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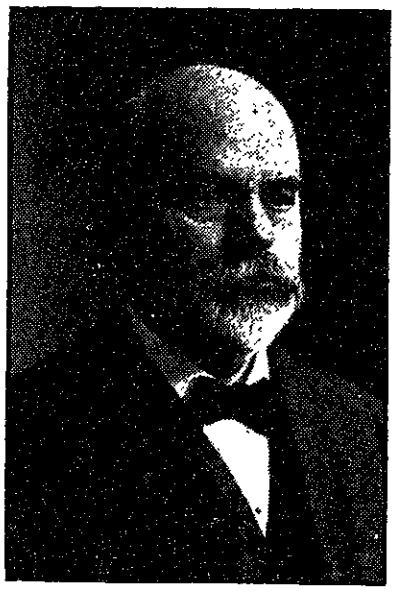
MARINE ENGINEERING

Option in Fourth Year by Head of Naval Arch. Dept.

By. PROF. C. H. PEABODY.

The option of marine engineering was started in 1885, with the intention of giving an opportunity for the study of the contribution and operation of large steam engines, especially as applied to the propulsion of ships. As stationary engines approach the size of marine engines there is a tendency for them to approach the type of construction that has become standard for them; and in any case the methods for determining the proportion and dimension of engines of all classes are substantially the same.

Custom assigns the construction of the propeller to the marine engineer, and he therefore needs a good conception of its operation and the conditions that lead to good efficiency. The option, therefore, takes up the discussion of the resistance and propulsion of ships so far as is necessary for that purpose. This instruction is accompanied with the design of a propeller, and the computation



PROF. CECIL H. PEABODY.

of the results of a progressive speed trial.

The design of a marine engine is so intricate that it cannot conveniently be worked out directly, but must be made to depend on the intelligent adaptation of conditions that have been formed to give good results in engines already built. These conditions can be expressed in certain simple approximate methods which can be controlled by the determination of factors that can be varied to suit different conditions. When the factors are well determined a new engine can be designed with rapidity and a good degree of certainty. The methods, in fact, are of the order of interpolation or extrapolation of results already obtained. After the proportions and sizes of the various members of the engine have been assigned, the complete design may be undertaken to ascertain whether the engine is well adapted to its service.

The final design includes (1) the construction of probable indicator diagrams, and the determination from them of the forces exerted by steam pressure on the members of the engine; (2) the design of the moving parts of the engine and the computation of their weights, so that the dynamic forces due to their motion can be determined; (3) the determination of the resultants of the static and dynamic forces for a sufficient number of crank angles and the relation of the conditions that give the maximum stresses in the various members of

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HISTORY AMD SUMMARY OF MECHANICAL ENGINEERING

The Growth of the Course in Curriculum and Apparatus. Iimportance of Investigations Conducted.

By PROF. GAETANO LANZA.

In most industrial pursuits there are certain processes to be carried out and attention must be given to devising and preparing the means of doing this effectively and cheaply, to the best machines to be used for all the steps, a consideration of their efficiency, durability, first cost, the expenses necessary for their attendance, also for their maintenance, repairs, etc., to the construction and arrangement of the power plant whether steam or water is used, to the system of transmission, the design and construction of buildings adapted for the work, including foundations, water supply, drainage, heating and ventilation, light, lighting, fire protection, and a large number of matters of a similar character all of which are engineering problems. With such questions the mechanical engineer is concerned, and his duties consist in solving problems of this kind as they arise. In order that he may be successful he needs: first, a knowledge of scientific principles and of the experience of the past, and second, his own experience. The latter cannot be imparted in a school, but each man must acquire it for himself subsequently.

Hence the function of the school is to give to the student knowledge of and power to apply scientific principles, so that he may be able to make use of those which bear upon his particular work. Such a purpose is clearly outlined in "A Plan for a Polytechnic School in Boston," by Prof. William B. Rogers in 1846. (See Life and Letters of Wm. B. Rogers, pps. 420, et seq.) The first catalogue of the Institute was issued in 1865 and the first course in the list, then called Course I, was that in Mechanical Engineering. While no separate engineering laboratory was proposed at that time, there was proposed a laboratory of Physics and Mechanics. In the year 1873-74 was installed a 20 H. P. steam engine with a condenser, weighing tanks, and the apparatus necessary for tests which, together with the boilers of the Institute, formed the first plant established in any school adapted to the making of engine and boiler tests. It was rendered possible by the fact that Mr. George B. Dixwell was willing to bear a part of the expense in order that an experimental study in which he was interested might be made upon cylinder condensation.

In the year 1881-82 a testing machine of fifty thousand pounds capacity was installed in the laboratory of Applied Mechanics, so arranged as to render possible the testing of full-sized beams up to twenty-five feet span, and immediate use was made of the machine to test the transverse strength of full-sized timbers, an investigation that has been pursued ever since and which has served to establish constants for use in practice that are quoted as authority in many sets of building laws, engineers' hand-books, and elsewhere. Moreover, the plan of the work now being pursued by the Division of Forestry of the Department of Agriculture of the United States has been largely based upon the methods used and the results obtained at the Institute.

In the year 1883-84 the course was re-organized and a development of the laboratory was started which has caused it to expand from the small plant installed in 1873-74 to its present dimensions and equipment. It now occupies 23,500 square feet of floor space and contains a great amount and variety of machinery adapted for the work, an Emery Testing Machine of three hundred thousand pounds capacity, and a Steam Turbine of five hundred Kilowatt capacity, besides many other large machines. The course of instruction has been continually developed in the attempt to keep it up to the needs of the times.

The two fundamental sciences upon which the principles of engineering mainly depend are Mathematics and Physics. The student should acquire not only a thorough knowledge of those portions of pure mathematics that he needs in order to make the calculations required in his work but he should also have the power to draw the necessary conclusions which concern the subjects with which he must deal in his profession, and this power is all-important, for if he is to be fit to assume responsibility at some time, he ought not to allow himself to use any formula without knowing how it was obtained and what are the assumptions made in deducing it, as well as the experimental basis upon which rest the constants which he uses. Moreover, as time goes on, important work is less and less trusted to "rule of thumb" engineers.

A course in Physics affords the suitable preparation for a proper understanding of the scientific principles of most of the work with which the student will come in contact. Therefore he should have a thorough course in general Physics and, in addition, he needs a certain amount of work in the Physical Laboratory, since it teaches him how to make careful and accurate experiments.

Turning next to the subject of drawing, including descriptive geometry,

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two of the objects to be accomplished are first, the power of execution, and second, the power to read and to express ideas by means of drawings; in other words he needs to know the language of drawing, for in his future work it is a language which he will constantly use. Of course the student should be taught to make all the detailed drawings needed in the shop and also the necessary assembly drawings, and to make them in such a way that they can be practically used, i. e., according to a good shop system of dimensioning. He also needs the power to use his drawing in the solution of problems whether of Mechanism or of Machine design, or other subjects.

Some brief remarks will next be made in regard to that portion of the professional work which is given in the classroom. The subjects are treated thoroughly, comprehensively, and in proper sequence, both the theory and the results of experiments made under the conditions of practice being presented.

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STEAM ENGINEERING

Detailed Description of the Course Given to Third-Year Students.

By PROF. E. F. MILLER.

The course in steam engineering as given today, differs considerably from the course given ten or fifteen years ago. This is due partly to the changes which have taken place in the methods of generating power, partly to the advance made in the design of steam machinery, and partly to the fact that a great deal of new work must now be given each year in order to keep pace with the advances made along steam engineering lines.

The course has been increased by about fifteen lectures and since the study of Valve Gears, which was formerly given under the head of "Steam Engineering," has been transferred to the second year where it is taken now as a part of the study of Mechanism, there have become available some

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twelve hours more, which have been used to advantage in new work in steam engineering. Before taking up the theoretical work of the course in steam engineering the students are given a series of cuts illustrating many of the auxiliaries used in connection with modern power stations, different systems of pumping by means of compressed air, different types of pumps, and various types of condensers, dry vacuum pumps, circulating pumps, together with general descriptions of the different types of steam turbines and steam engines. They are also given some work on cooling towers, coal handling, and coal handling machinery, and the construction of coal pockets.

Following this general descriptive course comes the theoretical work in Thermodynamics. This includes the study of perfect gases, saturated steam, superheated steam, economies of engines, turbines, design of turbine nozzles, calorimetry, compressed air, air compressors, refrigerating machines, and

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