDAVOINE and P. A. PAINDAVOINE-DUFOUR, Les Fontanettes à la Chapelle aux Pots, Oise, France. In this patent the invention has for its object a suction and force pump in which the effort required for operating it is distributed and rendered uniform, thus rendering its running exceedingly easy, so that far less fatigue is occasioned than would be necessary for operating under the same working conditions an ordinary suction and force pump.

CANDLESTICK. — J. KINDELAN, Leadville, Col. This readily adjusted miner's candlestick comprises a body portion consisting of a single length of spring-steel bent to form a loop terminating in segmented portions; a spike extended from one of the segmental portions; a hook on one of the segmented portions and segmental plates secured to the said portions.

VALVE.—C. E. SIMPSON, Portsmouth, Ohio. The more particular object of the inventor is to produce a valve that will prevent scale or foreign substances from being caught on the valve-seat as the valve is being closed, thereby preventing the injury often done by scale being crushed on or imbedded in the valve-seat or preventing the valve from entirely closing because of the obstruction having caught between the closing parts.

WORKING BARREL FOR OIL AND OTHER PUMPS.—W. H. WESTERMAN, Marietta, Ohio. The object in this case is to produce a working barrel which is now usually made of brass, iron, or steel that will combine the advantages of iron, steel, and brass, that will be cheaper and stronger than ordinary barrels, and one in which the cups or valves can be readily inserted without sticking and one in which the ends will not be crushed in when coupled with another section of pipe or barrel.

HOSE-CLAMP. — J. E. JOHNSON, New Paynesville, Minn. The invention is an improvement in that class of clamps that comprise a band and pivoted cam, which is permanently secured to one end of said band and adapted for detachable engagement with the other, the construction being such that in the closed position the cam holds the band drawn tightly around the hose.

DIRT-SCRAPER.—J. HARTER, Tiffin, Ohio. In this case the invention has reference particularly to improvements in dirt-scrapers for road and field work, the object of the inventor being the provision of a scraper of simple and novel construction and operating to thoroughly harrow or break up the dirt of a road or field and then smooth the same.

ROLL-PAPER HOLDER AND CUTTER.—J. F. FINAN, Cumberland, Md. The invention is in the nature of a paper-holder and cutter for holding upon a store-counter or elsewhere a roll of paper from which sheets of varying size may be cut off at will to suit the size of package to be put up. It is an improvement upon the device for which Mr. Finan was formerly allowed a patent.

Household Utilities.

TRAP FOR SINKS, BATH-TUBS, AND THE LIKE.—A. SAVARD, Omaha, Neb. In its practical entirety this trap forms an integral part of the sink, bath-tub, or wash-basin with which it may be associated. It is easy of access for the purposes of cleansing or emptying accumulated contents and possesses the capacity for long and repeated service. The invention refers more especially to traps for sinks, bath-tubs, wash-basins, and the like, pertaining generally to the type of such devices forming the subject of Letters Patent formerly granted to Mr. Savard.

CRIB.—W. W. GRIGSBY, New Orleans, La. The invention relates, more definitely stated, to crib attachments to bedsteads, and has for its object an improved attachment of this character, adapted for ready attachment and detachment, and adapted when detached to be folded into compact condition facilitating its being shoved under the bedstead or stored away ready for use.

WINDOW-FASTENER. — R. G. FRASER, Philadelphia, Pa. Mr. Fraser's invention pertains to window-fasteners, his more particular object being the production of a simple, efficient, and reliable fastener capable of locking the upper and lower sashes in any desired position and offering certain constructional advantages, such as the prevention of windows rattling or any movement between the upper and lower sashes until desired.

Machines and Mechanical Devices.

MICROMETRICAL ADJUSTMENT FOR PRINTING-FILM FRAMES.—B. DAY, West Hoboken, N. J. Mr. Day's invention relates to the accurate hinging and holding of a printing-film frame and its printing-film so that they can be raised, lowered, removed for inking, and replaced and yet fall on the work in exactly their original positions, also to devices whereby subsequent prints from the same printing-film printed over or alongside the first print, can be manipulated with accuracy and the manipulation recorded for future reference. Many features of this invention and especially those relating to adjustment, can be operated in connection with Mr. Day's Weighted Hold-Fast, which is already patented.

LOOM-SHUTTLE.—W. H. WILSON, New Bedford, Mass. In this patent the invention relates to weaving; and its object is to provide a new and improved loom-shuttle having a spindle arranged to prevent undue wear and sidewise vibration and consequent breaking of the thread and to allow convenient renewal of a spindle-shank when broken or otherwise injured.

HEDGE-TRIMMING MACHINE.—R. SMITHERS, Nortonville, Kan. The objects of the improvement are to provide mechanism, first, to cut the top and side of hedge at the same time; second, for the proper adjustment of the sickles to cut either the top or the side separate; third, to raise or lower the horizontal sickle so that it can be adjusted to cut any height hedge while in motion; fourth, to facilitate vertical adjustment or the removal of the horizontal sickle; fifth, for adjusting the one end of the platform as may be required on inclined or uneven surfaces.

FILM-HOLDER FOR PICTURE-EXHIBITING MACHINES.—M. SMITH, Winnipeg, Canada. One purpose of the invention is to provide a film-holder for use in connection with picture-exhibiting machines, which will be readily operated and in which imperforate films can be used, thus simplifying the operation and greatly adding to the lifetime of the films.

WASHING-MACHINE.—H. F. PFLUM, New York, N. Y. A principal object of the invention is to produce a machine the construction of which especially adapts it for portability and enables the machine to be readily detached or attached in operative position. A construction has been adopted also which enables the principal part of the device to be thrown to one side, so as to facilitate the attachment of a wringer in the position normally occupied by the same. It relates especially to that class which may be operated by hand.

BLINDSTITCHING SEWING-MACHINE.—F. HERMAN, Lincoln, Neb. The object of the invention is to provide an attachment whereby blindstitching may be effected, with a greater degree of perfection and reliability than heretofore. The attachment is secured to the bed-plate and head of an ordinary sewing-machine, preferably such as is employed for manufacturing purposes rather than of the domestic class, and but little modification of the sewing-machine proper is required.

Medical Appliances.

TOILET ARTICLE.—F. A. STEELE, New Rochelle, N. Y. In its preferred embodiment the invention comprises a packing of paper having on one side a mass of absorbent material—to wit, cotton-batting covered by a woolen fabric. Preferably both the paper and the absorbent material are medicated, so that when dampened the medicines will act on the anus, thus exerting a curative effect at the same time cleansing the parts.

HYPODERMIC SYRINGE.—J. W. HORNER, Columbus, Ind. Mr. Horner's invention consists of a novel form of the ordinary hypodermic syringe designed to secure a tight fit of the piston in the syringe-barrel without risk of accidental loosening of the piston and by a very simple and practical construction. One modification of the invention gives a syringe of such compact form when closed as to be especially well adapted to the limits of the small case forming a physician's outfit.

Railways and Their Accessories.

RAILWAY-CAR TRUCK.—G. C. STEWART, Marengo, Ind. The object of the inventor is to provide details of construction for a car-truck that will counteract the lateral yielding movement of the car-body on its spring-supports, either forward, rearward, or sidewise, and by cushioning such a lurching movement obviate in a large degree the objectionable jerking motion incidental to the operation of cars having running-gear of ordinary construction. It more particularly relates to trucks of running-gears for street-railway cars propelled by motors actuated by electricity.

APPLIANCE FOR CAR-COUPLINGS.—P. W. HOGAN, Durand, Mich. Mr. Hogan employs an appliance comprising a hood or bonnet to adapt the appliance to be readily fitted in place over one of the heads of a coupling between the cars in the event of breakage of some part of the head—say, for instance, the usual knuckle carried thereby—combined with which head or bonnet is a knuckle to take the place of the one broken, means being also employed for securing the appliance in position for effective operation.

Pertaining to Vehicles.

CHECKREIN-FASTENER.—C. W. BARRETT, Hanford, Cal. The invention has reference to improvements in devices to prevent accidental detachment of a checkrein from a check-hook, the object being to provide a fastening device that will be simple and inexpensive and that may be readily connected to any ordinary form of check-hook.

Designs.

DESIGN FOR A ROSARY.—B. TEUBNER, New York, N. Y. This rosary as designed is very ornamental and chaste. The medals containing the heads of saints at the usual intervals are well executed, the Lord's at the junction of the loop and the pendant suspending the crucifix being in the form of a heart.

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.

Inquiry No. 7958.—Wanted, makers of slot machines for vending water.

Inquiry No. 7959.—Wanted, a machine for engraving names, etc., on glassware.

Inquiry No. 7960.—For manufacturers of wire nail machines.

Inquiry No. 7961.—Wanted, parties to undertake the manufacture of 22-caliber round rifle barrels, 22 and 24 inches long, such as used on modern repeating rifles.

Inquiry No. 7962.—Wanted, a pump run by electric motor, an inch inlet and ¾ inch discharge, 16 feet suction, 40 feet raise, rotary; with motor ¼ h. p.

Inquiry No. 7963.—Wanted, manufacturers of dextrine.

Inquiry No. 7964.—Wanted, manufacturers of cardboard puzzles.

Inquiry No. 7965.—Wanted, balls of about 1 inch or 1¼ inches in diameter for static machine; also wire suitable for brushes; also rubber in sheets and rods for same machine.

Inquiry No. 7966.—For makers of wire bands (electrically welded).

Inquiry No. 7967.—Wanted, a machine or appliance for cutting out canvas gloves.

Inquiry No. 7968.—Wanted, makers of soap-molding machines.

Inquiry No. 7969.—Wanted, the name and address of the maker of the monarch wall paper trimmer.

Inquiry No. 7970.—Wanted, makers of translucid fiber, wire glass or other material for use in factory buildings.

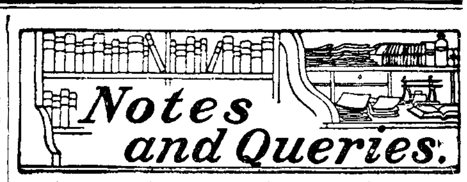
Inquiry No. 7971.—Wanted, parties to do enamel work of special kind.

Inquiry No. 7972.—Wanted, parties to make small steel castings in small quantities.

Inquiry No. 7973.—Wanted, information concerning the Braum-Viga calculating machine.

Inquiry No. 7974.—For parties making small castings, and who enamel them.

Inquiry No. 7975.—For makers of small castings cast in metal molds to exact size.



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.

(9917) V. P. says: A few weeks back I was a member of a party visiting a gold mine in Colorado. When descending the shaft we were told by operator that the elevator could be dropped faster than our bodies could fall down the shaft. A. The elevator could not fall faster than your body unless pulled down by some force other than gravity. The law of falling bodies is that the acceleration due to gravity is 32.16 feet per second.

Letting g = 32.16 feet per second in one second,

v = final velocity, or velocity at time of contact with the earth,

t = number seconds,

h = space in feet passed in t seconds,

then $v = gt$.

Thus, a body allowed to start falling from a point of rest, resistance of air neglected, falls 16.08 feet the first second. The acquired velocity is 32.16 feet per second. The distance fallen in two seconds would be $h = \frac{gt^2}{2} = 16.08 \times 4 = 64.32$ feet, and the acquired velocity is 64.32 feet per second. The increase in velocity in each second is constant, and is 32.16 feet per second. Thus,

$$v = gt = \frac{2h}{t}$$

(9918) H. H. asks: Is the specific gravity test of kerosene oil important with reference to its condition of purity? Is it important with reference to its lighting qualities? Is the so-called heat test of kerosene oil sufficient to prove its lighting qualities as well as its purity? Can adulteration, affecting the lighting quality of kerosene oil, be discovered by any other method than the specific gravity test? Will adulteration tend to lower or raise the so-called "flashing point" of kerosene oil? A. The specific gravity, or rather the Baumé test for kerosene, is an important test as regards its purity, but is only equal in importance with other tests which the oil has to withstand. There are many adulterants which could be used which would not change the specific gravity of the kerosene. The lighting qualities of kerosene depend, with equal importance, upon the "fire test," the "flashing point," the "viscosity," and the "specific gravity" of the oil. Adulterants can be used which raise the flash point or which lower the flash point. It all depends upon the kind of adulteration. As to the detection of adulteration in kerosene oil, we would say that it would be extremely difficult for one, other than an experienced oil chemist, to discover accurately the adulterant used, for in many cases pure kerosene will come far from the required tests and still contain no adulteration. One-half of one per cent of moisture in the oil could be easily detected from the cloudiness of the oil.

(9919) P. A. R. asks: Please send to my address any statistics you may have in back issues of your paper, in regard to the controversy which exists as to when the next year will come containing fifty-three Sundays. Some say that it will come in fifty years, others say in one hundred and ten years. A. The question when a year will contain 53 Sundays is not properly a subject of controversy. It can be decided by any one who will make a table of the years with care. Each common year contains 52 weeks and 1 day. Each common year then begins and ends on the same day of the week. Each leap year has 52 weeks and 2 days, and ends one day in the week later than it began. This is all which need to be known to settle the question. Now to begin, 1905 began and ended on Sunday, and so had 53 Sundays, 1906 begins and ends on Monday, and has 52 Sundays. 1907 begins and ends on Tuesday with 52 Sundays. 1908 begins on Wednesday, but as it is leap year it ends on Thursday, and 1909 begins and ends on Friday, while 1910 begins and ends on Saturday. All these have 52 Sundays. Now 1911 begins and ends on Sunday, and has 53 Sundays. This is six years later than 1905. The years of this century which will have 53 Sundays are 1905, 1911, 1922, 1928, 1933, 1939, 1950, 1956, 1961, 1967, 1978, 1984, 1989, 1995. It is seen that the differences are 5, 6, and 11 between the years of this series.

(9920) A. R. Van H. asks: 1. Will a four or a five inch spark of an induction coil penetrate a piece of glass or a piece of hard rubber 1/32 inch thick? If it will, will it penetrate the same, 1/16 inch thick? A. The electrical energy of a spark four inches long through the air would probably pierce a thin glass, or a piece of thin hard rubber. We have no figure for the thickness. The discharge points should be brought close to the glass on opposite sides, and the discharge be made as suddenly as possible. 2. I read in one of your papers of the number of pounds of water that flows over the Niagara Falls a second, but I cannot find it now. Would you please tell me the number? I think it was 213,000, but I am not sure. A. The commonly accepted volume of water passing over Niagara Falls is 224,000 cubic feet per second. This is 14,000,000 pounds per second. Falling 160 feet it gives about 7,000,000 horse-power continually.

(9921) H. M. asks: Does the buoyant or floating power of a tank filled with air vary in accordance with the depth to which the tank is submerged? For example: Would the lifting power of this tank be greater when the top of the tank would be one foot below the surface of the water than it would be if the top of the tank were ten feet below the surface of the water? If you could refer me to any literature which dwells on subjects of this kind, your kindness would be most highly appreciated. A. A tank closed airtight and submerged in water is buoyed up by the weight of the water it displaces, that is by amount equal to the weight of a volume of water which is the same as the volume of the tank. This is independent of the depth of submergence. If, however, the tank is open at the bottom, so that water enters it, its buoyant power decreases as it is sunk deeper into the water, since water enters and compresses the air into a smaller volume. The only point involved is the volume of water displaced. The principle is called Archimedes's principle, which may be found in any text-book of physics. Probably Kent's "Engineering Pocket Book," price $5, will give you the most assistance in matters of hydraulic engineering.

(9922) P. C. G. asks: Will you please describe to me just what is "denaturized" or "denaturalized" alcohol, that is now before Congress for entry free of duty? A. Denaturized alcohol is common alcohol to which some substance has been added to render it unsafe for its natural use; that is, if a small percentage of wood alcohol be added, the mixture is poisonous, and cannot be used for making any liquors for drinking, but it can still be used for mechanical purposes, or in the arts. There are other substances which may be added to alcohol with like effect. The word denaturized is not in the dictionaries as yet.

(9923) W. E. B. asks: In your issue of February 3, in an article headed "New Conceptions in Astronomy" by Prof. Edgar L. Larkin, he says: "A trillion is a million million." Webster's unabridged says: "A million million is a billion." Can Notes and Queries throw any light? A. You surely do not read your Webster as we read ours. Ours states under "Billion; according to the French and American method of numeration, a billion is a thousand millions, or 1,000,000,000; according to the English method, it is a million millions, or 1,000000,000000." The English method places six figures in each period; the French, three figures in a period. A trillion in a book published in England is 1,000000,000000,000000; in a French or American book a trillion is 1,000,000,000,000—only a millionth part of an English trillion. Prof. Larkin is an American and names numbers according to American custom. Webster's Dictionary, under "Numeration," states the matter clearly; so, also, does it under "Billion" and "Trillion." We follow the French or American method of writing and reading numbers.

(9924) A. C. asks: We had a discussion in our shop, and as we cannot try it I would like you to decide:. Weigh a tubful of water and then put in a 10-pound fish and if the fish does not touch the bottom will it weigh any more? A. If a fish alive or dead is put into a tub of water and no water runs over, the tub and fish will weigh as much more than the tub weighed before as the weight of the fish. That is because the fish is added to the contents of the tub. If a live fish is put into a tub entirely full of water and the fish floats in the water without resting any weight on the bottom of the tub, as much water in weight as the weight of the fish will flow over as the fish enters the water, and the tub, fish and remaining water will weigh the same as the tub and water weighed before the fish was put into the water. Every body submerged in a liquid is buoyed up by a force equal to the weight of the liquid displaced. If the fish sinks to the bottom and bears any part of its weight on the bottom of the tub, the tub will weigh more with the fish in it than it did before the fish was put into the tub. This last is, however, rarely if ever the case.

(9925) L. R. asks: What is the expansion of a zinc bar 40 inches long, during a variation of five degrees—say from 100 to 105 deg. F.? Is there any metal or alloy that will give a greater expansion? If so, what and how much? A. The expansion of a bar of zinc 40 inches long for a change of 5 deg. Fahrenheit is a trifle more than three ten-thousandths of an inch. Cadmium will expand slightly more than zinc, about in the ratio of 30 to 29.

(9926) R. T. asks: 1. How many amperes does a 110-volt incandescent lamp require? A. A 16-candle lamp at 110 volts takes about one-half an ampere. 2. What is the principle of a pedometer? A. A pedometer is moved by the rocking motion of the body in walking. It will register by the same motion when one is not walking. The motion of a rocking chair may make it run. 3. How long will a storage battery retain its full charge? A. A storage battery does not lose charge by leakage. So far as that goes the charge will be retained indefinitely.

(9927) G. A. R. asks: 1. A spark cannot be passed between two electrodes separated by a vacuum. Are we to infer from this that a vacuum is a perfect insulator? A. A perfect vacuum would be a perfect insulator. 2. The distance separating two particles can be halved. This second distance can then be halved and so on—according to mathematics, infinitely—which would require infinite time. Yet practically it can be accomplished in a finite time. How is this explained? A. It is quite true that mathematical zero cannot be reached by the successive division of a number by two, or by halving a certain space. But that need disturb no one. It is easy to reach a value less than any assignable value, and that is practically zero. Thus in the case of our money. When a sum has been halved successively till it is reduced to less than one mill, the process must end, since there is no denomination in which to express the value. Practically the problem you present is a logical quibble, of interest only to a mathematical quibbler. There ought always to be common sense back of logic, but unfortunately it is not always plainly visible.

(9928) A. A. F. asks: 1. How do they get this very low zero you speak of in February 10, 1906, No. 9887? A. Absolute zero is computed from the behavior of gases when cooled. Their contraction leads to the belief among scientific men that all heat would be gone from matter if it were cooled to 459 deg. F. below zero. 2. What is the lowest natural temperature known, and the lowest artificial cold yet produced? A. The lowest thermometer reading ever reported upon the earth is from a self-registering thermometer which was left for a number of years in the Arctic regions. It showed 95 deg. F. below zero. Previous to this the lowest observed was at a place in Siberia, 90 deg. F. below zero. 3. Please explain this: Haswell on page 879 asks: How many fifteens can be counted with four fives, operation

$$\frac{4 \times 3 \times 2 \times 1}{1 \times 2 \times 3} = \frac{24}{6} = 4.$$

A. The formula you give for fifteens to be made from four fives is the ordinary formula for combinations demonstrated in algebra. You will find it in any large algebra. 4. Why is it colder at the south pole than at the north? A. The southern hemisphere is largely covered with water, hence it is colder. The earth is farthest from the sun in July, which is the mid-summer month of the southern hemisphere. This makes the summer there a little colder than the northern summer.

(9929) E. H. asks: Would you kindly inform me where I could find a good description of Marconi's magnetic detector which is used in connection with a Wheatstone recorder? How are the inductance coils that are used in both the receiving and sending station wound and what size wire is used? What is the resistance of the choke coils used in the receiving circuits? A. You will find the Marconi magnetic detectors described in Maver's "Wireless Telegraphy," which we can send you for $2. Several sizes of choke coils are also described in the same book, as also are the induction coils.

(9930) J. D. writes: I have purchased some selenium for the purpose of making electro-light experiments, about which I have read so much in technical papers. I think it must go through some sort of a process before it can be used, for I find it to be a poor conductor of electricity. With a 1,000-ohm telephone ringer not the slightest effect is produced upon so delicate an apparatus as a telephone receiver. A. Selenium is not a conductor of electricity in any condition. It is a better conductor after it has been prepared than in the ordinary condition. It is kept for several hours at a temperature just below its melting point. It is then spread over the space between parallel wires, better wound upon a porcelain tube, so that the two wires are quite near together. When it has cooled it is in the sensitive state. The current sent from one wire to the other will be increased by allowing light to fall upon the selenium cell, as it is called. The resistance will be several hundred ohms probably at the lowest. We would advise you to apply to the professor of chemistry or physics at the University in your city. These men are always glad to give advice and assistance to others.

(9931) A. R. asks: Does a cannon ball fired from a cannon follow the tangent of the barrel a short distance after leaving the mouth of the cannon or does its path describe an arc with a diminishing radius beginning at the mouth of the cannon? A. A cannon ball becomes a falling body as soon as it clears the mouth of the gun, and falls in the same manner as far as distance and velocity is concerned as if it were to fall from rest with no forward motion. It does not follow the tangent of the barrel at all.

(9932) R. S. McF. asks: Would you kindly explain how I could use a 100-volt induction motor on a 110-volt current? I tried one way by connecting a 10-volt lamp in series with it, but had no satisfaction. A. A small resistance coil placed in series with your motor will take up the extra ten volts and enable the motor to run with safety. The wire must be of a size which will carry the current without heating too much. The small lamp you used was not able to carry the current required. Its filament had too high a resistance to allow current enough to flow for the motor, and so the motor did not get current enough to turn it.

(9933) C. W. asks: In your issue of February 10, 1906, page 137, Notes and Queries (No. 9887), you state that absolute zero is —459 deg. Is it a fact that scientists have accepted this as absolute zero? On what is it based? How was it determined? and how is it measured? What does absolute zero mean? Is it a condition of temperature at which no heat whatever exists or is radiated? A. It may be positively stated that all modern scientists accept 273 deg. C as absolute zero, or the temperature at which molecular motion would cease, all heat would be gone from matter. Astronomers believe that this is the temperature of the spaces outside of the earth's atmosphere. The degree we gave, —459 deg. F, is the Fahrenheit equivalent of —273 deg. C. The idea of absolute zero is based upon the fact that all gases at the freezing point of water expand and contract by the same amount if the temperature is changed one degree and this amount is 1/273 of their volume if the temperature is changed one degree Centigrade. Since the volume of a gas is dependent upon its temperature it is evident that the cooling of a gas degree by degree will cause it to shrink proportionately till if it is cooled 273 degrees its power to shrink will be gone also; that is, all the heat will have left the gas. This reasoning is not weakened by the fact that the gas would change to liquid before the absolute zero is reached. Dewar has gone within a very few degrees of absolute zero in the attempts to liquefy helium. The absolute scale was devised by Lord Kelvin and is very frequently employed in giving temperatures in scientific papers. It is the only scale in which the degrees have a direct quantitative relation.

NEW BOOKS, ETC.

High-Tension Power Transmission. By the High-Tension Transmission Committee of the American Institute of Electrical Engineers. New York: McGraw Publishing Company, 1905. 8vo.; pp. 466. Price, $3.

At a meeting of the Board of Directors of the American Institute of Electrical Engineers on September 26, 1902, the resolution was passed to appoint a committee for the purpose of collecting data on present practice in electric transmission at high voltage. The work covered a large scope, including data upon line construction, insulators, insulator pins, and the like, and conditions of operation at different voltages and under different climatic conditions, also conditions attendant upon the switching of high-tension circuits, and data respecting lightning and static disturbances, and the use of grounded protective wires. The work of this committee brought out much valuable information, which is here collected in compact and convenient form, and should prove a very valuable addition to engineering literature.

Wireless Telegraphy and Telephony. By Prof. Domenico Mazzotto. Translated by S. R. Bottone. New York: Macmillan & Co., 1906. 16mo.; pp. 416; 253 illustrations. Price, $2.

The object of this work is to present to the reader in as simple a form as possible the principles on which the wireless system of signaling is founded, and to describe the apparatus required. It also follows step by step the progress of different inventors who have revised wireless systems, and it traces chronologically the progress made in wireless telegraphy from the first experiments of Marconi at Bologna to the last results of transatlantic wireless signaling.

Taschenbuch der Kriegsflotten. VII. Jahrgang, 1906. Mit teilweiser Benutzung amtlichen Materials herausgegeben von B. Weyer, Kapitaenleutnant. Mit 410 Schiffsbildern. Muenchen: J. F. Lehmanns Verlag. Cloth, 16mo.; pp. 392. Price, $1.75.

This year's annual of the world's navies, edited by Capt. Weyer, shows considerable improvement over last year's volume so far as the amount of material published is concerned. Furthermore, the number of pictures of vessels actually in commission has been increased. There is hardly a single type of vessel that is not illustrated both by photographs and by clear diagrams. Naturally, the most marked changes to be noted in the volume before us are the records of the Russian loss and Japanese gain in naval power. An admirable feature of the book is the collection of naval programmes of the various countries. Capt. Weyer announces the intention of publishing an appendix in the month of June, which will contain whatever modifications have been made in the navies of the world since January, 1906.

Lectures on Mathematics. By Edward Burr Van Vleck, Henry Seely White, Frederick Shenstone Woods. New York: Macmillan Company, 1905. 12mo.; pp. 187. Price, $2.

This book is published for the American Mathematical Society, and contains the papers read at the Boston Colloquium, in 1903. The subjects covered are Linear Systems of Curves on Algebraic Surfaces, by Mr. White; Forms of Non-Euclidean Space, by Mr. Woods; and Selected Topics in the Theory of Divergent Series and of Continued Fractions, by Mr. Van Vleck.

The World Almanac for 1906. New York: Press Publishing Company. Pp. 569. Price, 25 cents.

The 1906 edition of the World Almanac and Encyclopedia, which has just been issued, differs little from its predecessors of other years, beyond the usual addenda, corrections, and enlargement necessitated by the occurrences of the past twelve months. The book is so well known and so largely used by many of the reading public that it needs little recommendation at the hands of the reviewer. It will often be found invaluable as a supplement to reference works of a general character, for the comprehensive information contained in its pages is of necessity concise and brief. Particularly varied and brief are the facts relative to New York city and vicinity, and this portion of the publication forms an excellent guide book and directory, not only for the stranger, but for resident New Yorkers as well. The arrangement of the major part of the general information in tabular form, together with the wide cross-indexing of the table of contents, is of great assistance to the reader in locating any of the data in the book.

Congress of Arts and Science. Universal Exposition at St. Louis, 1904. Edited by Howard J. Rogers, A.M., LL.D., Director of Congresses. Vol. I. History of the Congress by the Editor. Scientific Plan of the Congress by Prof. Hugo Muensterberg. Boston and New York: Houghton Mifflin Company, 1905. 8vo.; cloth; pp. 626. Price, $2.50.

To the readers of the technical press, the papers which constitute this first volume of the Proceedings of the Congress of Arts and Science, which met at the Universal Exposition of St. Louis, 1904, are more or less familiar. Their collection and publication in book form assuredly gives them the permanence which they deserve. Among the more important papers which were contributed may be mentioned Prof. Simon Newcomb's "Evolution of the Scientific Investigator"; Prof. Ladd's "Development of Philosophy in the Nineteenth Century"; Prof. Ostwald's "Theory of Science"; and Prof. Poincare's "Principles of Mathematical Physics."

Weltausstellung St. Louis, 1904. Die Chemische Industrie (Unter Rücksichtnahme auf das Unterrichtswesen). By Dr. Paul Cohn, Alfred Hölder, K. U. K. Hof- und Universitäts-Buchhändler. Vienna: 1905. 4to.; pp. 112.

In this monograph Dr. Cohn has presented a very comprehensive view of the chemical exhibits of the St. Louis Exposition of 1904. After a general introduction in which the general scope of the chemical industry is set forth, and its relation to expositions explained, he passes to a discussion of metallurgy and anorganic industrial chemistry. The progress of the industry in each country is discussed in detail. The second division is devoted to fuels and organic technical industries and discusses at some length dye-making in various countries. The third division is devoted to pharmaceutical operations, essential oils and perfumes. In the fourth division, fats, soaps, candles, glycerine, and explosives are treated. The fifth division is a special treatise on educational work and scientific instruction. A summary closes the monograph.

The Pennsylvania Railroad System at the Louisiana Purchase Exposition, Locomotive Tests and Exhibits. Philadelphia: The Pennsylvania Railroad Company, 1905. 8vo.; pp. 734; 800 illustrations Price, $5.

This valuable work is a compendium of the elaborate series of tests carried out by the Pennsylvania Railroad Company in connection with their exhibits at the Louisiana Purchase Exposition at St. Louis. This plant was the most complete locomotive testing plant ever erected and the tests of the eight locomotives that were submitted were made with every refinement known in the art of carrying out mechanical tests of this character. In planning the plant, it was laid out with sufficient capacity to accommodate locomotives of widely varying types and dimensions. It was intended originally to present the plant merely as an exhibit, and at the close of the exposition to remove it to the Pennsylvania Railroad's property; but it was ultimately determined to carry on at St. Louis a series of tests and enlist the interest of the engineering profession and railroad company in making them as comprehensive as possible. In all, eight locomotives, of widely varying character and design, were tested, and the results are embodied in the present volume. After a description of the general exhibit of the company, the testing plant is described and illustrated in great detail, working drawings being given of all the parts. Then follow chapters on the formation of the advisory committee, and on the plan, scope, and method of recording the tests. Each of the eight locomotives is taken up in its turn, detailed working drawings being given of each one, and a mass of tables and diagrams which, considering the high professional skill with which the data have been gathered, are unique in the history of the locomotive. This work will prove invaluable to everyone who has to do with the design and operation of the steam locomotive.

ALTERNATING CURRENTS: THEIR THEORY, GENERATION, AND TRANSFORMATION. By Alfred Day, D.Sc., M.I.E.E. New York: The D. Van Nostrand Company, 1906. 8vo.; pp. 291. Price, $2.50.

In the present volume Mr. Day has attempted to gave a general account of the principles, construction, and use of alternating current measuring instruments, generators, motors, and transforming machinery. A great deal of attention has been given to methods of testing. The book is clearly and concisely written and many matters which are not generally understood, or which are of too recent origin to have found their way into text books, are thoroughly gone into. The book is very practical in character. It is illustrated by no less than 178 diagrams. All types of alternating current motors and dynamos, as well as the latest form of motor operating upon either direct or alternating current, are described with the aid of the diagrams. The book goes into the theory and practice of alternating current machinery in a most thorough manner.

THE MOST POPULAR HOME SONGS. New York: Hinds, Noble & Eldredge, 1906. Price, 50 cents.

This is a very complete collection of secular and religious songs which have been popular in this country at all periods of its history. Besides well-known English and American songs, some of those of other nations are included.

YEAR BOOK OF THE PENNSYLVANIA SOCIETY, 1905. Edited by Barr Ferree, secretary. New York: The Pennsylvania Society, 1905. 8vo.; pp. 208.

The Pennsylvania Society was organized seven years ago with the purpose of collecting historical material relating to the State of Pennsylvania and keeping its memory alive. The present volume is the fifth year book issued by the society. It contains much historical matter of interest chiefly to Pennsylvanians and is illustrated with half-tone plates of old houses, historical events, etc. A full report of the sixth annual dinner of the society, which commemorated the 117th anniversary of the ratification of the Constitution of the United States by the Pennsylvania Convention, and which was given in honor of Senator Philander C. Knox, is fully reported in this volume.

FAULTY DICTION, OR ERRORS IN THE USE OF THE ENGLISH LANGUAGE AND HOW TO CORRECT THEM. By Thomas H. Russell, LL.D., editor-in-chief of Webster's Imperial Dictionary. Chicago: George W. Ogilvie & Co., 1905. Pp. 150; bound in leather. Price, 50 cents.

This small vest-pocket aid to the use of correct English will be found both interesting and useful to all those who desire to speak correctly. The words are arranged in alphabetical order. The errors which are discussed are those of grammar, construction, or faulty rhetoric. and unauthorized words. The correct pronunciation of words which are sometimes mispronounced is also given in many instances.

VIOLINS AND OTHER STRING INSTRUMENTS, AND HOW TO MAKE THEM. Edited by Paul N. Hasluck. Philadelphia: David McKay, 1906. 16mo.; pp. 160. Price, 50 cents.

This book is compiled by the editor from the columns of Work. It contains explicit directions for the making of violins, violoncellos, mandolins, guitars, banjos, zithers, and dulcimers. The introductory chapter treats of the materials and tools required in making these instruments, while other chapters are devoted to the making of violin molds, the varnishing and finishing of violins, Japanese one-string violins, and a double-bass violin. The book contains much valuable information condensed in a small space.

HANDBOOK ON REINFORCED CONCRETE. By F. D. Warren. New York: D. Van Nostrand Company, 1906. 12mo.; pp. 271. Price, $2.50.

This handy little volume is intended as a reference book for architects, engineers and contractors who have to do with the designing of concrete structures. The work treats of a general form of design rather than any one particular system. The treatment of the many phases entering the design has been carried out upon well known formulæ based on the theory of elasticity, and not upon empirical formulæ based upon experiments wholly. Sufficient tests were made, however, to determine the co-efficients and constants needed. The book is in four parts, the first of which gives a concise *résumé* of the subject from a practical standpoint and tells of the difficulties met with in practice and the remedies for the same. The second part contains a series of tests which justify the use of constants and co-efficients employed in preparing the tables in Part III. These tables should give the designer all the necessary information for ordinary use. It does not cover the more intricate designs, however. Part IV treats of the design of truss roofs from a practical standpoint.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending March 13, 1906.

AND EACH BEARING THAT DATE

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

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Air compressors, means for operating the electric unloaders of, F. V. Longacre. 815,025
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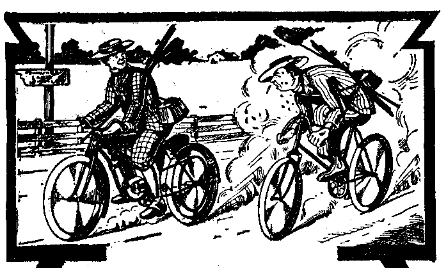

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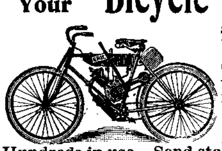

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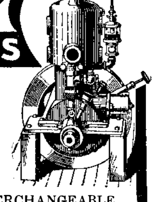

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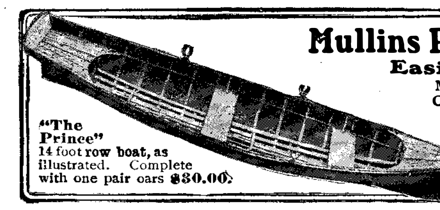

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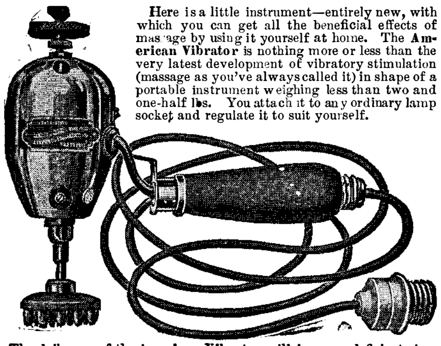

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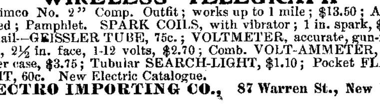

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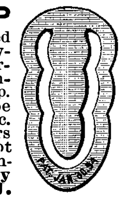

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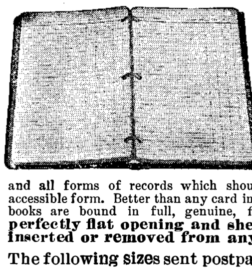

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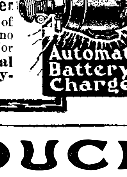

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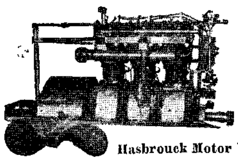

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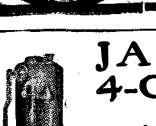

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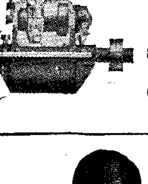

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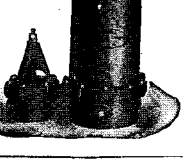

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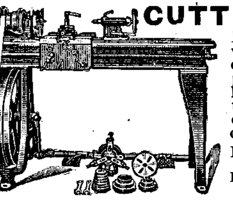

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