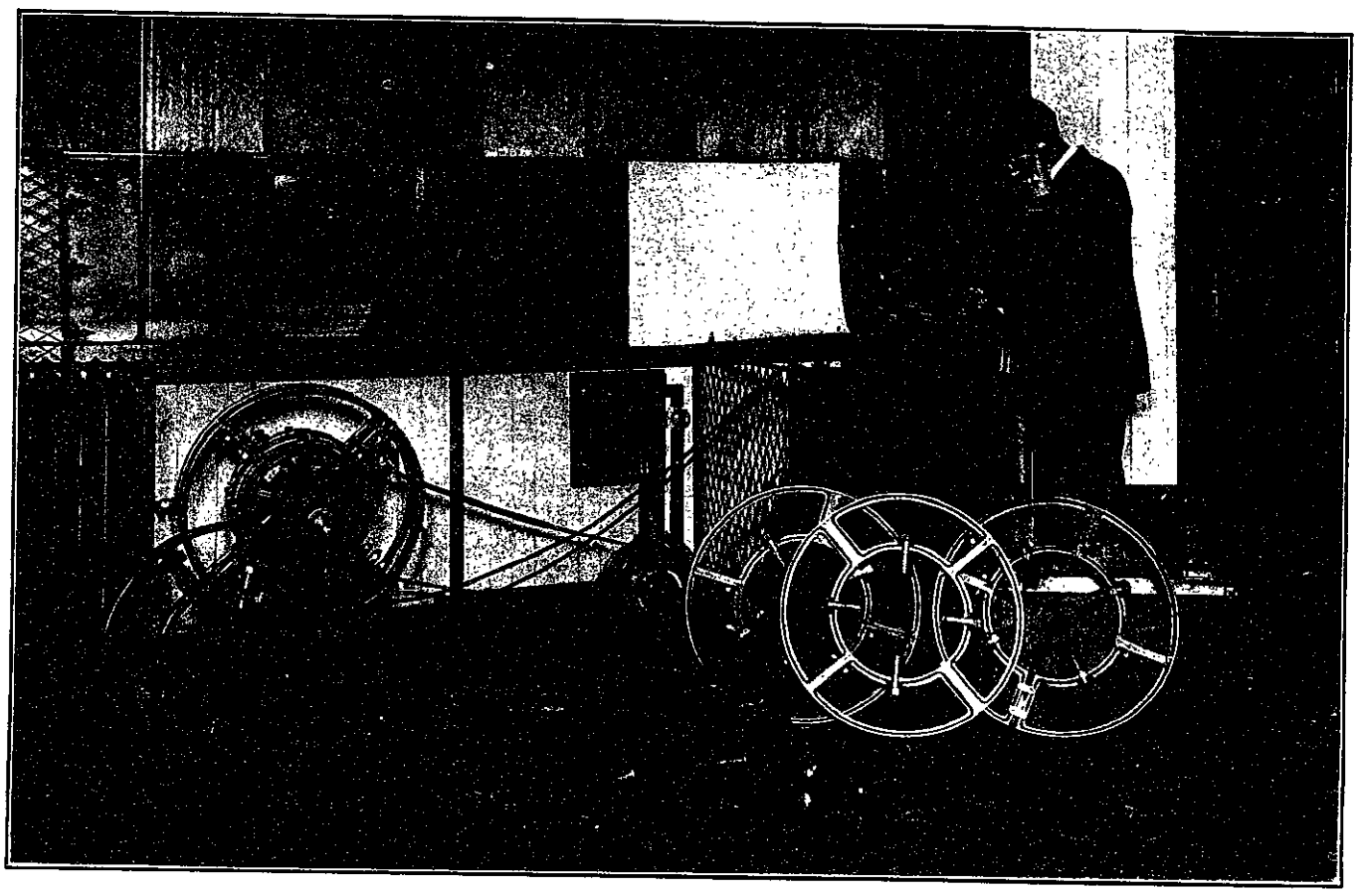

TORSION METER AND CALIBRATION APPARATUS.

WARSHIP DESIGN

(Continued from page 73.)

dering number of solutions, fluctuating and progressing along with the technical development. Also probably unequalled are the magnitude and cost of experiments which have been carried on in time of peace to settle questions that otherwise could only have been solved through war experience.

Therefore, in order that the students should be able to benefit by previous experience, a course in warship design must begin with a historical review, explaining the causes, technical and military, which have led to the various steps in the development of warships. Such a course broadens the view of the students, affords a basis for the full understanding of the later lectures on design, and helps him to avoid the repetition of the errors of previous designers.

Accordingly, a course of the History of Development of Warship Design, going back to the middle of the last century, when steam power and armor were introduced into the navies, forms the introduction to the theoretical part of the course.

The entire course falls into two parts, a theoretical and a practical; the former consisting of lectures, and the latter of design work. It is the aim of the lectures to supplement the standard course of naval architecture with the information necessary for carrying out the design and construction of warships. The course comprises the following main subjects: Principles and Methods used in Warship Design, Structural Arrangements and Details, Preliminary Design of Machinery and Propellers and their installation in Warships, Anchor and Steering Gear, Drainage, Ventilation, and Heating, Installation of Artillery and Ammunition, and Armor Protection. These lectures are not only made descriptive, but also critical and comparative, giving not only the "How" but also the "Why" of each feature. Thus the attention of the student is drawn to the reasons why the various arrangements and constructions are used, and critical comparisons between the practice of different navies are made throughout the lectures.

The design work proper consists of the preparation of a preliminary design carried to about the same degree of completion as is the case with the designs worked out by the navy department, for the purpose of enabling contractors to make their estimates. This work embodies the preparation of lines, distribution of weights, powering of the ship, disposition of artillery and armor, storage of ammunition, arrangement of machinery and living quarters, anchor-gear, boats, steering gear, etc. Complete calculation of weight, stability, and strength are carried out in accordance with the methods used by the Bureau of Construction and Repair of the United States Navy. Detail drawings of various structural elements are also worked out. Each student prepares a half block model so as to obtain a clear idea of the form of the ship which he has designed, and on this model he lays off the outside plating, etc., as done in ship yards for determining the general arrangement of the plating and framing and the length of individual plates.

The instruction in design work is carried out in general on the following principles. First, the student studies the problem before him, guided by the explanations given in the lectures and by plans of ships of similar type and size, and selects that arrangement or construction which best conforms to the special requirements of his design. He then independently sketches out how he would solve the problem or construct the part in question, and lays it before the teacher. After being criticized by the teacher, and eventually modified, the student proceeds to prepare the final design. In this way the student is forced to make a study of the working drawings of actually built ships, and learns to exercise his judgment and to think for himself.

It is necessary in such work to have for the use of the students a great number of plans of actual ships, together with working drawings and details. This want the Institute is enabled to meet by means of a great number of plans of United States warships, about two thousand in number, which the Navy Department has loaned to the Institute for this particular purpose. Moreover, a large private collection of plans, working-drawings and compilations are at the disposal of the students.

MODEL-CUTTING MACHINE.