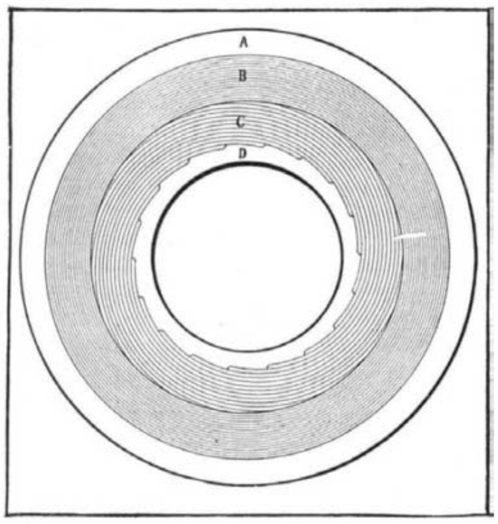
HIGH-VELOCITY 6-INCH WIRE-WOUND GUN FOR THE UNITED STATES ARMY.

The Board of Ordnance and Fortifications of the United States army recently made an allotment of $41,000 for the construction of a 6-inch Brown wire-wound gun which, if it fulfills the requirements of the

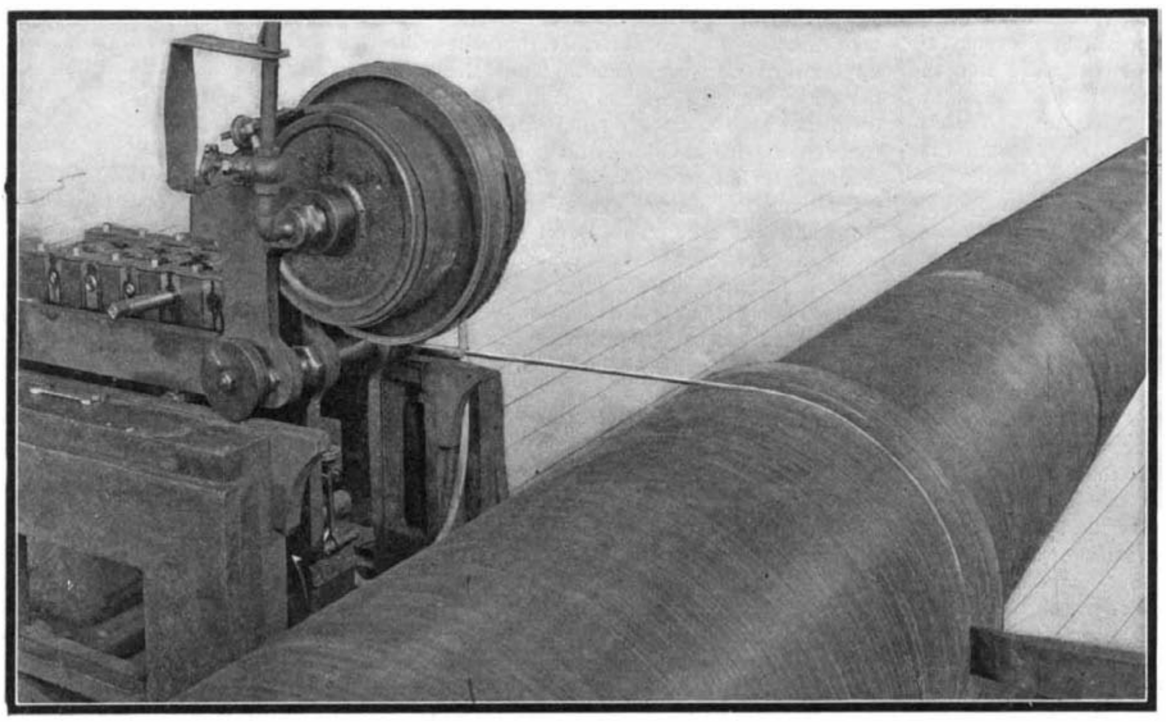


A. Trunnion jacket. B. Wire. C. Segmental tube. D. Liner.

Cross-Section Through the Gun at the Powder Chamber.

specifications on which it is built, will certainly be the most powerful piece of its weight and size in existence. The gun will shortly be tested at Sandy Hook proving ground and fired 250 rounds, with gradually increasing powder pressures, the last five rounds being fired under from 45,000 to 50,000 pounds maximum pressure in the powder chamber. The estimated service velocity of the gun is 3,541 feet per second, under a maximum powder pressure of 42,823 pounds.

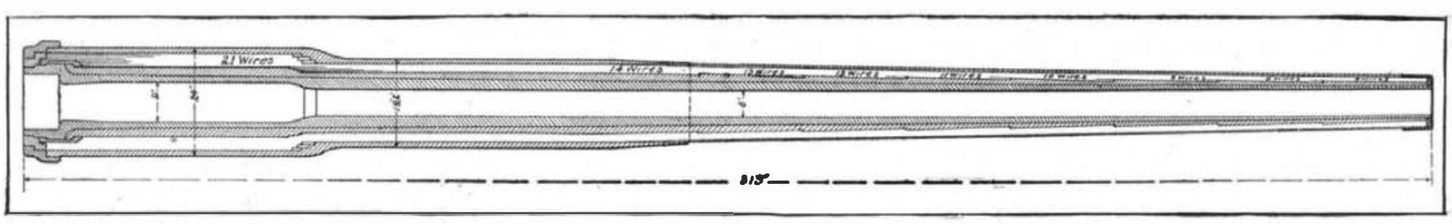
The full significance of these figures will be realized if we compare them with the ballistics of the 6-inch 50-caliber navy gun which is designed for a muzzle velocity of 2,900 feet per second when firing a 100-pound projectile. On February 8 of the present year the Bureau of Ordnance, in consequence of recent failures of some navy guns, decided to reduce the service velocities, and an order was sent out that the 6-inch, 50-caliber navy gun was to have a service velocity of only 2,700 feet per second, which is 800 feet per second less than the service velocity designed for the new wire-wound gun under construction. As the striking energy of the shell varies as the square of the velocity, it will be seen at once how very much more efficient the new piece will be than the latest type of navy gun.



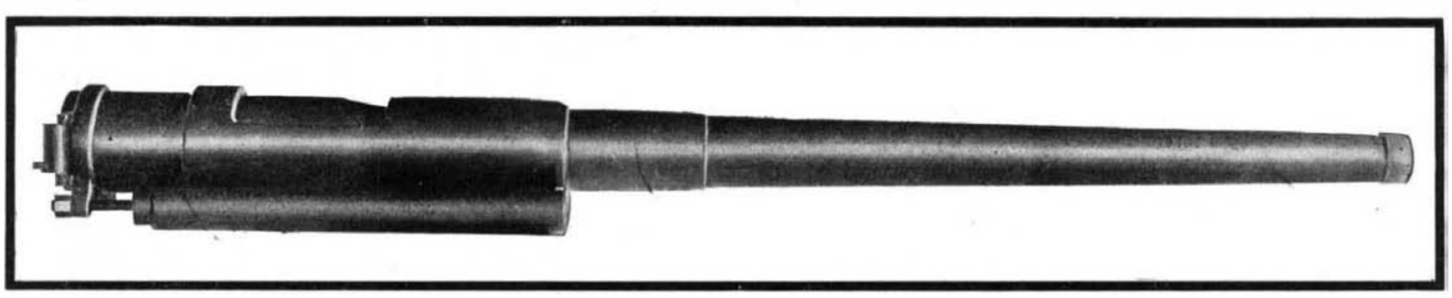
Winding the Wire Upon the Gun, Under a Tension of 2,500 Pounds per Wire, or 125,000 Pounds per Square Inch.

If a person who was quite unacquainted with modern gun construction were to watch the tedious and costly process of building up a modern high-power gun, he would naturally ask why it is not forged out of one solid piece. The gun-maker, in explaining to the inquiring layman why guns must be built up piecemeal would point out that, in forging masses of metal of the size that would be required, it would be impossible to detect any hidden defects, and that, steel being a highly elastic material, it is necessary that in the finished gun, if the whole mass of the gun is to be available in resisting the bursting effects of the powder, the metal be brought into a certain condition of initial strain. He would tell him that in a 12-inch gun, for instance, where there may be a foot or more of solid metal surrounding the bore, the pressure of the powder gases would stretch the metal at the bore of the gun to the rupture point, before the outer layers of metal were able to add their full resistance to that of the inner layers; that the bore of the gun would be cracked, and that the crack would eventually extend from bore to circumference. He would explain to him how Rodman, an army officer, at the time of our civil war, very cleverly met the difficulty in cast-iron guns, by running a stream of cold water through the bore of the gun when it was being cast, chilling and contracting the metal at the bore, with the result that as the body of the metal throughout the gun cooled from bore to circumference, it contracted and gripped the bore, throwing the latter into a state of compression, and placing the rest of the metal of the gun in a state of initial tension. The effect of this was that when the gun was fired the pressure of the powder gases was felt throughout the whole section of the gun from bore to circumference and every part of the metal did its share of duty.

He would then explain to him that as the manufacture of steel developed, the superiority of this metal to cast iron for gun manufacture became evident, and the Rodman principle of gun construction was applied by first making a steel tube containing the bore of the gun, and then shrinking on successive hoops of steel which, as they cooled, threw the inner tube into a state of compression, and were themselves left in a state of tension. He would explain to him further that in addition to the higher resisting qualities of steel over cast iron, the former metal, having the advantage of being built up in hoops which are forged on a mandrel, the metal of the hoops can be subjected to more thorough working and inspection, with a view to improving the quality of the steel and eliminating all defects. The gun manufacturer would then proceed to explain to our supposititious layman that the system of building up guns by winding steel wire upon an inner tube was a further step in the direction of securing thorough inspection of the steel, and of placing the finished gun under conditions of initial compression and tension which would be accurately known to the maker.



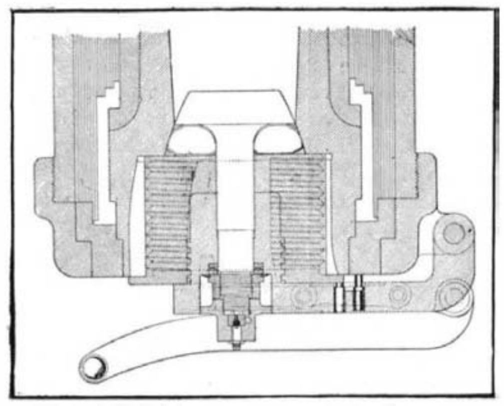
Longitudinal Section, Showing Thickness of Wire Winding.



New 50-Caliber, 6-Inch, Wire-Wound Gun for the United States Army, Shortly to be Tested at Sandy Hook. Maximum Powder Pressure 42,823 Pounds. Muzzle Velocity, 3,541 Feet per Second.

THE MOST POWERFUL GUN FOR ITS WEIGHT IN EXISTENCE.

Although the wire-wound gun is but little known in the United States, the gun built by Capt. Crozier and the various Brown wire guns which have been built and tested by the army being the only guns of the wire type that have been built in this country, the wire-wound system has been adopted by the English navy and is the standard type that is built by the two great gun-making firms of Armstrong and Vickers-Maxim in England. All the large guns of the latest English warships are wire guns, as are the weapons which are doing such good service in the Japanese navy during the present war in the Far East. The system has, therefore, long ago passed beyond the experimental stage. The difference between the wire gun herewith described and the English and Japanese guns is that in the former the fundamental principles upon which wire guns are constructed have been carried further along their logical lines of development, with ballistic results that are proportionately superior.



Longitudinal Section Through the Breech.

In the construction of the new 6-inch gun, the foundation consists of a forged steel lining tube with an elastic limit of 60,000 pounds and an ultimate breaking strength of 105,000 pounds to the square inch. This tube extends for the full length of the gun, which is 26 feet 1 inch in length, and it is enlarged from a diameter of 6 inches in the bore to a diameter of 9 inches in the powder chamber, which has a length of 49.3 inches and a cubical capacity of 3,120 cubic inches, which latter, it will be seen, is exceptionally large for a gun of this caliber. On this tube is assembled what is known as the segmental tube. It is formed of a series of sheets of rolled steel, 308 inches in length, 21½ inches wide at the breech, and 4½ inches wide at the muzzle of the gun, which are rolled into an involute shape and wrapped together to make up a solid tube. The sheets are first assembled on a stepped core, or former, and securely clamped. The core is then withdrawn and a stepped lining, of the section shown in our engraving, is forced into position within the segmental tube and the clamps are firmly screwed down, one at each 6 inches of the length of the tube, which is then centered in the lathe and turned to size. A new series of clamps is then put on, and the exterior of the segmental tube is turned down into stepped frustums of cones, each step being equal to the thickness of one wire, or one-seventh of an inch. There are seven of these steps over the bore of the gun and four steps where the powder chamber commences, one of the latter steps being the depth of one wire and three of the steps equal to the depth of two wires. Now comes the process of wire winding. One end of the wire is driven into a hole bored into the segmental tube at the first step from the powder chamber, and the wire, which is one-seventh of an inch square, is wound upon the gun under a tension of 2,500 pounds. The thickness of the winding varies from seven thicknesses, or one inch, at the muzzle to 21 thicknesses, or 3 inches, over the powder chamber. A trunnion jacket, extending from the breech to beyond the trunnions, a distance of about 12 feet, is then shrunk on with sufficient tension merely to prevent its rotation upon the segmental tube. A sheet-steel tube is also placed over the chase of the gun for the purpose of giving it a finish and protecting the wire wrapping. It should be noted that no reliance is placed upon the trunnion jacket or the chase covering, for the strength of the gun. By a study of the sectional view of the breech, it will be seen that the thrust of the breech-block is taken up jointly by the lining tube, the segmental tube, and the trunnion jacket, and a very even distribution of the longitudinal stress is thereby secured. The advantage of using a segmental built-up tube to carry the tension of the wiring is that the plates, being rolled down to a thickness of one-seventh of an inch, the danger of hidden flaws existing in the metal is practically eliminated; whereas when the solid tube is used, as in the built-up guns, there is sufficient thickness of metal for such flaws to exist without being detected. Moreover, in the segmental tube, should a flaw exist and a fracture occur in any one plate, it could merely extend through the thickness of one-seventh of an inch, and would not, as in the case of a solid tube, extend radially through the whole thickness of the tube.

In an investigation of the principles of the segmental tube wire gun by Prof. Denton, of Stevens Institute of Technology, Hoboken, N. J., Mr. Denton estimated that there was no loss of longitudinal or tangential strength in the built-up tube, for the reason that the tension of the wire windings throughout the whole length of the tube will bind the segments together "with sufficient pressure to cause the frictional adhesion between its curved lines of division to exceed the shearing forces which would be transmitted along these lines in a forged tube of the same thickness, when fired with powder developing the highest current pressures." He found, moreover, that "the metal of the segmental tube, by virtue of the magnitude of its frictional adhesion" (due to a tension of 125,000 pounds to the square inch in the wire winding), "is as available as a source of longitudinal strength and transverse stiffness as the same thickness of solid metal." Prof. Denton further found that "the distribution of the wire windings secured a practically uniform compressive resistance in the lining tube throughout its length, and without exceeding about 90 per cent of the elastic strength of the tightest wire. The lining of the tube was probably compressed so that under 50,000 pounds per square inch of powder pressure it was not required to exert a tensile resistance." In other words, the principles of the wire gun had by this system developed to such a high point that when this gun is fired at Sandy Hook in the last few rounds, with a maximum powder pressure of 50,000 pounds to the square inch, and a corresponding muzzle velocity of about 3,900 feet per second, the lining tube will still be under some of the initial compression which was given to it when the wire was wound on; which means that the wire with its high elastic limit of 150,000 pounds to the square inch, will be comfortably taking care of the enormous forces developed by the powder.

The unusually high velocities secured in this gun are due to the exceptionally large powder chamber. Owing to the abundant supply of gas given off by the burning powder, the pressure on the base of the shell is maintained at a high figure even to the moment that the shell leaves the muzzle, when the pressure is no less than 23,721 pounds to the square inch. In the earlier guns, the powder pressures fell rapidly toward the muzzle and it is this high muzzle pressure that has caused the blowing off or bursting of the chase of several guns of the hooped type during the past few months. It can be seen at once that by increasing the number of windings of wire over the muzzle, this part of the gun may be made relatively just as strong and reliable as any other portion.

There were recently received at the National Museum two termitariums from Jamaica, which are regarded as the greatest curiosities which have been placed in the institution for a number of years. The termitarium is the residence of a tribe of termites, or white ants. One of these specimens was at once shipped to St. Louis, where it will form a part of one of the government exhibits at the exposition. The other was placed on view in the museum. The largest of the two nests received by the museum is about four feet long and two in diameter, being shaped a great deal like an elongated double peanut, round and oval at the ends, and with a narrower portion in the center, with a decided crook between the two ends. This was built around the limb of a tree, and in order to get the nest the limb was cut, leaving about a foot extending from each end of the nest. The construction of the nest consists of leaves overlying each other, and arranged in such order that it was likened to a bill file with bills placed in regular order one over the other.

THE RUSSIAN ICE-BREAKER "ERMACK."

(*Continued from page 360.*)

blades are enormously thick, and are calculated to be brought up by ice without breaking when running at full speed. The machinery is all designed to withstand this test.

The "Ermack" is capable at half power of putting 1,300 tons of weight on the ice to crush it down, when in her ordinary ice-breaking trim, with a draft of 22 to 23 feet. The bow is enormously strong, and for a considerable distance the frames are only 12 inches apart. The ice-belt at the bow extends to the keel. At the sides of the ship it is 27 feet deep.

The "Ermack" left the Tyne on her maiden voyage to Cronstadt early in March, 1899, under the command of Capt. Vassilieff, Admiral Makaroff being also on board. In less than a fortnight after sailing, the ice-blink was seen just before dark, the first drift-ice being met with off the western end of the harbor of Revel. In the Gulf of Finland the small drift ice is first met; this gradually grows to a paste, which, in calm weather, soon solidifies into floes. These increase in size until the solid ice is met, and it is here that the packs of ice are found. The "Ermack" proceeded by night through the ice, her course illuminated by the electric searchlight. On the rocks and islands in the Gulf of Finland the ice forms to an enormous thickness, and the noise occasioned at the bow of the vessel when breaking ice was considerable, but the vibration set up forward was very small. The "Ermack" pursued her way through the ice right up to Cronstadt. Below Cronstadt the vessel could easily break her way through the ice at 8 knots an hour, the ice field being from 18 inches to 24 inches thick, with 6 inches of snow upon it. Three days after her arrival at Cronstadt she was ordered to Revel to save steamers that were in danger of being crushed by the ice, and to open the port. Upon arrival at Revel Bay it was found that an enormous ice-pack had been formed across the entrance to the bay, 15 miles from the town of Revel. The pack had formed during a northwest gale that had blown the drift-ice from the Baltic into the bay, packing it in a dense mass 3½ miles across, about one-third of a mile wide, and from 20 to 25 feet thick, completely closing the harbor. In two hours the "Ermack" succeeded in crushing a way through this ice-pack in fourteen charges. During the limited time that the "Ermack" was on that station she was instrumental in salving eighty-two vessels that were fast in the ice.

In order to test the capabilities of ice-breakers of large size in polar ice, the "Ermack" was sent to Advent Bay, in Ice Fjord, Spitzenbergen. She was fully provisioned for twelve months. Advent Bay was left on August 5, 1899, and on the following day she encountered the first polar drift-ice. Then the fight began in real earnest. Collisions with enormous masses of ice occurred continually. The floes became thicker and older as the ship proceeded north. It was soon a task of ice breaking and charging continually. When stopped by ice, the vessel retired 100 yards or more, got up speed to strike the strong spot, and continued to do so until the obstruction was broken down. In some of the water lanes it was strange to note how the ice had separated in a vertical cleavage, leaving the walls of solid ice on each side of the canal from 12 feet to 20 feet thick. With half boiler power the "Ermack" could force her way through polar ice 12 feet to 14 feet thick at 2½ to 3 knots an hour.

Reference should be made to the arrangement for coupling up the "Ermack" with other vessels in order to make a train of ships for more effectually dealing with thick ice. Although the "Ermack" is big and strong, there is, of course, a limit to her capacity of breaking up ice and to the speed with which she can perform the operation. A vessel pushing astern of her, therefore, would supply additional power for the work. Forward, the stem is set at an angle of 70 deg. from the vertical. In going through ice she slides up, raising her bow, and this causes the ice to break down. She might, of course, mount the ice until her forward propeller came in contact with it; but this is made of sufficient strength to withstand the shock. That, however, is not what is expected generally to occur, as the form of the bow is designed to insure a constant breaking down of the ice. This would absorb an enormous amount of power; but if another vessel, either an ice breaker or an ordinary steamer, were pushing astern, naturally the speed could be increased. Moreover, a steamer not so strongly built as the "Ermack" would be protected by following close behind her. For this reason a recess has been built into the counter. This recess is designed to take the stem of the following vessel, arrangements being made for lashing the latter in firm contact with the leading craft.

The Geographical Society of Philadelphia.

The annual reunion of the Geographical Society of Philadelphia was held Tuesday evening, April 26, at the Hotel Roosevelt, Philadelphia. President Angelo Heilprin, the noted Arctic explorer and student of Mont Pelé and other volcanoes, in his opening remarks sketched the history of the society from its organization twelve years ago to the present, mentioning the great geographical discoveries made in the period in the Far North, Asia, Africa, and the Antarctic regions, in some of which members of the society have participated. The society began in a modest way with fifty-one members and has grown so that a hall seating several hundred is now needed for the open meetings. Excursions to points within reach from Philadelphia are a feature of the summer work of the society.

Prof. Heilprin announced that the Elisha Kent Kane gold medal for noteworthy geographical achievement had been awarded to Capt. R. F. Scott, R. N., of the "Discovery," who has been in charge of the British Antarctic expedition which has recently returned in safety to New Zealand after two years of arduous work. The principal features of Captain Scott's geographical work have been the tracing of the eastern edge of the Antarctic continent for 350 miles south of Mount Erebus; the journey of the "Discovery" eastward from Mount Erebus for 640 miles along the edge of the great ice-barrier to new land, named by this expedition King Edward VII. Land, which is probably a portion of the Antarctic continent. Capt. Scott has attained a point further south than any other explorer, and the geographical results of the expedition under his care are among the most important which have been achieved in recent years.

The chief speaker of the evening was Commander R. E. Peary, U. S. N., president of the Eighth International Geographic Congress, which is to meet in this country in the fall. Commander Peary said that when he was attached to the League Island navy yard, fifteen years ago, he completed the plans for his first expedition into the Antarctic regions, and presented them to Prof. Heilprin, then the president of the Academy of Natural Sciences, who took a hearty interest in the matter and, in connection with Capt. Amos Bonsall, Mr. H. G. Bryant, and others, began the agitation which made possible the Peary South Polar expedition of 1891.

To-day Arctic exploration is not to be considered a foolish matter, but it is a broad national undertaking participated in by the President, Congress, the press, and the people. The object, of course, is the North Pole, which is the mathematical center of the northern hemisphere, where there is but one day and one night in the year; where there is no west and no north, and every wind is a south wind. It is the last great geographical prize which the earth has to offer, and in view of the work which has been carried on under the auspices of the United States, its winning belongs by right to this nation.

The undertaking divides itself naturally into two parts. The first section is the journey by ship to the north shore of Grant Land; the second section is the 420 nautical miles from Grant Land to the Pole. The journey from New York to Cape Sabine or Cape York can be made every summer in about two weeks time. Here Commander Peary would get Esquimaux and dogs, and proceed to Grant Land in from two days to two weeks, according to the season. This journey is the uncertain part of the preparatory work, but it has been made by four ships. The ship would be frozen in off Grant Land by the middle of September, and the preparatory work for the next season's dash to the Pole would occupy the time until the long Arctic night set in. About the middle of February returning light would enable the sledges to start north, and they would have three months or more in which to cover the 840-mile journey to the Pole and back before there was any chance of the ice breaking up. Commander Peary himself has made several dog journeys longer than this.

The features which promise success for a new expedition are that the explorer would take an especially constructed ship which would depend primarily upon steam power for propulsion and would have auxiliary sail, rather than a sailing ship with auxiliary steam, as has been done heretofore. The second feature would be the extensive utilization of the native Esquimaux, which would be possible through the personal influence which Commander Peary has obtained with the tribe during his previous expeditions. The third feature would be Commander Peary's intimate personal knowledge of the coast. The nervous strain due to the long winter night, is the great drawback to work in the polar regions. The cold, which is easily provided against, is only relative in any case and is therefore a negligible factor. The value of the attainment of the Pole lies in getting many geographical data which need not be enumerated, farther than that they lie in pendulum observations which would be invaluable for determination of the exact shape of the globe, and in observations bearing upon terrestrial magnetism and the meteorology and the economics of 300,000 square miles