attained; and during the full-power trials, 89.2 revolutions, 21,870 horse-power, and a speed of 19.62 knots were developed and maintained for 13½ hours. The highest horse-power recorded throughout these trials was 23,500.

A sister ship to the "Caronia" is now in course of construction at the same shipyard. This vessel is of identical dimensions and tonnage, only instead of being propelled by reciprocating machinery, Parsons marine turbines are to be installed. These two vessels are to be run side by side, and comparative data in actual transatlantic practice will thus become available. This vessel, which was recently launched, is rapidly approaching completion.

The equipment of the "Caronia" is completed by an installation of Marconi's wireless telegraphy, a special room for which is provided on the boat deck.

CHICAGO'S FREIGHT SUBWAYS.

In 1899 the Illinois Telegraph and Telephone Company began to build a series of tunnels under the streets of Chicago for the purpose of carrying the wires and cables of the company's automatic telephone system. This network of tunnels is now utilized for a quite different purpose than that for which it was originally constructed. This further use is as a system of electric traction for the handling of freight, express, and mail. The company, now incorporated under the name of the Illinois Tunnel Company, was granted a franchise for this purpose in July, 1903. It is controlled by the leading railroads which enter Chicago. Something of the immense importance of this undertaking to Chicago will be gleaned from the following account. Perhaps similar systems of tunnels will some day be built in other American cities.

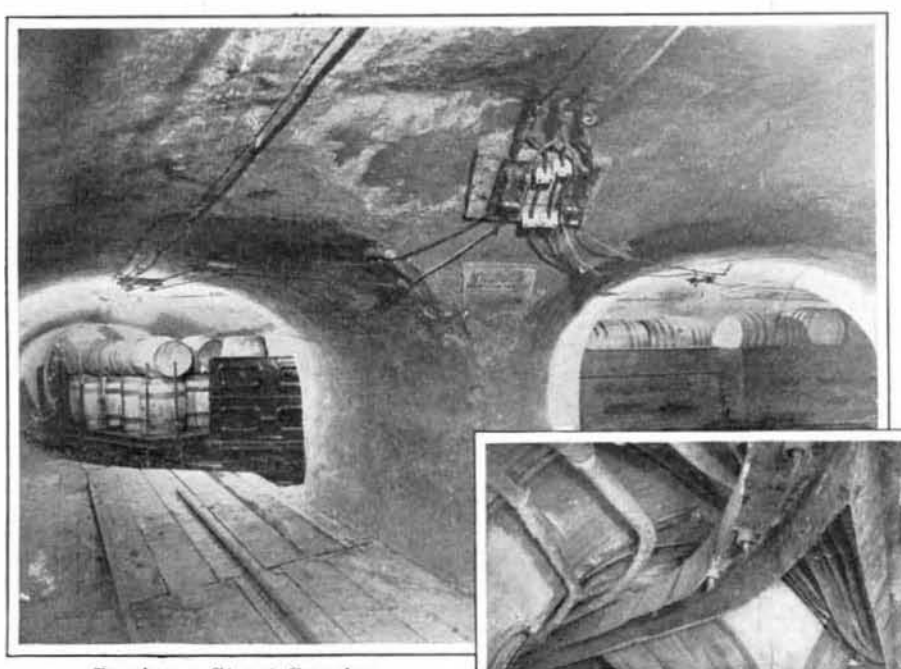
The great advantage of a system of freight haulage of this kind is apparent at a glance. Far below the surface of Chicago's streets scores of electric locomotives are pulling freight trains that are taking thousands of tons of coal into the boiler rooms of skyscrapers, without dirt, noise, or sign of effort in the street. They are removing tons of ashes, and caring for the excavations from the basements of buildings in course of construction. More than this, they are hauling daily many thousands of tons of freight which was formerly carried over the pavements in wagons. On February 15, 1905, the company entered into a contract with the government under which all of Chicago's second, third, and fourth class mail matter will be transferred from the railway stations to the new post office through the tunnels. A further plan to utilize the tunnels for mail purposes involves the building of chutes connecting the street-corner mail boxes with boxes in the tunnel, where the mail can be collected by cars. When the new schemes are perfected and added to the present pneumatic tube service for first-class mail, Chicago will have the most perfect underground mail facilities in the world. Eight hundred and eighty tons of mail will be handled in the tunnels daily, in special locked United States cars The system will be in operation by June 1.

Without noise, dirt, smoke, or the slightest delay to traffic, the central business district of Chicago has been honeycombed with these tunnels. Twenty-eight miles already have been constructed, and extensions are projected.

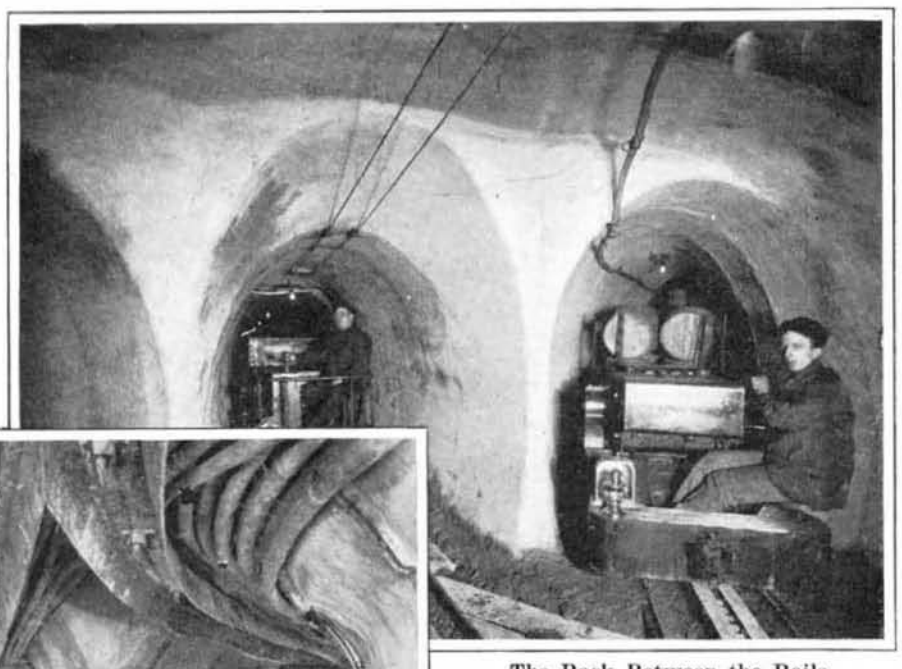
Fourteen per cent of the railway mileage of the world centers in Chicago, and operates to and from a business district one and one-half miles square. This is the territory of the freight subways. In it are thirty-eight railway stations, and every working day more than 112,000 tons of freight are moved to and from them. This situation has caused great congestion in the streets, and this the subways have met and relieved. The cars of the tunnel company are run directly into the railway freight houses, loaded, and run through the tunnels to the consignees. Here the cars are run into the basement of the warehouse through an opening cut in the masonry, raised to the desired floor on elevators, and unloaded. If the goods are not intended for immediate delivery, the cars are run into the company's storehouses and kept there till required. Every building on the route of the tunnel can be connected to it by a lateral shaft for the above purpose.

The work on the telephone tunnels was planned in 1899, but did not actually begin until September, 1901. It was found that the space below the paving was almost completely taken up by water and gas pipes, sewers, and the conduits of other companies. After investigation of the soil underlying Chicago, it was decided to build a deep tunnel conduit system, as this could be done without danger to adjoining property or without interfering with other corporation rights. After considerable difficulty in securing the final municipal permit to construct the system as planned—in fact, numerous alterations were necessary—and in making an accurate survey of the streets, the company was at length allowed to begin work on the undertaking. The trunk line tunnels were to be 12 feet 9 inches by 14 feet, and the branch tunnels 6 feet by 7 feet 6 inches.

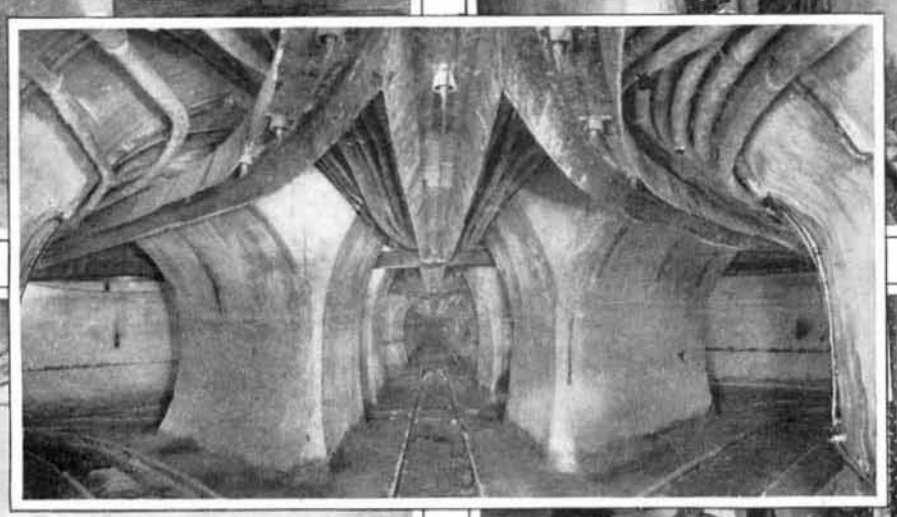
The work was carried on almost entirely in firm clay, which was encountered about 19 feet below the street grade. The pneumatic system was used more for protection against labor troubles than for other reasons, for should the workmen go out on strike, there would be no damage if the work were left for a time in an uncompleted state. The airlocks, placed just outside the seven shafts, had iron doors imbedded in concrete, and were long enough to accommodate the work, in some cases as many as ten cars being in a lock at once.



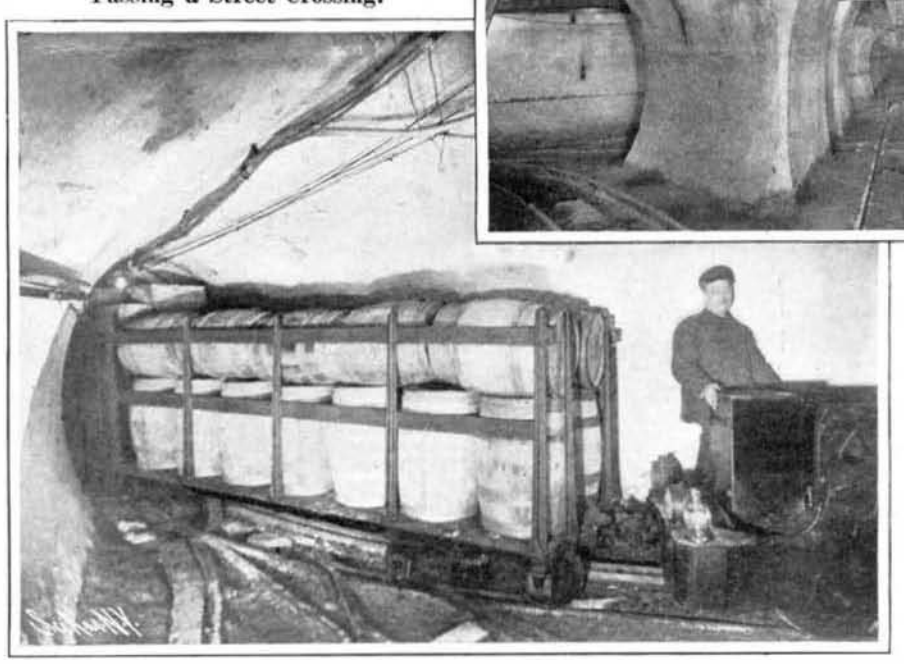
Passing a Street Crossing.



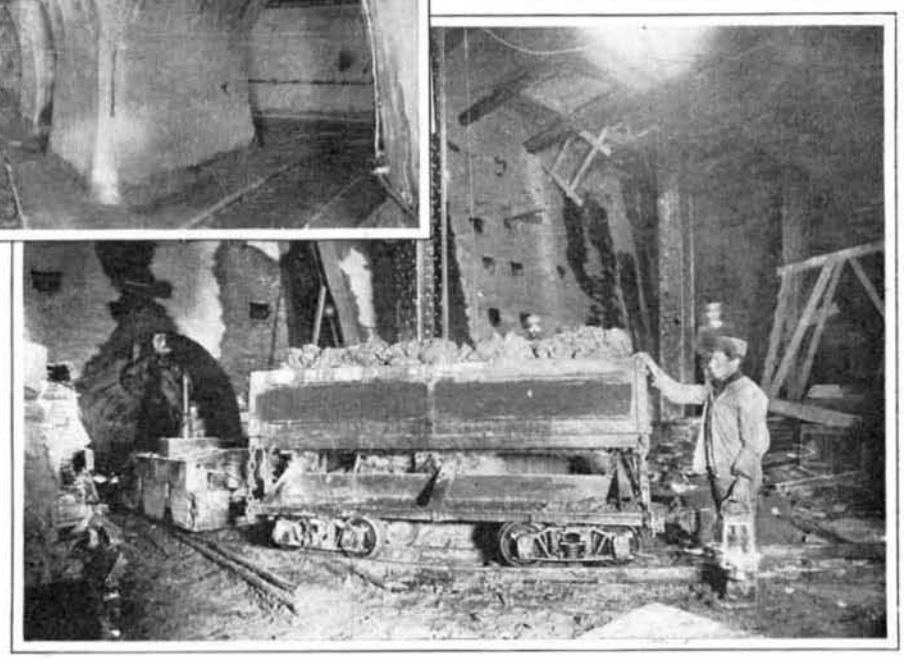
The Rack Between the Rails.



Typical Street Intersection.



Electric Locomotive and a Loaded Freight Car.



Removing Excavated Material from the Basement of a Building under Construction.

CHICAGO'S FREIGHT, EXPRESS, AND MAIL SUBWAYS.

The work was carried on by miners working in three shifts of eight hours each, the nature of the soil permitting the work to be done in this way. The distance excavated averaged about 21 feet at each of fourteen working headings, and 12 miles of tunnels were virtually completed in about ten and a half months.

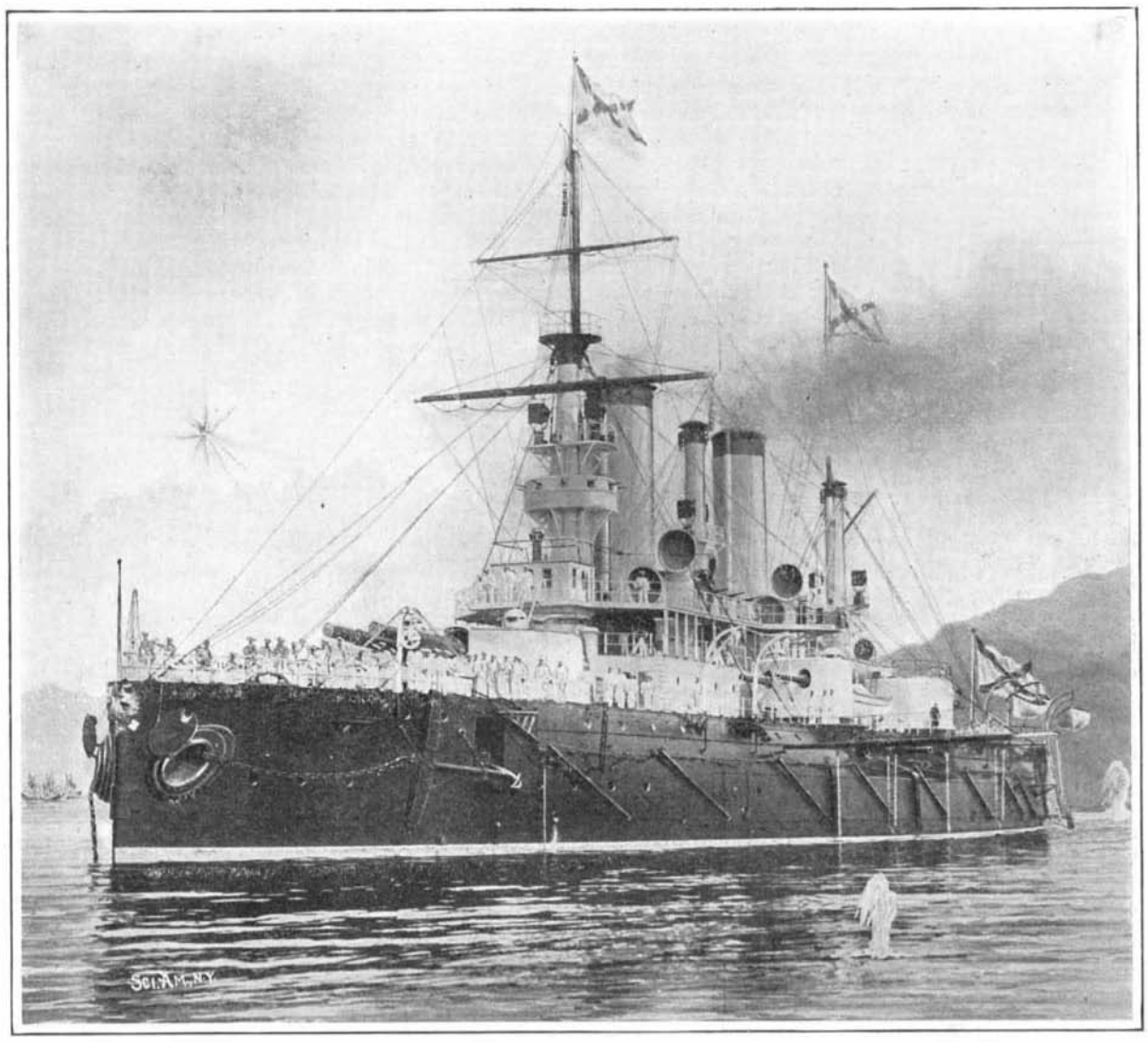
The concrete was placed in the bottom of the excavation and thoroughly tamped, the lagging placed on top of the concrete, iron ribs made of channel bars being placed on the bottom three feet apart, and the lagging laid at the sides against these ribs. The concrete was then thrown behind the two-inch plank lagging in six-inch layers. The use of concrete absolutely avoided any chance of settlement of the earth, as it was tamped into the entire space between the lagging and the excavation, no matter how irregularly the digging or mining had been done. For part of the work steel lagging plates were used as a special precaution, on account of the extra weight of the concrete. In proceeding with the work, the face of the preceding day's work was cleaned and a plaster coating of cement, made in pro-

portions of one to one, sand and cement, was plastered on the old work, forming a seal and making the structure almost entirely a homogeneous one. The 6 by 7½ lateral tunnels were constructed with 13-inch bottoms and 10-inch walls of concrete. The trunk system tunnels were built with 21-inch bottoms and 18-inch walls. The cement used for the making of the concrete was American Portland (Atlas and Chicago A. A.), and the company subjected each and every barrel to a fourteen-day test under rigid specifications. On the straight work mixtures of five parts broken stone and screenings, or five parts mixed gravel and sand, to one part of cement were used, while at the intersections a mixture of four parts stone or gravel to one of cement was adopted.

A large equipment of small tramcars, some 900 in number, built to run on a 14-inch gage, double-track system, was provided to dispose of the excavated material. The cars were hoisted by power-driven elevators up the shafts to the head-houses and the material dumped into wagons. Much of this was deposited on the lake front, a special 10-ton, stiff-leg derrick being provided for unloading the wagons. In this way much valuable land was added to Grant Park. At one shaft near the river an endless chain drew the cars up an incline onto stagings or platforms extending over dump scows moored to the dock below, and the cars were then emptied into these. The platforms could be raised and lowered as required, so as not to interfere with the river traffic.

The steepest grade in the tunnels is 1.75 per cent, and the grades at the railway terminals do not exceed 12 per cent. The latter steep grades form the approaches to the tunnels, which are built with the rails some 30 feet below the street level. The four-way intersections have curves of 20-foot radius, and the sharpest curves on the main lines are of 16-foot radius.

The track is 2-foot gage, laid with 56-pound T-rails fastened by bolted clamps to cast-iron chairs imbedded in the concrete floor of the tunnel. Part of the system is overhead trolley, while the rest is of the Morgan third-rail traction system. This latter consists of a perforated metal plate (½ inch thick and 4 inches wide) forming a rack which is bolted between two lines of timber stringers. These serve to protect and support the rail. A special construction for the tunnel work was devised in the use of chairs of bent steel channels to support the rack. The locomotives are of the class used in mine haulage work, but are peculiar in the method of taking current. The rack rail serves both for traction and as a third-rail conductor, the current being led to motors, geared to the axles, with suitable controlling devices. The track rails are used for the return current. The wheel base of the locomotives is 24½ inches. With one 75-horse-power motor the weight is about 3 tons; with two 80-horse-power motors, about 5 tons. The trolley locomotives are of the ordinary type used in mine systems.



This ship was twice struck by mines, and once by a torpedo, without being sunk. She was the last of the Port Arthur fleet to be destroyed. When 203-Meter Hill was captured she went outside the harbor, where the lofty Liaoshan Mountain screened her from observation. She let down her torpedo nets and was three times attacked by the whole torpedo squadron before she was hit. She did not sink; but next day, Capt. Von Essen opened her valves and sank her in deep water.

The Battleship "Sevastopol" in Port Arthur Harbor.

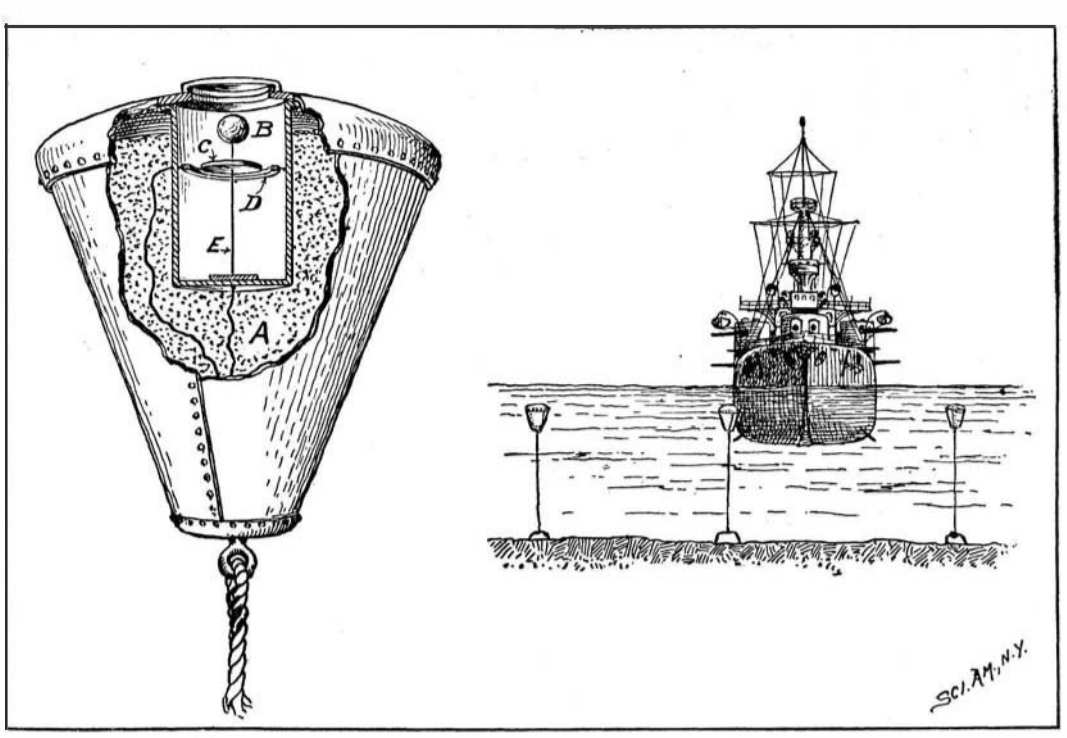
Eighty-five and six-tenths per cent of the freight cars of the United States now have air brakes.

STORY OF THE OPERATIONS OF THE RUSSIAN FLEET AT PT. ARTHUR AS TOLD BY ONE OF THE COMMANDERS.

To all interested observers of the great naval conflict between Russia and Japan, it has been a matter of regret that so little has been made known as to the actual work done, during the long siege of Port Arthur, by the ships of the Russian navy. The information contained in official dispatches has been sufficient to give the general public only a vague idea of what was taking place behind the impenetrable curtain, which a strict censorship flung before the stage whereon this, the greatest and most heroic naval drama of modern times, was being enacted.

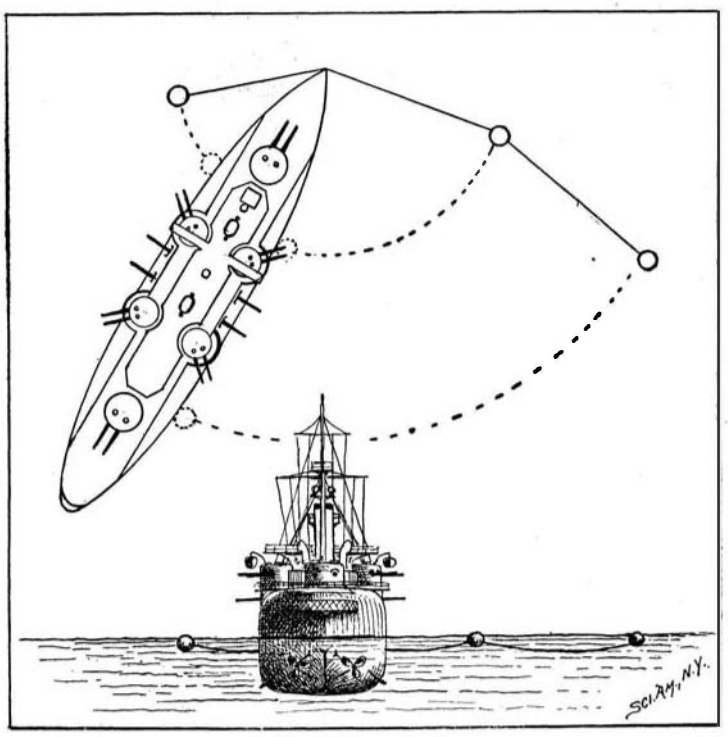
The sudden loss of three of the best ships of the Russian fleet, in the unlooked-for torpedo attack on the night of February 8, placed the Russians at such a numerical disadvantage, that there was little hope of achieving any decisive victory over the Japanese until reinforcements should arrive from Europe. All the subsequent engagements were fought against odds which rendered the result, barring accident, a foregone conclusion. To be convinced of this, it is only necessary to bear in mind that the torpedo attack of February 8 and the battle outside Port Arthur on the morning of February 9, resulted in the torpedoing of the two best battleships and one of the finest cruisers of the fleet, and the disablement of one of the battleships and three of the cruisers by shot holes below the waterline. From that time to the final sinking of the "Sevastopol" in the last days of December, practically all our information regarding the Russian fleet has come from Japanese official reports; and while these have been in the main reliable, they have consisted chiefly of statements of the damage inflicted by the Japanese either by gun, torpedo, or mine, and have given us very little information as to the damage and loss which they themselves have received from the Russians.

During the long months of the siege, it was a matter of frequent speculation as to what was being done by the Port Arthur fleet in repairing the serious injuries



This is the type of stationary, or anchored, mine used by the Japanese, whose torpedo boats ran in to the mouth of the harbor at night, and dropped them in position across the channel. They consisted of an iron shell filled with high explosive, *A*. The firing mechanism consisted of a ball, *B*; flexible rod, *E*; contact disk, *C*; and contact ring, *D*. When mine was struck by ship, *C* was thrown against *D*; circuit was closed and *A* was detonated.

Anchored Mines, Laid by the Japanese, and Removed by "Sweeping."



The Japanese strewed in the outer channel, leading to Port Arthur, a number of floating mines, connected by cables, in sets of two or three. The "Petropavlovsk" struck one of these, and as she moved forward the mines swung in, wrecking her hull at three separate points.

How Makaroff's Flagship, "Petropavlovsk," Was Sunk.

THE OPERATIONS OF THE RUSSIAN FLEET AT FORT ARTHUR.