THE TURBINES OF THE BATTLESHIP "NORTH DAKOTA."

The battleship "North Dakota," which is now nearing completion at the yards of the Fore River Shipbuilding Company, possesses special interest, not merely because she is our first ship of the "Dreadnought" type, but also because she is the first battleship in our navy to be equipped with steam turbines. She will be driven by two of these, each of which will be of 12,500 horse-power. The steam will be expanded in nine stages, and will exhaust to a condenser operating under 28 inches of vacuum. We present three photographs, one showing a complete rotor, with the reversing turbine on the forward (in the illustration) end of the shaft, and the nine stages of the go-ahead turbine carried upon the same shaft. Steam is admitted at the far end of the shaft, and travels through the successive series until it reaches the wide space between the last of the go-ahead and the last of the reversing wheels, which space is easily recognized in the engraving by the wide gap between the wheels. Another engraving shows one-half of a section of the casing, with two half sections of the fixed blading of the last stage of go-ahead turbine, and the complete set of reversing blades in place. The third photograph shows a segment of one of the wheels, and indicates clearly the method of arranging the blades and fixing them in place.

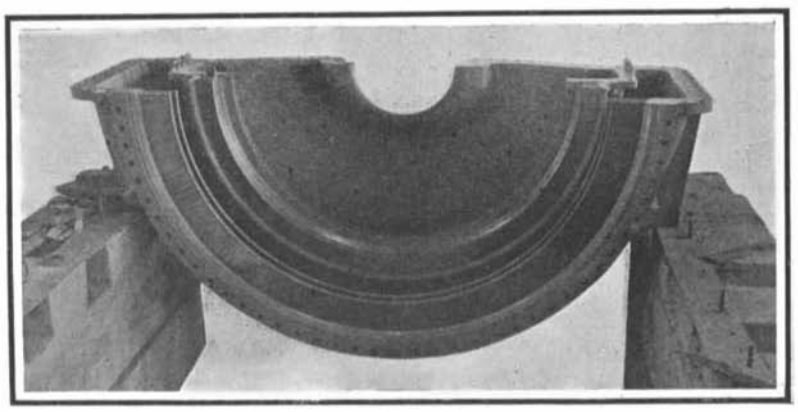
The Curtis turbine is what is known as the impulse type. To bring the speed of rotation down to a practicable limit, this type is divided into several separate pressure stages, and each stage contains three or four rows of revolving buckets. A single-wheel, impulse turbine attains its maximum economy when the speed of the buckets is about half that of the steam which impinges upon them. Since a jet of high-pressure steam, expanded in and delivered from a correctly-designed nozzle, will issue, if discharged into a vacuum, with a velocity of 4,000 feet per second, it is evident that for the buckets to attain maximum velocity they would have to move with a peripheral speed of 2,000 feet per second. With a view to reducing the speed to a practicable limit, several wheels, each contained in its own independent steam-tight chamber, are assembled upon the same shaft. The live steam is introduced upon the set of blades in the first chamber. Here it is expanded down, delivering up part of its energy. It then passes through a set of nozzles to the second chamber, where still more of its energy is given up, the process being repeated in each successive chamber upon each successive set of blades, until the steam is delivered to the condenser. In the nine stages of the "Dakota's" turbines there are four series of blades on the first wheel, and three on each of the others. The working speed at the blades is about 160 feet per second.

One of the marked advantages of the Curtis type of turbine is the nicety of control of the steam admission. In the go-ahead steam chest there are twenty independent valves, each opening one of the twenty nozzles for the first-stage wheel. For continuous running as many nozzles are opened as will supply the right amount of steam for the speed desired, and the go-ahead throttle valve is left open, thus giving a full pressure in the steam chest. The go-astern steam chest has the same number of nozzles, but only eight of these have valves. In maneuvering the ship, the nozzle valves in the steam chest are left open, and the speed is controlled by the throttle valve.

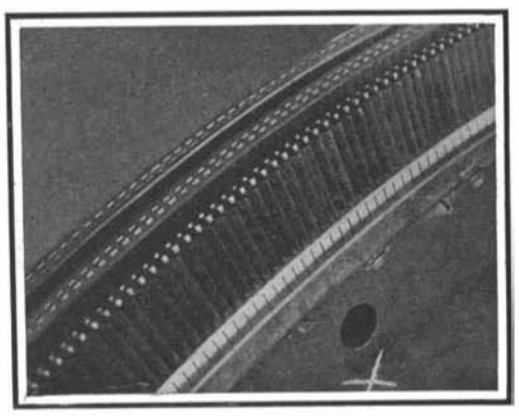
Another marked advantage of this system is that there is practically no leakage of steam between the ends of the blades and the adjoining surfaces. The steam which escapes past the ends of the blades, of course does no work upon them, and in pressure turbines of the Parsons type this leakage, especially in the high-pressure elements, is very serious, and shows a marked effect in reducing the economy. In the Curtis type the steam, moving at high velocity, passes directly across the surface of the blades, and has no tendency to pass around the ends of them. Consequently, not only does practically all the steam that passes through the turbine do useful work; but the clearances between the blades and the casing may be made large, and the danger of contact between the two, with its consequent disastrous stripping of the blades, is avoided. This clearance varies from ¼ of an inch to 2 inches.

Other advantages are that a smaller number of blades is necessary; that the construction of the blading may be made considerably stronger; separate cruising turbines are not necessary; the amount of power developed on the shaft is under close control, being determined by closing down the required number of nozzles; a lower pressure is used in the interior of the cylinder; and, perhaps most important of all, is the fact that the revolutions may be considerably lower, with the resulting advantage that two instead of four screws may be used and higher propulsive efficiency secured.

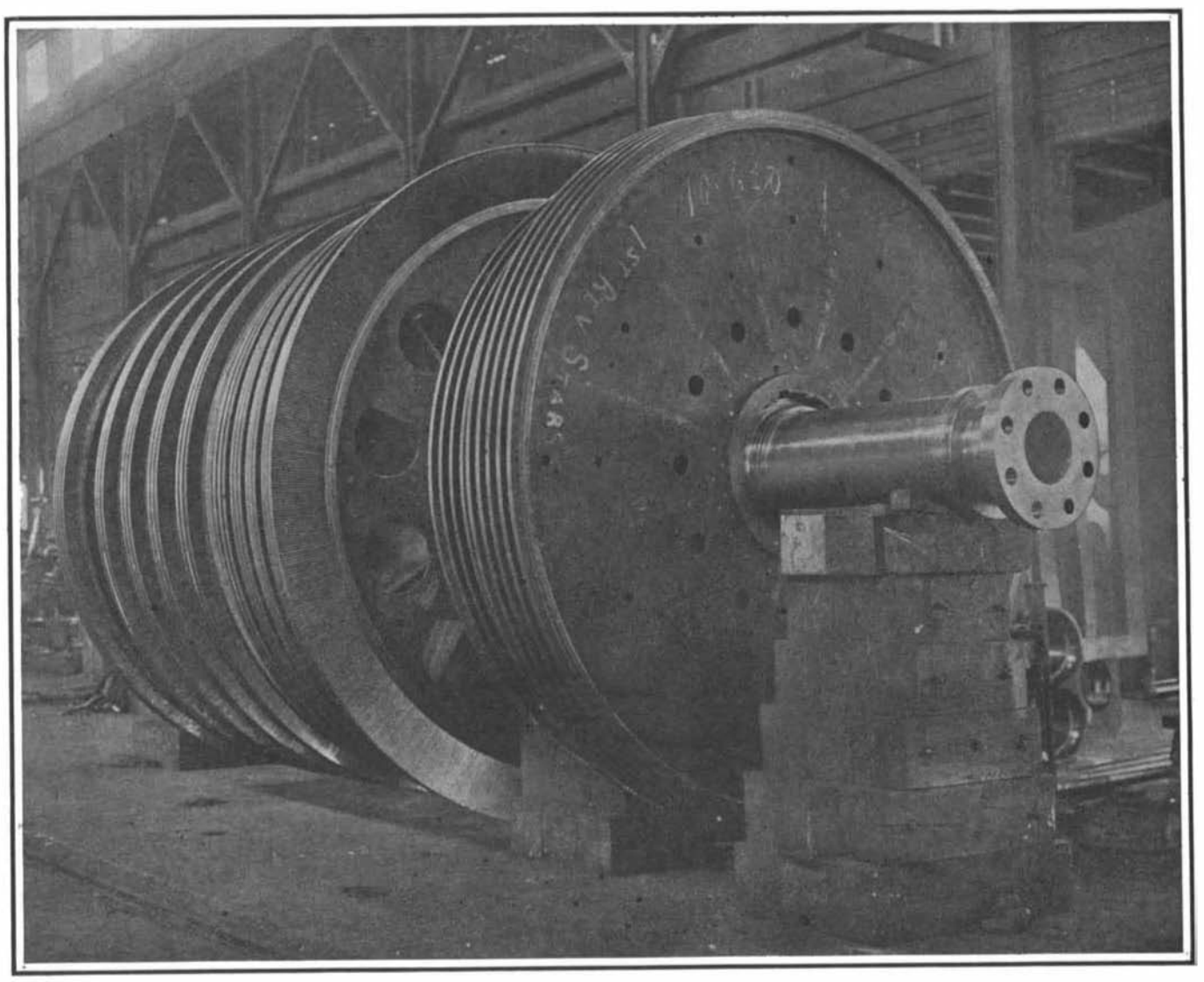
The accompanying illustration, showing a section of blading, illustrates the method of assembling and holding the blades in place. The blades are manufactured from a special bronze, which is formed to the desired section by being drawn through a die into long bars. These are cut into the desired lengths, and each length is notched or drilled at its ends for attachment to the base and the shroud. The inner ends are set in a channel-shaped piece of steel, known as the base, the ends of the blades being milled for this purpose. At the outer ends the blades are notched, and the notches fit into corresponding holes punched in a thin strip of steel known as the shroud, which passes entirely around the set of blades. When the blades have been assembled, the ends of the notches are riveted down over the shroud. In some cases the blades are built up into segments by casting on a composition base on the inner ends and a shroud on the outer ends, the blades being held during the casting in a sand core with their ends projecting. In this case the ends of the blades fuse into the cast parts, thus making a practically solid piece of the whole segment. The segments of blades, as thus formed, are held in the steel wheel rings by inserting the bases in rectangular grooves around the rings and calking the edges of the grooves.



One-half of a section of the casing with fixed blading in place.



Segment of wheel, showing method of fastening blades.



The rotor, showing the nine stages of the go-ahead turbine and the two stages of the go-astern turbine.

TURBINES OF THE BATTLESHIP "NORTH DAKOTA."

Durability of Leather.

The following results of a series of experiments recently made by M. C. Lamb, have especial interest for the manufacturer of book leather, which is exposed to the destructive influences of the products of combustion of illuminating gas:

1. Leather properly tanned with alum and chromium is very durable, having a probable useful life of three or four centuries. 2. The use of tannin in conjunction with chrome alum greatly diminishes the durability of the leather. 3. The best vegetable tanning agents for book leather are those which contain pyrogallic acid, such as sumach, algarobilla, chestnut extract, and mirobolan. 4. Acid dyes applied to book leather should be prepared with volatile organic acids. 5. Basic dyes should not be "fixed." 6. Varnishing with shellac or albumen affords the best protection against destructive influences.

At the recent meeting of the New York Branch of the Associated Clubs of Domestic Science, Dr. Harvey W. Wiley, chief of the United States Bureau of Chemistry, urged that the nation can control only the interstate commerce phase of the pure food question and that the benefits of the agitation on this question will be enjoyed only after State legislatures are compelled to recognize the danger in impure and adulterated foods and to provide against their sale.