thington Admiralty" bilge pump between decks, their combined capacity being 1,000 gallons per minute. The electric light plant, consisting of three Armington & Simms engines, has a capacity of 2,400 lights. Two of these engines are shown below the main deck. They are of the direct connected type. The pilot house carries a search light which will enable objects to be distinguished at a distance of two miles.

Steam is supplied by four steel boilers of the lobster return flue type, each 11 feet wide, 9 feet 3 inch diameter of shell and 33 feet long, with steam chimneys 87 inch diameter and 10 feet 6 inches high. Forced draught is supplied by two large "Dimpfel" blowers, driven by independent engines. The steam pressure is 55 pounds to the square inch, and the total horse power 4,000. The engines, boiler and machinery were constructed by the W. & A. Fletcher Company, of Hoboken, N. J.

The Adirondack was modeled and designed by Mr. John Englis, vice-president of the company, and embodies the results of long years of experience as to the requirements of river navigation. Externally, as the excellent photograph taken specially for the SCIENTIFIC AMERICAN will show, she is an extremely handsome vessel, with all the characteristic marks of a Hudson River boat, and more than the ordinary beauty in her lines. By careful saving of weight in the design, it has been possible to give her an extra deck over the number carried by other ships of her size and horse power on the river. There are five in all: the main, saloon, gallery, upper gallery and dome decks, and all this on a draught of 8 feet of water. There are 350 staterooms, including 24 parlor rooms and 4 suites of parlors. There are also 286 berths in the cabins and 120 berths for the crew. Each stateroom has an iron or brass bedstead, and has a window on the outside of the vessel. The dining room on the after part of the main deck is surrounded by large windows, which give an uninterrupted view of the river on both sides. Two private dining rooms at the extreme after part of the vessel open into the main dining room. All these rooms are finished in white mahogany, with decorated panels in the ceiling, and at each intersection of the panels is an electric light drop covered by a round cut glass globe. There are 200 such lights in the dining room alone.

STAIRWAY FROM SALOON TO GALLERY.

From the quarter deck, which is finished in white mahogany, a grand staircase leads to the main saloon, which is unusually handsome in its appointments and decoration, the predominating style of the latter being Empire, white, green and gold. A rich effect is secured by the beautiful design and workmanship of the wrought iron and mahogany hand rails around the galleries; and it is noticeable that the dome ceiling is free from any break by lighting appliances, the lights being concealed at the base of the cove.

On the upper tier, in the extreme after part of the upper gallery, is situated the café and smoking room, which is arranged with windows on three sides, so as to provide a clear view of the beauties of the Hudson River.

In addition to the ample water supply in case of fire, the thermostat is used in every stateroom and in all exposed parts of the ship, so that any outbreak of fire would be quickly located.

The Adirondack has never as yet been run at her maximum power; but she has run with a full load of freight and passengers from alongside her dock at New York to Albany, a distance of about 144 miles, in 7 hours and 55 minutes. The fastest speed, 20½ miles an hour, was made between New York and Hudson, the speed being considerably reduced in the upper river by shoal water.

ARMOR FOR FORTIFICATIONS.

Between projectiles and armor there has been a constant struggle for superiority, for while, on the one hand, every effort has been made to bring the projectile to such a state of perfection that it will destroy even the strongest fortification, the resisting power of armor has, on the other hand, been just as steadily increased. It has been extremely difficult to find armor suitable for naval purposes, because, although the thickness of the armor was an important consideration, it had to be limited on account of the danger of overloading the vessel to which the armor was applied. At first, and until 1875, rolled iron was used for armor and then

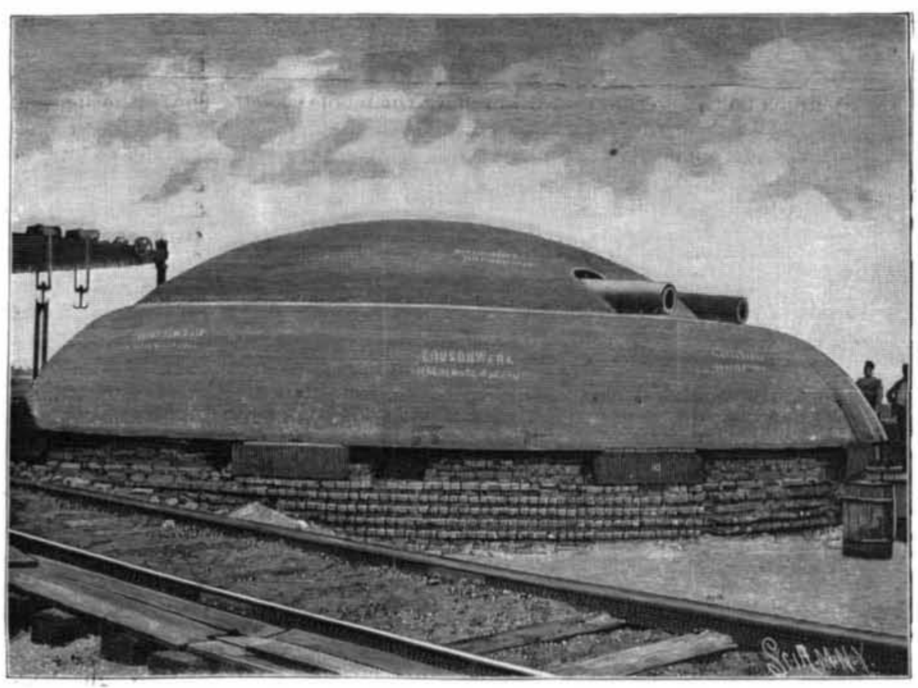


Fig. 1.—CHILLED IRON ARMOR TURRET FOR TWO 24 CM. GUNS—EXTERIOR VIEW.

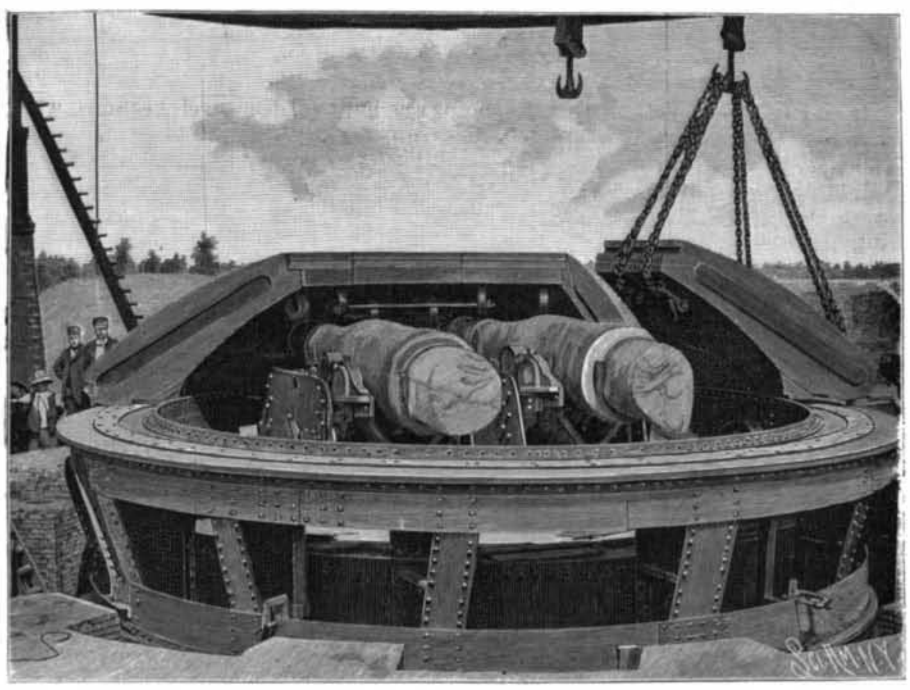


Fig. 2.—CHILLED IRON ARMOR TURRET FOR TWO 24 CM. GUNS IN COURSE OF CONSTRUCTION.

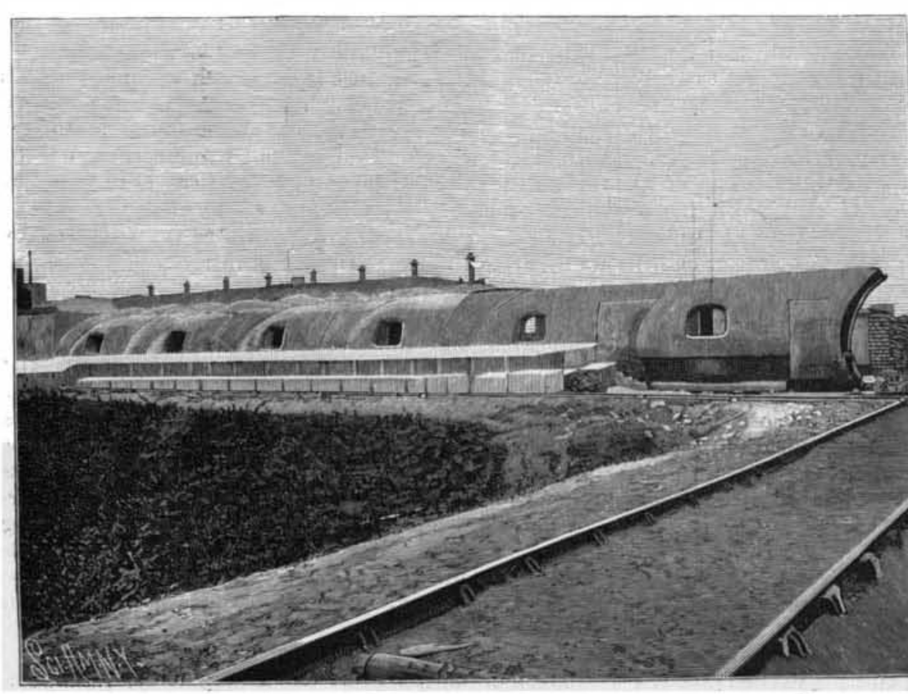


Fig. 3.—EXTERIOR VIEW OF A CHILLED IRON ARMOR BATTERY

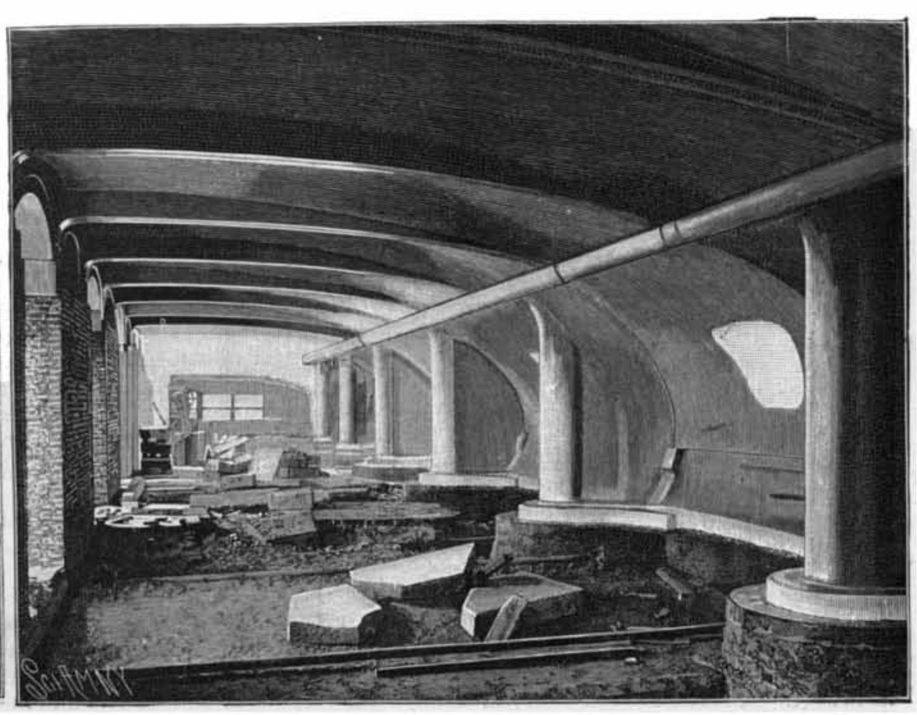


Fig. 4.—INTERIOR OF A CHILLED IRON ARMOR BATTERY.

steel was adopted; but, as this showed too great a tendency to be racked by fire, a compound armor was constructed by welding a plate of steel on one of iron. More recently nickel-steel armor (first made by Krupp) and the Harvey armor have been much used. The latter consists of soft steel, the surface of which has been carbonized and hardened so as to give it great power of resistance.

Finally, it became necessary to use armor on coast fortifications, as it was impossible to build walls thick enough to resist the terrible force of the new guns, and even if the masonry could have withstood the high explosives in the projectiles the embrasures in such thick walls would have limited the range of the guns behind them. Plates of armor like those used for vessels were employed on land fortifications, but later chilled iron armor, which was first made by Gruson in 1868, was substituted for rolled iron armor. The great weight of the former rendered it impracticable for use on vessels, but made it especially effective in annihilating the live force of the striking projectile. It is used for stationary parapets, for batteries and for revolving turrets. Our engravings Nos. 3 and 4 show interior and exterior views of a battery made of chilled iron, for 24 centimeter guns, in course of construction. The porthole plates are curved so as to cause the attacking projectiles to slide off, and these plates are supported by pillar plates. Below the porthole plates are the pivot plates that carry the pivots on which the carriages swing, and in front of them, reaching to the lower edge of the portholes, is the glacis of beton or stone blocks. The battery is in a casemate which is protected at both ends from the shells of the enemy by heavy walls and earthworks.

Where a wide range is to be covered, armored turrets are used which are made to revolve so that the guns can be fired in all directions. Chilled iron armor of the type used for vessels is employed for these turrets, and the form and arrangement of the first ones were the same as in the turrets of monitors. Gruson was the first to undertake the construction of a turret to which chilled iron is adapted, and thus a new model for armored turrets was obtained. The cylindrical form with a flat or arched top has generally been abandoned and the preference given to a cupola-like arrangement of the whole turret, which presents no vertical surface, whereby the action of the striking projectile is very much weakened. Our illustrations Nos. 1 and 2 show a revolving cupola or turret for two 24 centimeter guns, in course of construction. No. 2 shows the cupola resting on a wrought iron base which, in turn, is revolvable on a circle of rollers. The tongues and grooves that form the connection between the separate plates are plainly shown. The gun carriages have no sidewise movement, as this is obtained by the revolution of the cupola. The guns are raised and lowered by hydraulic power, and when fired the recoil is taken by two hydraulic brake cylinders for each gun, limiting the recoil to 2 to 3 calibers. The guns return automatically to the firing position. Aim is not taken through the portholes, but through a little sight opening in the roof of the turret. The revolving mechanism and the pumping mechanism for the hydraulic power are usually operated by hand, but in France, where the turrets were intended to turn in carrousel fashion during a battle, motors were used. A brake device is provided to prevent accidental turning of the turret when only one gun is to be fired. A suitable stationary glacis is arranged on the masonry foundation and surrounds the revolving portion of the turret. This is illustrated in cut No. 1. This glacis is embedded to its upper edge in beton or granite. Forty or forty-five men are required to operate such a turret, only six of whom are needed to man the guns. Under favorable circumstances each gun can be fired about once in three minutes.

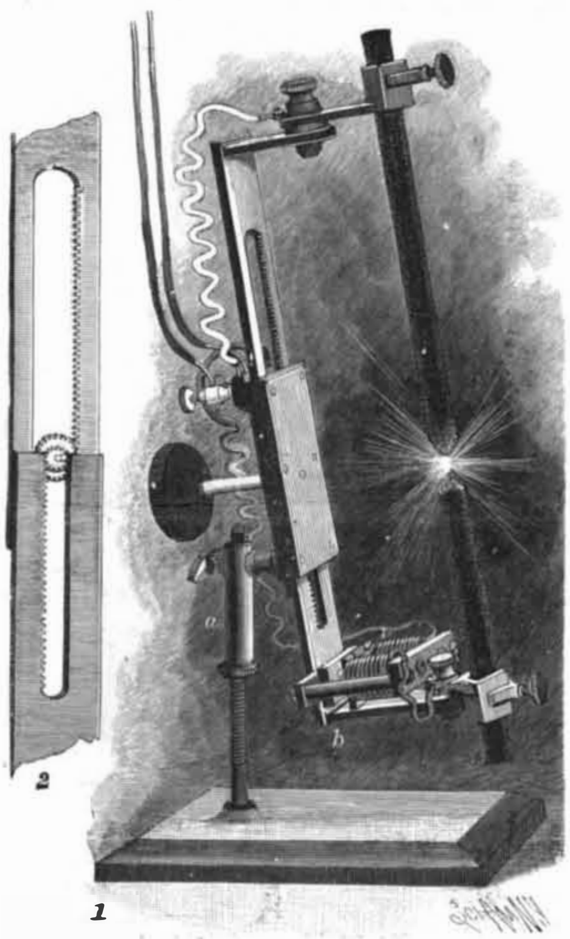
As only long cannon for direct fire can be employed in such revolving turrets and batteries—generally arranged in pairs in the former—cupolas for howitzers and mortars have to be differently arranged. These weapons are always fired at the same angle, and therefore the cupola which turns in the circular glacis can be quite flat and, on account of its light weight, be rigidly connected with the carriage, which revolves on a central pivot. Carriages of this class are especially adapted for inland fortifications and are called "armored carriages." For the shorter mortars the cupola is contracted to a sphere inclosing the mortar, only a small portion of the cupola about the opening extending from the glacis.

By the introduction of the disappearing turrets an attempt was made to obtain greater safety than could be expected with turrets which simply revolved so that only their portholes are turned from the enemy. The first of these were constructed by the Schumann-Gruson works and were arranged for small and medium sized guns, but later a disappearing turret for heavier guns was built in France by Galopin. In such turrets the moving part, which is made cylindrical and covered with a slightly arched hood, has a sinking movement as well as a turning motion, and can be lowered until its top is on a level with the glacis, so that when in loading position there is no opening exposed to the enemy and the turret itself is scarcely visible. The disadvantages of this arrangement are that the wall carrying the portholes is so straight as to have very little resisting power, and that the motors required for large plants are very expensive. The Frenchman Mougin tried to solve the question of obtaining greater safety while retaining the approved armored cupola, by mounting a comparatively flat dome on a turntable by means of a cradle, so that when tipped forward the portholes are brought under the glacis, and when the cupola is swung back the portholes return to the firing position. This pendulum turret also has its disadvantages, the chief of which is that the circular opening between the cupola and the glacis cannot be covered, and if the portions of the enemy's shells should find an entrance there, they might easily disable the turret.

We have, as yet, mentioned only fortifications which to a certain extent may be considered proof against the fire of an enemy; that is, those in which an effort is made to supply protection against indirect as well as direct fire. In many cases, especially in coast fortifications, such overhead covering is not deemed necessary, and as a substitute for the closed revolving turrets, either the barbette turret—in which the guns fire over a stationary ring of armor—have been borrowed from armored vessels, or the disappearing carriage, designed by Moncreiff and completed by Armstrong and others, has been adopted. In the former the gunners are protected by a shield connected with the carriage mounted on a turntable. A longitudinal opening is arranged in this shield to provide for aiming the gun high, and it is closed by the barrel of the gun, which is thus left uncovered. In the disappearing carriage the gun also stands on a turntable in a basin of masonry or armor that is provided with a perfectly flat top, also of armor, which cannot be seen from a distance. If such an invisible turret is to be brought into action, the barrel of the gun is raised by means of a pneumatic device, and appears at an aperture in the roof, which is opened at the proper time, and then after being fired the gun is returned automatically, by recoil, to the protected loading position. Disappearing carriages of the front pintle form are used in batteries in which the guns are fired over an armored parapet.

Armored fortresses are found on the coasts of all civilized countries. In Germany and Italy—in the latter much has been done for the defense of its long stretch of coast—the above described Gruson chilled iron turrets are preferred, but elsewhere, as in England and the United States, disappearing carriages are more used. There are immense inland fortifications of unusual strength in Roumania, on the Russian frontier, which consist of three lines of defense about half a mile apart, the first consisting of portable armor shields for small rapid firing guns, the second of disappearing shields for medium sized guns, and the third of disappearing armored turrets. There must be from three hundred to four hundred such armored structures there, the greater number of which have been made by the Gruson works from designs of the late of Mr. Schumann. The fortifications at Bucharest must include two hundred and three armored turrets and these, as well as the fortifications on the Meuse, at Liege and Namur—with a total of one hundred and ninety-two armored turrets—were built from the plans of the Belgian engineer Briahnont. Of course, there are many armored turrets of this kind in other places, notable on the eastern frontier of France, in regard to which we have no detailed information.

As shown by the above, armor has become more and more indispensable on account of the development of projectiles, and the old competition between guns and armor is no longer restricted to naval warfare, but has been extended to warfare on land.—Der Stein der Weisen.



HAND FEED ARC LAMP.

HAND FEED ELECTRIC LAMP FOR LANTERNS.

BY GEORGE M. HOPKINS.

While a good automatic lamp is undoubtedly preferable to a hand lamp for uses necessitating the absence of the operator from the vicinity of the lamp, it is certain that an ordinary hand lamp is not to be despised, and when the hand feed is supplemented with a magnetic device for striking the arc, the difference between the two types of lamps referred to is not to the disadvantage of the hand lamp when the latter is used in a lantern or for some other purpose which permits the operator to remain near the lamp, so that he may adjust it at intervals of about four or five minutes.

The lamp shown in the illustration has been used for an entire evening without a flicker. The upper, or positive carbon, is cored, and the lower, or negative, is solid, hard Carré carbon.

On the threaded rod extending upward from the base plate is placed the sleeve, a, which is connected with the slide holder so as to have a slight inclination, as is usual in lamps for lanterns, in order to expose more of the face of the crater of the upper carbon. The slide holder contains two slotted slides; the one holding the upper carbon being 7½ inches long, the one holding the lower carbon being 6¼ inches long, each being 1¼ inches wide. To the lower end of the lower slide at b is pivoted an arm extending outwardly and supporting the lower carbon-holding socket. To the arm near the joint thereof is secured an upwardly extending stud carrying an armature. An electromagnet having an elongated yoke is supported in front of the armature by brass studs attached to a brass cross arm fixed to the lower slide. A curved brass spring fastened to the armature bears on the poles of the magnet and serves the double purpose of throwing the armature back and the carbon upwardly when the armature is released, and of preventing the armature from sticking to the magnet.

The upper carbon-holding slide is provided with a fixed arm extending outwardly and supporting an insulated carbon-holding socket. These sockets are connected with their respective arms by bolts, which are surrounded with soapstone insulators provided with flanges which separate the sockets and the arms. The heads of the bolts are insulated by means of mica washers. The holes through which the bolts extend are made oblong to permit of adjusting the carbons in a way to secure the best results, that is, by arranging the point of the lower carbon so that it will be slightly in front of the axial line of the upper carbon when the lamp is in operation.

In the slots of the carbon-holding slides are secured racks, which engage pinions on the spindle journaled in the slide holder (Fig. 2). The pinion for the lower carbon slide has half as many teeth as there are in the pinion for the upper slide, so that when the spindle is turned by the rubber hand wheel the carbons are moved in proportion to their relative consumption.

To an insulating strip attached to the back of the slide holder are secured two binding posts for receiving the wires connecting the lamp with the current supply. One binding post is connected with one terminal of the magnet, and the other terminal of the magnet is connected with the lower carbon socket. The other binding post is connected with the upper carbon socket.

The magnet is wound with coarse wire (No. 16 or No. 14), and the armature is adjusted to pull down the lower carbon about one-eighth of an inch. The carbon-holding sockets are formed of square brass tubing, with a screw at one angle which forces the carbon toward the opposite angle, and thus centers and aligns the carbons.

The Edison direct current is suited to this lamp when about fifteen ohms resistance is introduced in series with the lamp. A suitable range of current is eight to twelve amperes.

The great advantage of the arc striking device is that, after the carbons touch, the arc is instantly formed of the right length, thus saving the trouble of any fine adjustment by hand, and avoiding the possibility of any long continuance of a heavy current on the circuit. A very slight turn of the adjusting spindle, once in about four minutes, insures perfect steadiness. It is well to form a habit of thus regulating the arc after each change of slides. The illustrations are approximately one-third size.