the after deck. To these are added several rapid-fire guns of the smaller calibers, placed at the most commanding positions about the vessel. Her single military mast, in addition to the armored top, carries a powerful search-light mounted on an upper platform.

To give as great an armor protection as possible on a very limited displacement, the armor has been disposed in the form of an arc of a circle, turning downwards at the sides to four feet below the fighting-line. The armor on the crown is three inches in thickness, increasing to five inches at the sides. In order that the target presented to an enemy may be as small as possible; ballast-tanks have been provided capable of holding enough water to lessen the cruising freeboard three feet; so that the hull target exposed, in still water, will be represented by a segment of a circle, rising from zero at the water-line to four feet above at the centre of the vessel.

Particular attention has been paid to the subject of water-tight compartments, and the appliances for readily freeing them from water, both in case of accident and for restoring her to the normal line of floatation.

The ram bow with which this vessel is fitted, the speed that she is calculated to attain, and her handiness, all combine to render her a formidable and valuable addition to our seacoast defences, while her coal capacity, and ability to remain at sea at a 10-knot speed for over a month without recoaling, make her of the highest service as a cruiser.

Great care has been bestowed on the subject of light and ventilation below. A complete electric plant, comprising lights, fans, and blowers for ventilating, with all modern improvements, will undoubtedly do away with many of the ills that prevailed aboard former types of low-freeboard ironclads.

TOBIN BRONZE.

THIS alloy, manufactured by the Ansonia Brass and Copper Company, New York and Chicago, is attracting attention on account of its high elastic limit, tensile strength, toughness, and uniform texture. When rolled hot, the tensile strength of the bronze has been found to be greater than that of mild steel, certain tests showing for the bronze an average tensile strength of 79,600 pounds per square inch, and for steel 65,630 pounds; the elastic limits being 54,257 pounds and 36,510 pounds respectively.

Further, at a dead red heat, Tobin bronze can be forged and stamped as readily as steel. It is maintained by those who have experimented with and tested different kinds of metals with a view of determining their utility for forgings, that they find Tobin bronze to be the only bronze they have tried that will stand the process of drop-forging.

The alloy is lighter than copper, can be worked well in a lathe, and when finished has a bright golden color. Its freedom from blow-holes, durability, and anti-frictional properties adapt the bronze for use on all bearing surfaces; while its lightness, in addition to its great tensile strength, and resistance to the corrosive action of sea-water, renders it a suitable metal for condenser-plates, steam-launch shafting, ship sheathing, etc. When rolled in sheets and tempered or drawn in wire, it makes an excellent spring metal.

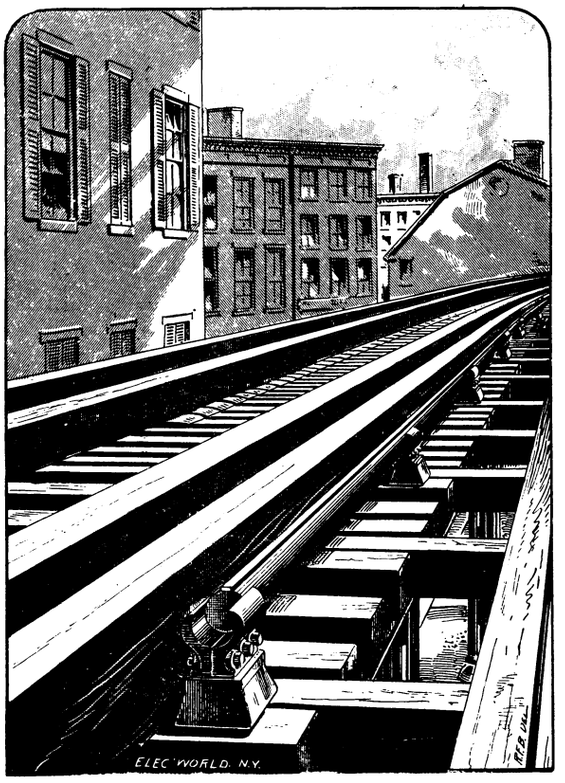
Its resistance to oxidation makes it a useful material wherever this is likely to occur. Some interesting experiments on this very point were made with the bronze by the inspectors of machinery of the United States steamers "Concord" and "Bennington."

With a view to determining its torsional endurance for steam-launch and yacht shafting, test specimens an inch long were cut at random from three-fourths-inch hot rolled rods, reduced to half an inch, and subjected to a torsional test in comparison with the best quality of machinery steel selected by Professor J. E. Denton, professor of experimental mechanics at Stevens' Institute, and tested by him on Thurston's autographic testing-machine. The results were as follows: average load at end of one-foot lever, which strained samples to elastic limit, for bronze 328 pounds, for steel 340 pounds; which ruptured samples, for bronze 633 pounds, for steel 711 pounds.

Another notable quality — its non-liability to give forth sparks — makes it invaluable for gunpowder machinery and gunpowder tools of every description.

A LARGE ELECTRIC-CURRENT CONDUCTOR.

A NEW departure in current conductors for electric-railway purposes has been taken by the Daft Company, who are now operating trains on a section of the Ninth Avenue Elevated Road in this city. The new kind of conductor is shown in the accompanying picture, which is a view on the road mentioned, looking south from Fourteenth Street. The conductor, which is supported by heavy insulated cast-iron brackets, runs along outside the outer guard-rail of each track. It is of round iron, three inches in diameter, and is surmounted by, and in perfect electrical contact with, a bar of phospor bronze three-eighths of an inch thick by one inch wide. This bar takes all the wear from the contact apparatus, and will retain a polished surface under all circumstances. The supporting bracket is made in two parts, as may be seen in the illustration, and has a grip sufficient to prevent all possibility of displacement



NEW DAFT CONDUCTOR, NEW YORK ELEVATED ROAD.

of the conductor. The conductor is elevated a considerable distance from the ties, and the supporting brackets are well insulated, so that the chances of loss of electric energy through leakage are reduced to a minimum.

The difference in cost of iron and copper admits of the greatly increased size of conductor, giving the same conductivity at much less expense.

The Daft Company are now equipping the Ninth Avenue road with this conductor from Fourteenth Street south to Rector Street station, near the Battery; the success attending the running of their trains north from Fourteenth Street during the past winter encouraging them to extend operations and equip a greater length of track as rapidly as possible.

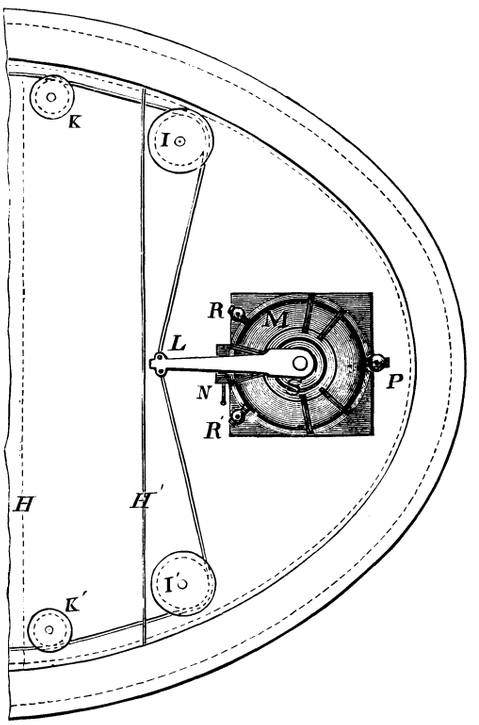
A METEOROLOGICAL EXHIBITION.

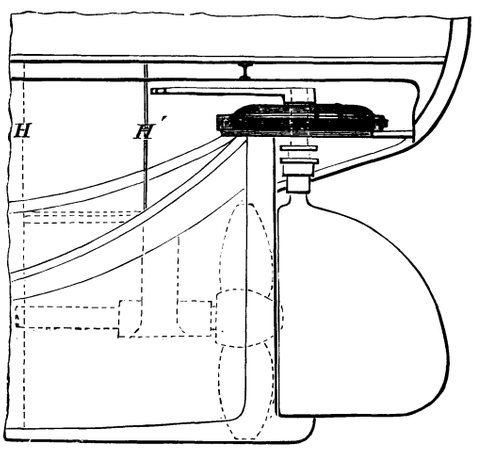
SEVERAL months since, the New England Meteorological Society, following the annual custom of the Royal Meteorological Society of London, decided to hold a loan exhibition in Boston in connection with its fourteenth regular meeting. The exhibition was opened in the physical laboratory of the Massachusetts Institute of Technology, Jan. 15, and was continued seven days. Among those who sent apparatus were Mr. Rotch from his Blue

Hill Observatory, the United States Signal Office, Harvard College Observatory, the Institute of Technology, the Boston Water Works, and the Draper Manufacturing Company of New York. Owing to the generous response to the circular requesting the loan of articles, particularly by the United States Signal Service, the exhibition was a success, and was so well attended by visitors that it was continued three days longer than was originally intended. Now that the feasibility of such an exhibition has been demonstrated, it is to be hoped that others will follow, as there can be no doubt of their effect in stimulating the study of meteorology.

THE HORNIG DIRECT-POWER STEERING SYSTEM.

THE steering system herewith illustrated is the invention of Julius L. Hornig of Jersey City, N.J. It may be operated by steam, hydraulic, or pneumatic pressure, the last being preferable. The motor is attached directly to the rudder-head, as shown in the

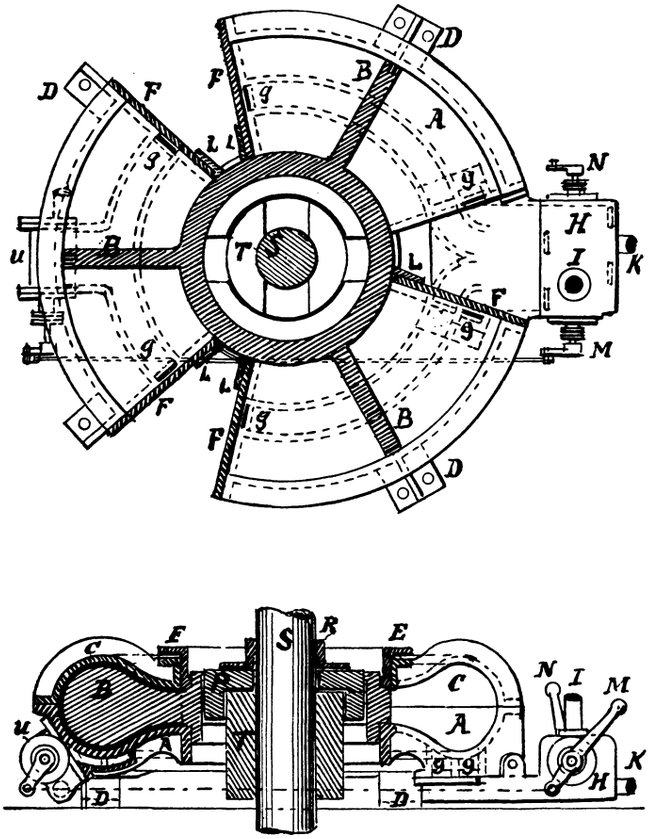




FIGS. 1. AND 2.

illustrations, though a special form of the motor is made which may be placed in any convenient part of the vessel, connecting with the rudder by chains, ropes, or rods.

The motor is shown at *M* in Figs. 1 and 2, the usual tiller, *L*, not being removed, so that the vessel may be steered by hand if necessary. In fact, either hand or power steering may be done, or both at once, as neither system interferes with the other. *I* and *K* are guide-pulleys for the usual tiller-ropes. *R*, *R* are relief-cocks, and *P* is a regulator-cock for the brake.



FIGS. 3 AND 4.

The motor has three pistons, working in an annular chamber, as shown in Figs. 3 and 4. *A* and *C* are the bottom and top cases of the chamber; *B*, the pistons; *D*, the legs by which the motor is secured to the deck; *g*, the ports; *H*, the valve-chest; *I*, the inlet-pipe; and *K*, the outlet-pipe. *M* is a lever for working the regulator-valve *U*, and *N* is the main valve-lever. *S* is the rudder-head; *T*, the motor hub; and *F*, the end covers or abutments.

The reason for preferring pneumatic pressure to operate the motor is that liquids have practically no elasticity, and may freeze, while steam will condense. Air, on the other hand, is subject to no change; and its elasticity makes it an excellent cushion to receive the shocks of wave-blows, thus relieving the mechanism from sudden strain. In 1886 two boards of naval experts, acting under government instructions, made trials of pneumatic steering-gear, and reported its superiority over other methods.

The pressure-valve, which is operated by the lever, as shown in the cut, regulates the action of the pistons by supplying pressure to one side while relieving that on the other, or *vice versa*; while the pistons and rudder will remain stationary when the valve is kept closed. The motor may be controlled from any part of the vessel by any of the usual mechanical methods or by electrical transmission.

PROFESSORS AYRTON and PERRY announce that Messrs. J. W. Queen & Co. of Philadelphia, Penn., are alone authorized to sell their electrical measuring instruments in the United States and in Mexico, and all instruments sent to America which have satisfactorily passed their tests will bear the firm's name on them as American agents, as well as being accompanied by a certificate of accuracy.