who was at length compelled to raise the siege in April, 1705. During the next twenty years there were endless negotiations for the peaceful surrender of the fortress, and in 1726 the Spaniards again appealed to arms. But the Conde de la Torres, who had the chief command, succeeded no better than his predecessors, and the defense of the garrison under General Clayton and the Earl of Portmore was so effectual that the armistice of June 23 practically put a close to the siege, though two years elapsed before the general pacification ensued. The most memorable siege of Gibraltar, indeed one of the most memorable of all sieges, was that which it sustained from the combined land and sea forces of France and Spain during the years 1779–1783. The grand attack on the place was made on the 13th September, 1782, and all the resources of power and science were exhausted by the assailants in the fruitless attempt. On the side of the sea they brought to bear against the fortress forty-six sail of the line and a countless fleet of gun and mortar boats. But their chief hope lay in the floating batteries planned by D'Arcon, an eminent French engineer, and built at the cost of half a million sterling. They were so constructed as to be impenetrable by the red hot shot which it was foreseen the garrison would employ; and such hopes were entertained of their efficiency that they were styled invincible. The Count D'Artois (afterward Charles X.) hastened from Paris to witness the capture of the place. He arrived in time to see the total destruction of the floating batteries and a considerable portion of the combined fleet by the English fire. Despite this disaster, however, the siege continued till brought to a close by the general pacification, February 2, 1783. The history of the four eventful years' siege is fully detailed in the work of Drinkwater, who himself took part in the defense, and in the life of its gallant defender Sir George Augustus Eliott, afterward Lord Heathfield, whose military skill and moral courage place him among the best soldiers and noblest men whom Europe produced during the 18th century.

Since 1783 the history of Gibraltar has been comparatively uneventful. In the beginning of 1801 there were rumors of a Spanish and French attack, but the Spanish ships were defeated off Algeciras in June by Admiral Saumarez. Improvements in the fortifications, maintenance of military discipline, and legislation in regard to trade and smuggling are the principal matters of recent interest.

THE FRANZ JOSEF I., NEW WAR SHIP.

ANOTHER addition was made to the Austrian navy by the launching on May 18 of the ram cruiser Franz Josef I. from the yards of S. Rocco in the Stabilimento Tecnico Triestino. Her dimensions are: Length (over all), 103·7 meters; length (between perpendiculars), 97·9 meters; greatest breadth (outside), 14·8 meters; draught (bow), 5·28 meters; draught (stern), 6·05 meters; displacement on the construction water line, 4,000 tons. The armament consists of two 24-centimeter and six 15-centimeter Krupp breech loaders of 35 caliber length, two 7-centimeter Uchatius guns as an armament for the boats and for landing purposes, eleven Hotchkiss quick-firing guns, and several torpedo-launching ports; indicated horse power with natural draught 6,400, speed 17·5 knots; with forced draught 9,800, speed 19 knots.

The ship is built of steel, and constructed according to the "double bottom" system along the engine, boiler, and ammunition rooms. The vaulted armor deck, extending 1·25 meters below the water line and protecting the most vital parts of the ship, is 0·057 meter thick. There are more than 100 water tight compartments below and above the deck. A protecting belt of "cellulose" is provided for the engines and boilers, extending from the armor deck downward.

The two main guns, placed on Krupp's hydraulic carriages, occupy positions in front and rear, and are protected by stands 0·09 meter thick and 1·60 meters high. They fire *en barbette* with a lateral range each of 260 degrees at bow and stern—*i. e.*, 130 degrees on either of the broadsides. The weight of the barrel of the gun is 25 tons, that of the steel shell 215 kilogrammes (about 430 lb.), that of the brown powder charge 100 kilogrammes; initial velocity of projectile, 610 meters; penetration, 0·524 meter iron; longest range, 17 kilometers (about 10½ English miles); range at 15 deg. elevation, 10 kilometers. The six 15-centimeter guns are placed in a kind of machicouli arrangement in two tiers on each of the broadsides, so that always four guns can fire in the direction of the keel to the front and rear. The weight of the barrel of the gun is each six tons, that of the steel shells 51 kilogrammes, that of the charge 22 kilogrammes; initial velocity, 610 meters.

The 11 quick-firing guns are partly placed along the broadsides, partly in the masts, of which there are two. The triple expansion engines, having each a bronze screw of 4·42 meters diameter, with three blades and a rise of 6·3 meters, make with natural draught 105 revolutions, and with forced draught 120. The pumping apparatus are able to lift in one hour 400 tons of water. The front boiler room contains a special cylindrical boiler for the working of the electrical apparatus, for hydraulic pumps of the artillery service, for anchor windlasses, ventilators, fire engines, etc. The whole engines weigh 890 tons. The bunkers have a capacity for 660 tons of coal, which allows for a run of 4,500 sea miles.

CLARK'S GYROSCOPIC TORPEDOES.

FIGS. 1 and 2 represent, upon a scale of about $\frac{1}{10}$, two types of torpedoes, the greatest number possible of the parts of which are made revolvable, so as to render the torpedoes as dirigible as the gyrating motion permits of.

Fig. 1 represents an electric torpedo actuated by accumulators, A A, keyed upon the shaft, and revolving along with the gearings. At the beginning of the running, the accumulators are not all coupled, but under the action of a clockwork movement which is set in motion at the moment of starting, metallic brushes descend one after another upon the collectors, B, and set in action new batteries for keeping constant or, if need be, accelerating the speed at the end of the travel.

Fig. 2 represents an air torpedo proposed by the same inventor. The air reservoir, C, revolves along with the gearings under the action of the pneumatic machine, D. The central shaft is hollow, so as to serve as a conduit. The admission of air into the slide valve of the machine is regulated by a clockwork which actuates a slide in an aperture whose form and dimensions are so calculated that the speed remains as constant as possible toward the end of the travel.

The trajectory of the two torpedoes is regulated by a cylindrical bellows, F, which gives entrance to the sea water. The springs shown in the figure balance the hydraulic pressure. The tension of these springs is regulated by the rod, H, according to the indications of the scale of depths, I.

When the torpedo reaches too great a depth, the action of the springs can no longer balance the increase of the hydraulic pressure, and the accumulation of the charge in the rear causes the front to rise toward the surface. When the torpedo reaches the surface, a contrary action is produced.—*Revue Industrielle.*

Fig. 1.

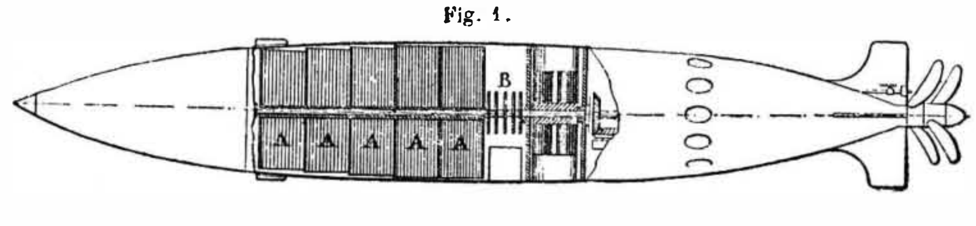
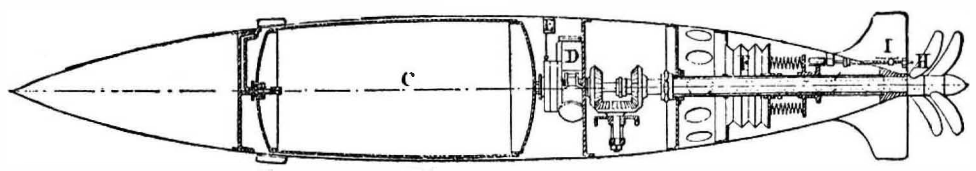


Fig. 2.



CLARK'S GYROSCOPIC TORPEDOES.

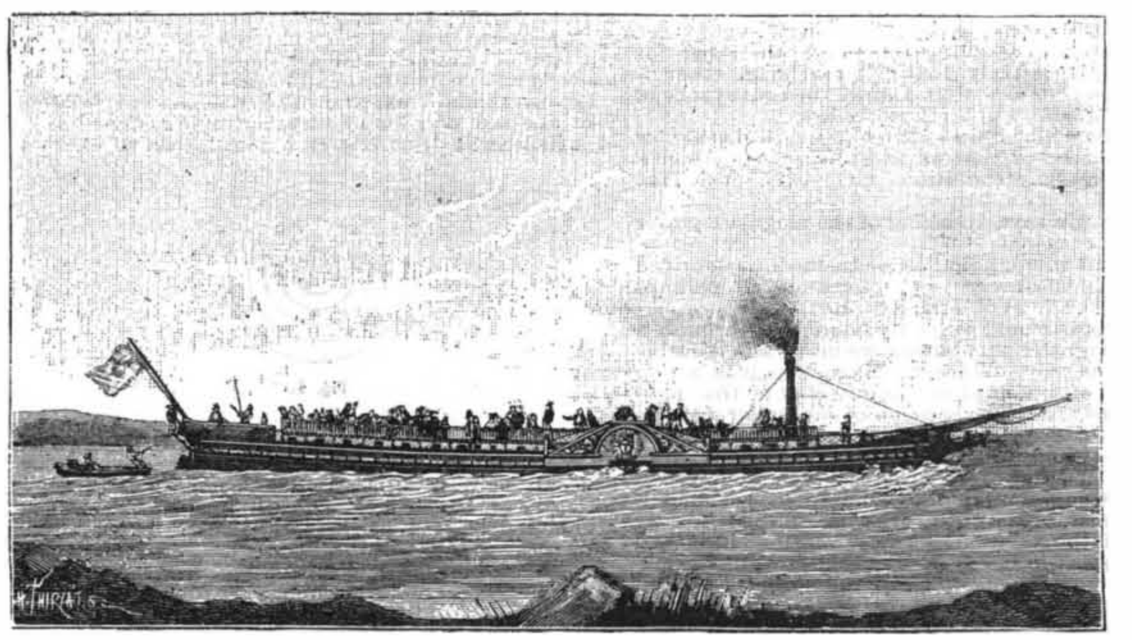
THE FIRST STEAMBOAT ON THE SEINE.

THE accompanying engraving represents the remarkable steamboat that the unfortunate Marquis de Jouffroy constructed at Paris in 1816, after organizing a company for the carriage of passengers on the Seine. De Jouffroy, as well known, made the first experiment in steam navigation at Lyons in 1783, but the inventor's genius was not recognized, and he met with nothing but deception and hostility. With the obstinacy of men of conviction, he did not cease to prosecute his task. He assuredly had an inkling of the future in store for the invention that he was offering to humanity.

The paddle wheel boat that he constructed at Paris in 1816 did not succeed any better than its predecessors; it was remarkable nevertheless in appearance and structure.

The engine was forward, as shown in the engraving, which is copied from a composition of Dubucourt's.

The company organized by the marquis was ruined, and, as well known, the unfortunate inventor himself died in poverty in 1832, at the age of eighty-one years. —*La Nature.*



FIRST STEAMBOAT BUILT ON THE SEINE.

THE ELECTRIC MOTOR TESTS ON THE NEW YORK ELEVATED RAILROAD.

THE American Institute of Electrical Engineers at its last meeting of the season, held June 25, again considered the subject of electrical traction, the paper presented by Mr. Leo Daft being based upon some recent electrical work on the elevated railroads and its bearing on the rapid transit problem. The *Railroad Gazette* gives the following abstract:

He introduced the subject with a tribute to the efficiency of the elevated railroad system as it is now operated by steam, with special reference to that section of it known as the Ninth Avenue line, upon which his experiments with the electric motor have been conducted, over which passengers are now conveyed a distance of five miles in 26 minutes for five cents, which he considered the best and cheapest municipal rapid transit in the world, and which is operated with a higher degree of safety than any other railroad in the world making an equal number of stops per 100 miles. On a recent holiday, April 30 last, 835,720 passengers were carried upon the entire system without noticeable detention or accident. The rapidly increasing traffic makes the demand for better facilities a pressing one, and as the average half million now carried daily will soon become a million, it appears doubtful if any method can be devised of providing for the growth by the use of steam motors on the present structures, which are now taxed to their utmost. To the mind of the mechanical engineer, having in view the ordinary coefficients of tractive ability, there is no remedy for this. The speaker stated that these coefficients were not entirely trustworthy. He reiterated his previously expressed opinion, based on frequent experiments, that there is a decided increase in traction gained by the passage of the electric current from the wheels to the rails, giving the details of one test where a motor with a load making a total of 600 lb. climbed a gradient of 2,900 ft. per mile, starting from a state of rest. He stated that some of those people who had ridiculed his statements had finally admitted that they were true.

The motor Ben Franklin, which had been used in making these tests on the elevated roads, weighed 10 tons, and performed service nearly equal to the steam motors weighing 18 tons. The object of these tests was the determination of coal economy. Tests with a Prony brake showed that the motor developed 128 H. P. The piece of track on which the experiments were conducted embraced 2,200 ft. of level track and $1\frac{8}{10}$ miles of gradients, varying from $11\frac{3}{10}$ to $98\frac{7}{10}$ ft. per mile, while at Thirtieth street the station is at the foot of the steepest grade, thus testing to the utmost the tractive capacity of the motor. The experiments were begun in October, 1888, and carried on between the hours of 9 P. M. and 4 A. M., beginning with one or two cars, the load being increased nightly until it was finally made up of eight coaches of 12 tons each, which were hauled up the 98 ft. grade at a speed of 7½ miles per hour, the entire distance being covered at the rate of $14\frac{6}{10}$ miles per hour. The maximum speed obtained on level with that train was 16·36 miles per hour. Seventy trips were subsequently made with a 70 ton train operated between the steam trains under 3 minutes headway, but the work was considered too critical on account of the absence of suitable brakes. A number of experiments made about this time showed that the mean speed with a three-car train running express on the up-town track was about 24 miles per hour, although the ability of the motor on a level with a similar train was nearly 28 miles per hour. This, however, was not the maximum speed, as the level track was not long enough to permit of its attaining the highest rate. It was the opinion of the speaker, however, that the speed attained could not be exceeded with prudence on the elevated structure.

The measurements of speed were made by dividing the track into 19 sections of 500 ft., each section being provided with a circuit-closing plate connected with a chronograph which was carefully tested. The indicator cards were taken at the central station by Mr. Idell and his assistants, and the dynamometer used was of the liquid type made by Mr. Shaw, of Philadelphia. The diagrams prepared from the data obtained were then explained by the speaker, who stated that there was not a marked difference between the 10 ton motor and the 18 ton locomotive in the initial effort on the level, as will be seen by comparing a run observed by a railroad officer on March 9 with a steam motor and a load of about 57½ tons. The steam motor required 1 min. and 29 sec. to make the distance from 14th to 23d streets, while the electric motor with a train of 70 tons made the same trip in 1 min. and 50 sec.; the absence of