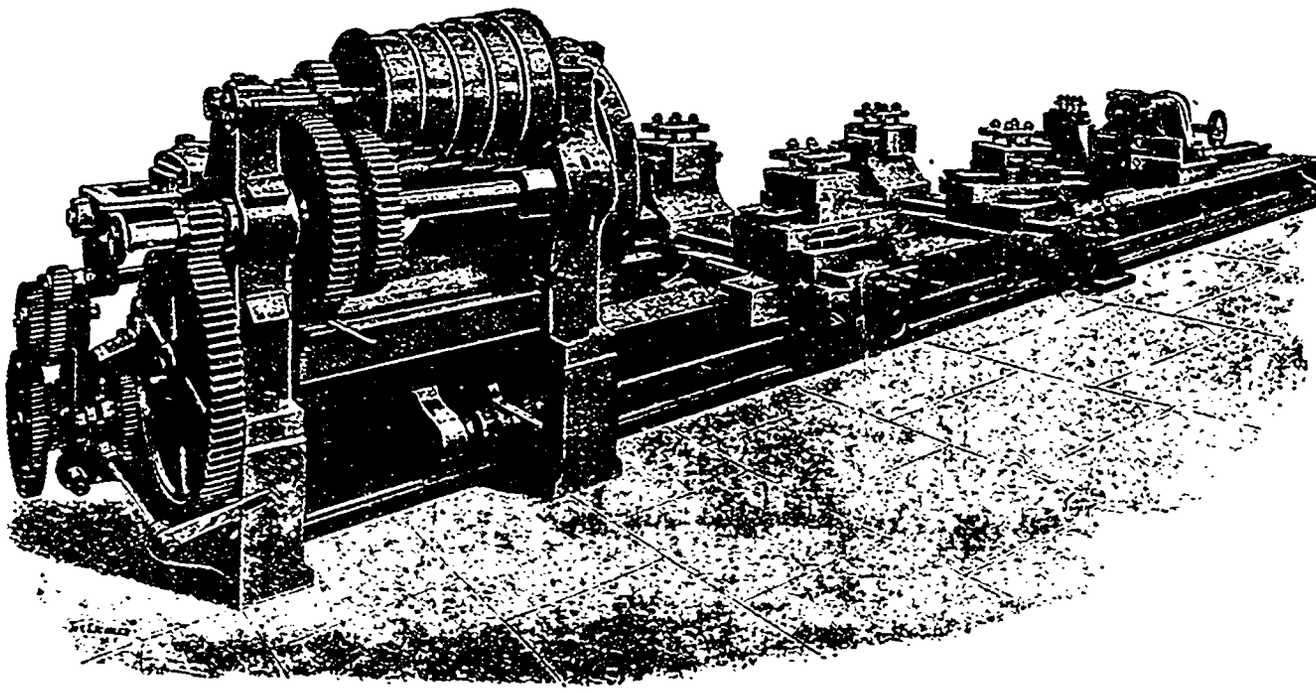
between the centers. The driving is effected through five speed cones direct on to the face plate, and two series of double and triple gear, giving twenty-five speeds to the spindle, all properly graduated to suit the different diameters admitted by this lathe. There are two saddles, each having a set of duplex compound slide rests; and there is also a compound slide rest on the loose headstock for turning the coupling flanges, so that five tools can be in operation simultaneously. The front slide rests are fitted with swivels for taper work. Further, each saddle is so fitted that by means of change wheels, tapers of any length and inclination can be automatically turned, this arrangement being of great



convenience for turning the tapered ends of propeller shafts, gun tubes and similar work. The saddles and loose headstocks can be rapidly adjusted on the bed by power motion, and throughout every convenience is provided for quickly manipulating the various motions in the lathe.

In all respects this machine is throughout of the most massive character, and it has been specially designed to take heaviest cuts possible. Its weight is about 60 tons.

ATTRIBUTES OF A GOOD TURBINE.

BY J. HUMPHREY.

As a safe, desirable and cheap motor, good and properly developed water power is unequalled Its moderate cost, which in many instances is less even than the expense for attendance of a steam plant, has not led to economy usual in other things, but has tended to the neglect of systematic investigation requisite for the general understanding of the best means for its improvement. Yet in most places where power is in demand, its value equals the cost of its equivalent as obtained by other and more expensive methods, and its fullest development becomes a matter worthy of attention. While great advance has been made during the last half century in the improvement of turbines, *until they have practically superseded other forms of* water-wheels, yet there are certain essential principles pertaining to their construction which should be better understood by users, especially as they are apparently unappreciated, or sadly ignored by many builders. As a first, and by no means unimportant element of a good turbine, the water should be applied to the running wheel with the greatest attainable velocity and force, and with proper direction for its best action upon the floats. This requires chutes or induction channels with sufficient space and correct form for the natural contraction of the vein of water in accordance with the laws of accelerating motion, in which most turbines are manifestly deficient, thereby causing more or less waste of energy of the water before it reaches the wheel.

Another quite as essential and rather more difficult part of turbine designing is in making the floats or pressure vanes of the running wheel of proper form to take the maximum force from the water, and transfer it to the work. This requires length and curvature of floats corresponding to the varying conditions of velocity, as the water is reduced from its highest initial speed to a very low one at its departure from the wheel, as it must be if high efficiency is reached, and as such length and curvature of float is variable under different conditions of use, as for different heights of fall and variable work or water supply, it is hardly reasonable to suppose that one form of float will suit every condition, or that the proper forms are likely to be determined by mere tentative experiment, as by the "cut and try" plan, which has been the system generally pursued by most turbine designers. Although fairly good results may have been attained in that way, with perhaps occasional excellent chance hits, yet the method is far from reliable in general practice, especially with the uncertainties which have attended methods pursued by advertising the efficiency of wheels for which evidently extravagant claims are made, and which are by no means warranted by philosophical examination, or practical use. Very few indeed of the many wheels now in use show either chute or float construction indicative of scientific design, or capable of highest efficiency.

A third, and quite important, feature in the economy of a wheel is the proportion of its discharge area to *the quantity of water applied.*

As it is certain that no more power can be obtained from the water than the difference between what it has at its application and that retained at its exit from the wheel, and as it is a well established and immutable