NOW IT'S WELDING ENGINEERING

By ROBERT B. TOBIAS

DUE to the steadily increasing demand by industry for engineers with specific training for all types of welding and sufficient knowledge and experience to master any welding problem, a new curriculum leading to a degree in Welding Engineering has been instituted by Ohio State University's College of Engineering according to Charles E. MacQuigg, Dean of the College of Engineering, and Professor Younger, chairman of the industrial engineering department.

The instructor for this new course is Mr. J. R. Stitt, graduate of Penn State University, and for many years in the employ of the Austin Company, manufacturers of heavy industrial machinery, where he received the practical training necessary for this important position of instructor in welding engineering.

Administration of the curriculum of this most unique degree is under the department of Industrial Engineering, which, for a number of years, has presented the shop instruction in welding required by the various curricula of the other branches of engineering. Entrance requirements are the same as for the other courses of study of the College of Engineering. Admissions are in the hands of the Entrance Board at Ohio State; however, no registrations will be accepted for this field of endeavor until the winter quarter. Any and all inquiries should be directed to the Entrance Board.

Students enrolled in welding engineering will take the same courses as students in the other fields of engineering during the first year, totaling 58 academic hours. During the succeeding years they will have the following courses and number of hours: mathematics (calculus), 15; physics, 19; mechanics, 18; metallurgy, 10; economics and accounting, 16; mechanical engineering, 19; drawing (work drawings and technical sketching), 3; English, 3; electrical engineering, 8; civil engineering (trusses), 5; industrial engineering, 41; welding (applications in industry such as—uses and construction work in boat and bridge building, office buildings, general construction, machine tools, jigs and fixtures, and electrical equipment), 11; and military science, 3. In addition, from 11 to 14 hours of elective subjects will also be permitted.

"The curriculum, embracing all branches of modern welding, such as electric, oxy-acetylene, and resistance, is an attempt to meet the need for a training for men desiring to specialize in this comparatively new technology," Dean MacQuigg states. "It seeks to supplement the training of civil, metallurgical, industrial, and mechanical engineers, each with some of the training of the others."

The Dean adds that "because of the rapid growth of the art and the very special techniques involved, there has been little opportunity for the design practices to become rationalized, and until lately the operations have been largely empirical. Also, that in view of the quite involved relationships between the nature of the metal to be joined, the design of the joint, the practice used in the manipulation of the torch or electrode, the nature of the filler metal, the heat treatment effects, and other important factors, the routine production of welds has become a highly specialized practice in every aspect."

"Amazing progress has been made in both the technique and exploitation of welding," Dean MacQuigg concludes, "but it has been delayed because of the lack of specially trained engineers. For example, the civil engineer competent to design the welded joints and to properly distribute stresses among the members of a structure frequently lacks the knowledge of how the welding operation might affect the properties of the metal involved. Progress made has been almost always dependent upon the cooperation of several kinds of engineers."

Preliminary preparatory investigation by a committee of department chairmen, in collaboration with industrial representatives, showed that in view of the decidedly marked strides of welding in all types of heavy goods industries and in the field of transportation, all indications point to the fact that this branch of engineering will be stable for many years to come.

Off-campus enthusiasm for adoption of this new curriculum has been shown further in the shape of an agreement of a prominent Ohio State alumnus to sponsor the project in its embryonic stage. Joining with him are important manufacturers interested in the fields of electric, gas, and other forms of welding. This sponsorship assures close contact with the latest in industrial developments, while at the same time the sponsors leave the courses and subject matter covered entirely to the college of engineering.

Modern electric resistance welding had its beginning in the winter of 1876-77 when Professor Elihu Thomson, a lecturer at the Franklin Institute, noted several phenomena, the further investigation of which led him to important developments. One was the principle of electric joining of metals.

Electric welding is based upon the principle: When an electric current is passed through metals, they are heated in direct proportion to the magnitude of their resistance. The resulting temperatures can be controlled so accurately that with the pressure of the electrodes squeezing the parts together, consistently strong welds are produced.

Electrodes are the parts which apply the electric current and the pressure to the metals to be fused together. Copper fitted the early requirements of high conductivity for such electrode material and was therefore the logical selection. However, pure copper is now obsolete due to the fact that it could not meet the demands of high production levels as it is soft and will not withstand production schedules without quickly deforming.

In the search for better electrode material, metallurgists have found that the necessary hardness could be obtained without too much lowering of conductivity by alloying copper with beryllium and cobalt or chromium in various combinations and percentages. This paved the way for two successful resistance welding electrodes: Trodaloy Number One and Trodaloy Number Seven. These "precipitation hardening" alloys are strengthened by special heat treatment that also brings about an increase in conductivity of electrical current. Another electrode material, Elkonite, is formed when the powders of copper and tungsten are pressed and sintered; and here again the required hardness can be procured without an excessive lowering of the conductivity.

A wide variety of metals can be successfully welded with these different electrodes, and the thickness of such welded stock can vary from two and one-half (2½) inches to foil 0.001 of an inch, bringing boiler plate and radio tubes alike within the scope of electrical resistance welding.

Now let us take a brief, hurried glimpse into the tremendous scope covered by the field of welding engineering.

Welding has long been an important factor in the fabrication of machinery and special engineering equipment, but there are still numerous industrial operations where its application has been limited. Welding is now entering machine tool manufacturing and the success or failure of preliminary efforts in this direction will unquestionably bring about a radical change in machine tools. Manufacturers of rolling mills still employ many castings but the trend is increasingly toward the application of welding in certain installations resulting in improved efficiency and less expense. Because of the flexibility of welded designs it is now more economical to design and construct a mill for the particular operative conditions for which it is intended instead of adapting equipment planned for another unit merely for the reason that it will eliminate pattern costs.

Illustrations of the present-day uses and future uses of welding in unique, ultra-modern, miscellaneous products are the fabrication of such apparatus as the Westinghouse flood control station across Turtle Creek at East Pittsburgh, such instruments as the 200 inch telescope for Mount Palomar, and construction jobs of such gigantic proportions as the welded superstructures of new overhead super-highways.

The fabrication of pressure vessels, storage tanks, and high pressure piping has been an accomplished feat for many years. Welding in this field is unlimited and has already made possible the use of temperatures and pressures exceeding those allowed with the riveted type.

The art of welding will create a new era in building construction. Since 1926 it has been used for the erection of smaller buildings and more recently for larger office buildings, but its growth has been rather limited, and this form of construction has not as yet been generally accepted. However, the adoption of welded structures in New York and London, its proposed acceptance by Pittsburgh and Chicago, and its use by the United States Navy, will start the ball rolling, so to speak; and consequently it is not merely presumption to assume that the all-welded class of edifice will conclusively and entirely supplant riveted structures. This will be realized because of noise elimination and the savings created by the reduction of the amount of steel required to carry the same working loads.

The success of completely or partially welded ships and barges is causing welding to become more common in the new vessels, and some authorities believe that it will revolutionize the ship-building industry. Welded ships are more rigid, lighter in weight, and require less maintenance. The improved seaworthiness of such ships has been emphatically demonstrated by the H. M. S. Hunter, reported to have struck a mine while on patrol duties in the Mediterranean off Almerin, Spain. For those interested in this incident, reference may be made to H. Stanley's article on *Damage to H. M. S. Hunter* in "The Welder", Volume X., N. 50. January 1938, page 15.

In transportation, the railroads are using arc, gas, and spot welding extensively in the construction of new equipment; and spot welding of special alloys is constantly growing in the building of modern aircraft.

The primary factor in all of these diversified applications of the science of welding, it will be noticed, is the fact that the final product is as strong, if not stronger, than the same product could possibly be when joined in any other fashion and at the same time the resultant piece of work is much lighter. These two factors of strength and light weight are of great importance to the industries which produce products in which weight must be moved, namely; automobile industry, railroads, aircraft, shipping, and also where there is no motion, but where weight is of vital concern in such things as machinery and building construction.

Energy is required to move any object, and therefore by lightening the weight of the object to be moved, large quantities of energy can be conserved. Energy conserved by this generation will be available for the use of posterity, and welding contributes largely to this conservation through this lightening. A striking example of energy saved by decreasing the weight is the automobile, for the engine is not required to expend as much energy pulling the vehicle.

The field of welded products has not even had so much as a scratch off the surface, and consequently here abounds a proverbial gold mine of opportunities for the ambitious, alert, far-seeing Welding Engineer.