ably the foreign competitors. Hitherto Germany has enjoyed a monopoly in the English toy market. Even cheap labor cannot place the toys upon the market at the same price at which the English manufacturer is selling his products, and at a highly satisfactory profit to himself.

ROLLING LIFT BRIDGES.

BY WALDON FAWCETT.

The rolling lift bridges which have been constructed during the past few years in Chicago and at other points in the United States constitute so distinct an advance over the types of movable structures heretofore utilized in spanning navigable waterways as to have aroused deep interest abroad; and the favorable verdict upon their claims for superiority indicated by the arrangements for the installation of similar bridges abroad is particularly significant in view of the fact that the most distinguished European engineers have for more than half a century wrestled with the problem of accommodating the highway traffic over congested waterways such as the Thames River.

The essential requirements of a movable bridge are many in number; a fact which, of course, lends interest to the solution of the engineering problems involved. In the first place, the bridge must be absolutely safe for all traffic crossing it and for traffic using the navigable gateway, and its mode of operation must be such as to cause the least possible delay both to the traffic crossing it and that using the waterway. Then there are other considerations, such as the desirability of providing the widest possible navigable channel, the non-encroachment on the dock space adjacent to the bridge, and, finally, the matter of economy of operation.

The original movable bridges which are of any interest from an engineering standpoint are what are known as the mediæval pivot or trunnion bascule bridges, which were used to span the moats surrounding fortresses or castles and which, when closed effectually, shut off communication. These bridges either revolved upon hinge pivots or trunnions in a vertical direction or were counterbalanced on the principle of the seesaw. During the first half of the century which has just closed a number of pivot bascule bridges were built, the spans ranging from 20 to 50 feet. The year 1869 saw the completion at Copenhagen, Denmark, of the largest bascule bridge which had, up to that time, been constructed. The bridge, which had a total width of 31 feet, consisted of two movable leaves operated by hydraulic power and gave a clear channel of nearly 57 feet. Some nine years later the honor of ranking as the largest bridge of this type passed to a structure erected at Rotterdam, Holland, which had a total width of 34 feet and gave a clear channel of over 75 feet. This continued to be the largest pivot bascule bridge until the erection of the Tower Bridge at London.

The development of the pivot bascule bridge led directly up to the invention of the rolling lift bridge, the latter type having been devised just as the Tower Bridge at London was nearly completion. The famous London structure was commenced in 1885 and completed in 1894. It provides a waterway 200 feet in width, and cost, all told, more than $4,000,000. The advance which has been made in movable bridges of late years could not, perhaps, be better illustrated than by comparing the Tower structure with a rolling lift bridge of even greater span at the entrance to the Grand Central Station at Chicago. The weight of the iron and steel in the London bridge is 14,000 tons, while that in the Chicago bridge is but 2,250 tons, and the entire cost of the latter was $126,000, less than the cost of the operating machinery alone of the Tower Bridge.

Only three types of movable bridges have been extensively used: First, the hinged, pivot or trunnion bascule bridge; second, the rolling lift or bascule bridge, the newest type; and, third, the swing bridge, commonly denominated "drawbridge," which has been in general use for years past by railroads all over the country. The invention of the rolling lift bridge grew out of the requirements of the Metropolitan West Side Elevated Railroad, which sought a way to carry the traffic of their four tracks across the Chicago River so as to enter the business center of Chicago. Various obstacles prevented the erection of a swing bridge and objections equally insurmountable precluded the possibility of operating satisfactorily a pivot bascule bridge patterned after the Tower structure in London. When it became apparent that the problem was to prove a grave one, William Scherzer set to work upon it and ultimately evolved the idea of the present rolling lift bridge.

The mode of operation of the rolling lift bridges is, as will be seen from the accompanying illustrations, extremely simple. Upon the approach of a boat the bridge seemingly splits across the middle and each half rears itself upright on the bank on which its shore end is resting. The two great advantages claimed for the rolling bridges, aside from economic considerations, are found in the fact that since no center pier is necessary for the support of the structure the entire navigable channel is available and is unobstructed for the passage of vessels, and in the form of construction which enables the rolling lift bridge to act as a barrier when opened for the passage of vessels, thus closing the roadway and preventing the accidents which have been caused in years past by trains running into open "draws."

One of the most recent demonstrations of the utility of the rolling lift type of bridge is found in the evidence that a number of contiguous railroad tracks may be carried across a waterway by the construction of single or double track bridges placed side by side. These bridges may be coupled together when it is desired to operate them as one bridge, or each bridge may be equipped so as to be operated separately. The first six-track movable bridge ever constructed was completed in 1899 at the South Terminal Station in Boston, the largest terminal station in the world. The Boston bridge consists of three double-track spans, which may be operated jointly or as one span. Still more remarkable is the eight-track bridge which has been but lately completed to form a crossing at Campbell Avenue, in Chicago, over the Chicago Drainage and Ship Canal, which is to form a connecting link in a navigable waterway between the Great Lakes and the Gulf of Mexico.

Electric power is used in the operation of rolling lift bridges, but the force required is surprisingly light in view of the fact that the movable spans are perfectly counterbalanced and roll or rock with a minimum amount of friction. Trials have proved that less than twenty seconds is required for the complete operation of opening and closing the spans of one of the largest bridges. In the case of the large bridge at Boston, previously mentioned, each double-track span is operated by means of a 50 horse power electric motor, and the bridge is usually opened or closed in less than 30 seconds, including the time required for locking or unlocking. Moreover, the entire bridge is operated by one man.

A most interesting record is that of the Rush Street Bridge, at Chicago, said to be the most active movable bridge in the world. During an average season of lake navigation comprising a little over eight months this bridge is opened between 10,000 and 11,000 times, or fully forty times every twenty-four hours. Yet the power expense for the operation of this bridge by electricity does not exceed 67 cents a day. Over another rolling lift bridge in Chicago the passage of trains aggregates 1,200 daily.

A novel plan has been followed in order to make the rolling lift bridges more rapid in movement and to insure absolute safety of the working parts, even in the event of an accident to the operating machinery. The movable leaves comprising a bridge are so counterweighted that they are at rest when opened at an inclination of about 40 degrees instead of in the horizontal position which they occupy when closed. Thus, as soon as the locks are withdrawn the leaves will, without the application of any power whatever, roll back and upward and open a channel of sufficient width for the passage of vessels.

The rolling lift bridge moves by means of a large circular wheel rocking upon a perfectly smooth and level track, and, in localities where the waterway to be crossed is comparatively narrow, bridges have been constructed with but a single leaf or span. It is claimed that one of these rolling lift bridges when open is more stable against wind pressure than the Eiffel Tower or the Park Row building in New York city. The engineers admit that larger stresses are safely carried by the substructures of the Forth Bridge and the Brooklyn Bridge than will ever in all probability have to be carried by the substructure of the longest span rolling lift bridge which is likely to be constructed, but they contend that were a span longer than either of the above required, sufficient substructure, counterweight and machinery could be provided to open or close the span. With a view to developing the artistic and monumental possibilities of rolling lift bridges some very handsome designs have lately been prepared. In such structures the counterweight and operating machinery will be inclosed and protected by monumental masonry.

The first International Congress of Petroleum was held in Paris in 1900, and the second has been fixed for 1902, at Bucharest. The permanent commission which was formed at the Congress of 1900 has its seat at Paris, and is constituted as follows: President, M. Ed. Lippmann, former president of the Société des Ingénieurs Civils of France; vice-president, M. Van Zuylen; general secretary, M. P. Dvorkowitz; assistant secretary, M. Neuburger, 37 rue Scheffer, Paris, to whom communications may be addressed. M. Dvorkowitz has lately founded at London a petroleum institute. This new establishment is designed for the uniting and studying of all matters relating to the geology, extraction, chemistry and manipulation of petroleum and its derivatives.

Correspondence.

The Design of Propellers.

To the Editor of the SCIENTIFIC AMERICAN:

Your comments on the design of propellers in issue of September 7 correctly sums up the present situation of the subject.

Years ago, when Rankine enunciated the theory of propulsion that a vessel was made to move forward by the propeller moving a mass of water in the opposite direction, and the larger this mass and the slower its velocity, the more economical would be the performance of the propeller, it became the custom to use propellers of large diameter and small pitch ratios. But experience taught that for a given case it was just as easy to have a propeller too large as too small in diameter, and that very small pitch ratios were extravagant in the use of power. When this fact was becoming recognized the writer pointed out that there was another factor which entered largely into the matter of propulsion, and which made the subject even more complicated and difficult to comprehend—it is that of the inertia of the water acted upon, or its resistance to being put in motion by the propeller.

The notion of a propeller churning the water, when revolving at a high speed, when properly designed and applied, should be exploded by this time, because it will not do so even when the vessel is made fast; but in this latter case it will simply act as a pump receiving the supply water at its forward end and discharging at the opposite. The only time when there is any likelihood of churning is when it is so situated that it cannot receive an adequate supply of water at its forward end.

Experience with propellers taught contrary to general belief at one time that very long screws were not efficient. In the case of propeller pumps it was found that by dividing a long screw into several shorter ones and situating them some little distance apart on the shaft that a better performance was secured. Here, then, we have some explanation of the good performance of the propellers of turbine vessels. They are favorably situated to receive their supply water and each separate propeller on the shaft acts as an independent one.

The field for improvement in screw propellers by any change in their configuration is extremely limited. But there is one direction in which a promising opportunity is presented for improvement in propulsion, and it is somewhat surprising that it has not received more attention than it has.

It is to utilize the energy in the water discharged by the propeller which is now allowed to go to waste.

A great many persons, even some fairly informed in marine engineering, cannot comprehend how any considerable loss takes place in this particular.

Let it be understood that the action of a screw propeller in driving a vessel is the reverse of a turbine wheel in driving a mill. In the case of the latter the object to be accomplished is to transmit through the shaft the power contained in the water flowing to the wheel and to have it absorbed in moving the machinery of the mill. In doing this a mass of water flows to the wheel with a velocity according to its gravitation and is discharged with a much less velocity. The energy due to this difference is that available for the work of the mill.

In the case of a propeller driving a ship, eliminating the factor of inertia before referred to, the water which it acts upon is at rest and it is necessary to give the water motion in order that the reactionary effect may furnish the thrust to move the vessel. To accomplish this the power developed by the engines is transmitted through the shaft to the screw which operates on the water, then discharges it with an accelerated velocity, action and reaction being equal; it is the reaction of this discharged water that furnishes the thrust to drive the ship. Now it is evident that energy is absorbed in moving the vessel and there must of necessity be energy in the water discharged by the propeller.

Hence the power of the engines is divided between moving the vessel in one direction and a mass of water in the opposite direction.

I. MCKIM CHASE.

Washington, D. C., September 16, 1901.

Work on the by-product coke ovens at the Maryland Steel Company's Sparrow Point plant has begun. They are of a new type, and cause a saving of the tar, ammonia, and gas which is thrown off during the process of roasting the coal from which the coke is made. Coke for use in the furnaces of the company will be furnished by the ovens and will probably also supply coal gas for the use of the city of Baltimore. Illuminating gas from by-product coke ovens has been used at Everett, Mass., where a large coke plant has been in operation for some time. It is necessary to treat the gas after it comes from the coke. Cheaper grades of coal can be used in these new ovens.

Automobile News.

Among the recent Alpine trips in automobiles may be mentioned that of M. Anchorena, who made the ascent of the St. Bernard. The following is an extract from his journal: "Leaving Martigny on the 8th of August at 4 o'clock, we arrived at the hospice of St. Bernard at 9:45 in the evening. The slope, which is very steep after Bourg-Saint-Pierre, is even more accentuated at the Cantine de Proz. This point is at 5,550 feet altitude, and the hospice is at 7,600 feet, making in round numbers a difference of 2,050 feet. As the distance is 4.2 miles, this makes an average grade of 10 per cent, but in reality the grade reaches as high as 15.5 per cent at some points. We made the descent the following day at 2:30. The rear brake took fire from the friction caused by this rapid descent, and we were obliged to make the remainder with the aid of the reversing gear, putting the motor in movement. The whole distance of the climb (measured by the difference of altitude) is 6,170 feet; Martigny is at 1,480 feet altitude and the hospice at 7,600 feet as stated above. The motor worked admirably, and we were able to make a part of the ascent with the second speed. One detail should be noted; the mountain routes in Switzerland are forbidden to automobiles, and I was obliged on this account to pay a fine of $20. This prohibition results from the danger which the encounter of the machines presents to the mules, as they become frightened and risk falling over the precipices. The ordinary vehicles take 10 or 12 hours to make the ascent and 6 hours for the descent. The route is in good order, except near the summit, where there are quantities of loose stone."

Military automobiles of different types are now being constructed in all the leading countries of Europe. Several machines of new designs have lately been ordered by the German army. Among these is a light six-place vehicle, which has two seats in front and the other four disposed on each side of a small drawing table, on which maps, etc., can be spread out. A second machine is for the use of the artillery schools, to ascertain quickly the results of the target-ring. A third type resembles the English machine of the Simms pattern; it is an armored automobile of one place only, protected by heavy steel plates and carrying two Maxim guns. According to a circular recently issued by the Etat Major, the subject of military automobilism is to be of the first importance. At present the automobile is to be used by the artillery schools and for the fortified places and depots. As to the other types, their value will be best determined after the next grand maneuvers. This will no doubt be an important test of the military machines, as it will be remembered that the Reichstag has voted the sum of $35,000 for the purpose. The Russian government is now taking an active interest in the subject. It is said that a number of factories are to be erected at St. Petersburg toward the latter part of the year, under State control, for the construction of military automobiles and the different accessories, which up to the present had to be imported from other countries, especially from France. The British army called upon the Automobile Club to furnish several machines for this year's maneuvers, and the call was responded to by a number of volunteers, among whom were Mr. Mark Mayhew, with a light 7-horse power Panhard & Levassor machine; J. Hargreaves, with a 12-horse power Daimler, and Mr. Holder, with a 16-horse power Napier. These machines were placed at the disposition of General Buller for the whole duration of the maneuvers, which commenced on the 22d of July. The Self-Propelled Traffic Association also furnished a number of machines to Capt. Lloyd, Secretary of Transports at the War Office, among which were a quadricycle of the Ariel type and three steam tractors made by Thornycroft & Milnes. A novel type of military automobile is shortly to be tried upon one of the Italian railroads. It is heavily armored, and is designed to protect the railroads in time of war. It will transport an officer and two soldiers. The motor is of the gasoline type, single cylinder, and gives 7-horse power at 2,000 revolutions per minute. Bessemer steel is used for the armor plating and it is expected to carry Maxim guns. The total weight of this machine is 3,100 pounds. It will be used especially as an advance-guard for the trains, to explore the way.

The British War Office proposes to carry out a series of elaborate experiments by the artillery with the acoustic telemeter. The object of this contrivance is to locate the position of guns and rifles, which cannot be otherwise located owing to the invisibility of their discharge. The apparatus is the invention of General Gilletta, of the Italian army. The instrument denotes the direction from which the hostile firing is proceeding, and also records the distance at which the firing occurs. The instrument will also be subjected to a series of severe tests in the forthcoming Italian military maneuvers, a number of instruments having been specially constructed for this purpose.

Electrical Notes.

Work has begun on the electric railroad between Halle and Merseburg, the construction of which has been authorized by the Prussian government. The total length will be 10 miles. Power will be obtained from the River Salle.

The horse-car lines of New York exceed in length those of the rest of the cities of the United States combined. It is to be hoped in time that all of these feeders to more important lines will become converted to some electrical system.

The report of a committee to the Franklin Institute on the use of granite as an insulator for electrical purposes has been published. Granite chips are calcined and powdered feldspar and kaolin added with water to make a plastic mixture, and the molded objects heated to 3,000 deg. F. and glazed. The product absorbed 0.76 per cent of water in a year. It crushed at 7,000 pounds per square inch; showed a tensile strength 900 pounds per square inch; and a sample of a size not stated had an insulation resistance of 8 megohms.

From information published in the Oesterreichisches Handels-Journal, the Vienna-Pressburg line is to be constructed within the very near future, for the preliminary work is completed, and the representatives of the government are at present arranging the final details, regarding the use of the bridge across the Danube and the work to be done at the Hungarian end of the line, with Messrs. Siemens & Halske, who have obtained the contract, according to which the line is to be completed by March next year, and trains are to run at intervals of one hour.

The Central London Railroad's latest electric locomotive introduced to reduce vibration to a minimum is provided with lighter armatures than those previously employed. They run at triple the speed of the former engines, while gearing is used to reduce speed to the requirements of the drivers. The company also propose to experiment with the multiple unit system. For this purpose the trains will consist of two motor coaches, with four trailers, and although the total weight of the train will be only 96 tons, as compared with the 126 tons' weight of those at present in service, the seating capacity will be the same.

The capabilities of electricity as a motive force for automobiles was recently satisfactorily established by the accomplishment of a run from London to Reading and back, a distance of 94¾ miles, on one battery charge. The distance was covered in eight hours. The battery utilized was of the Leitner type, devised about one year ago for this purpose by Mr. Harry Leitner. This record was only one of a number of remarkable runs that were undertaken to prove the efficiency of the battery. On other occasions the car accomplished 70, 80 and 85 miles on one charge. During the course of the trials a total of 1,837 miles was covered by this one car, the units consumed for the purpose amounting to 954.8, and the cost on the average amounted to about three cents per mile. The car on every occasion carried four, and sometimes five, passengers.

Consul Mahin, of Reichenberg, reports that an electric street railway company has been formed at Carlsbad, and negotiations with supply and construction firms are invited. Carlsbad is as yet devoid of any kind of public conveyance, except cabs and hotel omnibuses, though it has a permanent population of 15,000, to which are added between April and October of every year 40,000 or more sojourners. The city is spread out, along the Tepl River, a distance of several miles, from the railway station to the Posthof, between which points street car communication would prove a great boon to the permanent and sojourning population. Branch lines on side streets leading to the villas and hotels on the adjacent heights would also be practicable. Communications addressed to the Elektrische Strassenbahngesellschaft, Carlsbad, Bohemia, would reach the promoters of this project.

The Municipal Council of Guyaquil has recently granted to a syndicate a charter authorizing the construction of an electrical tramway system in that city of some 50,000 inhabitants. The charter permits the use of any of the streets of the city, and provides for the construction of a new race course, including a bicycle track, in the suburbs of the town. It also grants the use of electricity for lighting and power. The concession runs for thirty-five years, at the end of which time the tram and race course will revert to the city without compensation. At present Guayaquil has a very poor mule-car system, despite which dividends have been superb—25 per cent annually for a number of years past. The principal streets of the city are lit by gas of an inferior quality—some sections by kerosene lamps. The mule-car system will probably be bought out and absorbed by the new company, which is now seeking capital in the United States. The matter is worth the attention of those interested in this line of business.

Engineering Notes.

Steel sleepers will be manufactured near St. Petersburg for Russian railroads.

Experiments with acetylene for lighthouse use have been carried out at Genoa. The acetylene light was seen at a distance of 40 nautical miles from Genoa.

The weight of electrical machinery in proportion to its output has been studied by Herr Seefehlner. The result of his observations, which he has collected from eighteen different sources, tends to show that up to a certain size the weight of materials per unit of power decreases rapidly with increasing capacity, but for higher capacities the weight per unit of power is very nearly constant.

A French syndicate has been formed for the purpose of mining iron and coal in the vicinity of Dover, England. Extensive mining rights have been acquired in the Alkham Valley, in the south of Kent, and not far distant from Dover. The boring is to be undertaken by French laborers under the supervision of skilled engineers from the Pas de Calais. A new American diamond drill is being erected for the work. Kent is very rich in iron ore, and at one time was the principal iron-producing district in England. At various parts of the country may be seen closed iron mines. The reason for their abandonment was the scarcity of coal, but at Dover and at other places rich seams of coal have been discovered beneath the iron ore strata, so that there is every possibility of the iron-mining industry in this part of England being revived.

The Egyptian government has granted concessions to an English firm for the mining of turquoises in the Sinai Peninsula. It is not proposed to open any new mines at present, but simply to rework the abandoned mines at Maghara and Sarakan. From the hieroglyphics upon the rocks in the district it appears that the ancient Egyptians originally opened these mines, and until recently they were worked in a spasmodic manner by the Bedouin Arabs. The English company proposes to install a modern mining plant and to engage Bedouin labor. This peninsula is now the only district in the world from which turquoises of the finest water may be obtained. The Persian mines, which have hitherto supplied the world's market in this direction, are rapidly becoming exhausted, but this peninsula is peculiarly rich in these stones.

A new method of burning liquid fuel has been devised by Messrs. Muirhead & Coy, a firm of electrical engineers of Beckenham, London. It is called the hydroleum system, and by means of it all descriptions of liquid hydrocarbons from petroleum to the various tars and tar refuse are consumed with an entire absence of smell and smoke. The burner comprises a combined feed of steam and oil, or refuse, and the vapor of these two is concentrated upon an incandescent fire brick, upon striking which the combined steam, by means of the intense heat, is divided into oxygen and hydrogen, and these combining with the carbon are ignited and passed through the boiler. So perfect is the combustion, and so intense is the heat that is generated, that a considerable economy is effected in the consumption of the fuel for boilers of every description. Tests with a 50 horse power Hornsby boiler have shown that 15 pounds of water are evaporated by the consumption of 1 pound of tar refuse, whereas with the same quantity of steam coal only 9 pounds of water are evaporated. The Admiralty have examined the process and intend to experiment with it in the navy.

M. Raoul Pictet, the famous Swiss inventor and chemist, has effected a remarkable discovery concerning the manufacture of oxygen upon an extensive scale for commercial purposes. The inventor has been engaged for three years upon this invention at his laboratory in Geneva, where he is a professor of chemistry and physics. When the process was satisfactorily perfected to permit of experiments being conducted he went to Paris and was persuaded to visit Dr. Dreyfus, the celebrated chemical expert, of Manchester, England. When the inventor had laid the scope of his idea before Dr. Dreyfus the latter, realizing its tremendous possibilities, sought the assistance of several experts in the steel and chemical industries, and arrangements were then advanced for experimenting upon an elaborate scale with the invention. For this purpose an extensive plant has been erected at the works of Messrs. Galloway, the famous Manchester boiler makers. The invention consists in obtaining oxygen from the atmosphere by physical means and not by the chemical process at present in vogue; but the process is so simple that it will not cost more than one cent to obtain two cubic feet of oxygen. It will be applied to the metal and chemical trades, lighting, and public health. The oxygen will be mixed with water gas, and a much more brilliant illuminant will be obtained at a much cheaper price. It possesses great heating properties, and for this purpose will be peculiarly adapted for smelting various mineral ores.