THE PROGRESS OF THE STEAM TURBINE.

THE earliest notices of heat engines are found in the "Pneumatics" of Hero of Alexandria, which dates from the year 200 B.C. One of the steam or motive power engines there mentioned is the Æolipiles, a steam reaction engine consisting of a spherical boiler pivoted on a central axis beneath which is placed a flame. The steam escapes by bent pipes facing tangentially in opposite directions at opposite ends of a diameter perpendicular to the axis.

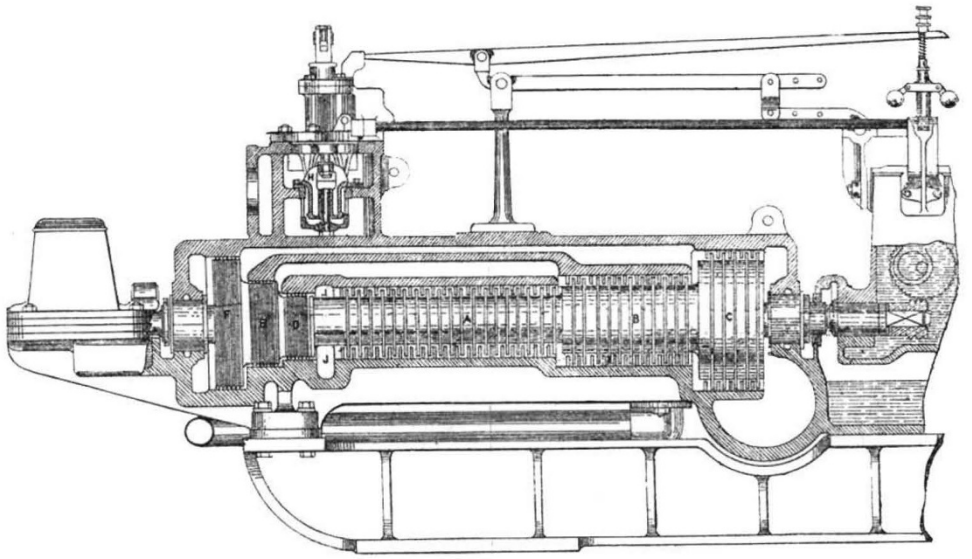

FIG. 1.—Sectional view of a Compound Turbine, showing the turbine blades and also the steam admission valve and bearings, as well as the governor gear.

The globe revolves by reaction of the escaping steam, just as a Barker mill is driven by escaping water.

No practical or useful steam engine appears to have been made on this or any analogous principle till the year 1884, though many attempts seem to have been made on more or less crude lines; meantime the piston engine of Papin, Savery, Newcomen, and Watts has been developed during the last 200 years, and by its general use has revolutionised the means of transit and tended to vastly increase the productive power of labour generally.

The want of a fast running engine for driving dynamos presented an immediate field for the application and development of a suitable steam turbine engine. The advantages of a steady running engine having no reciprocating parts, of small size and extreme lightness, were sufficiently obvious provided that fairly economical results as to steam consumption could be realised.

The highly economical results obtained from water turbines gave hopes that, provided suitable conditions could be arranged, similar efficiency would be obtained with steam as with water; and assuming this to be possible it would naturally follow, after taking all other losses into account, that the steam turbine would be more economical in steam than the piston engine.

These possibilities, and the interest of applying a practically new method for motive-power purposes, led the Hon. C. A. Parsons to build an experimental engine of ten-horse power coupled directly to a dynamo.

For practical reasons it was, however, necessary to keep the speed of rotation of the turbine as low as possible, and also to construct the dynamo to run as fast as possible, so as to couple the turbine directly to it; and in order to obtain the necessary conditions for steam economy the turbine was made what is called compound, or, in other words, a series of successive turbine wheels were set one after the other on the same spindle, so that the steam passing through them one after the other, the fall in pressure being spread over the series of turbines should be gradual, and the velocity of the steam nowhere more than was desirable for obtaining a high efficiency for each turbine of the series.

The turbine motor consists of a cylindrical case with rings of inwardly projecting guide blades, within which revolves a concentric shaft with rings of outwardly projecting blades. The rings of blades on the cylinder nearly touch the shaft, and the rings of blades on the shaft lie between those on the case, and nearly touch the case. It will be seen, on referring to Fig. 1, that there is left between the shaft and the case an annular space, which is filled with alternate rings of fixed and moving

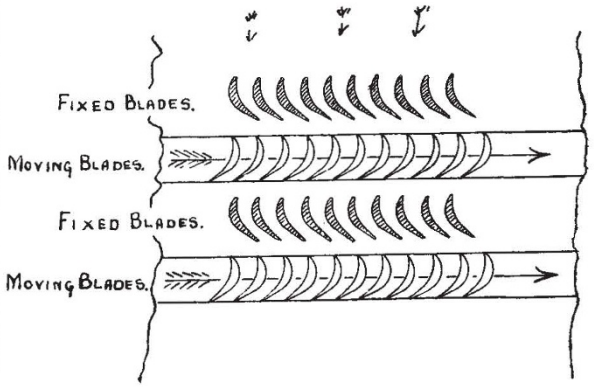

FIG. 2.—Section through blades in annular space between shaft and casing showing relative positions of fixed guide blades and moving blades. The three arrows at the top indicate the direction of motion of the entering steam.

blades. Fig. 2 shows one form of blades which is used. Steam entering at J (Fig. 1) passes first through a ring of fixed guide blades, by which it is projected in a rotational direction upon the succeeding ring of moving blades, imparting to them a rotational force; it is then thrown back upon the succeeding ring of guide blades, and the

reaction increases the rotational force. The same process takes place at each of the successive rings of guide and moving blades. The energy to give the steam its high rotational velocity at each successive ring is supplied by the drop in pressure, and the steam expands gradually by small increments. In a moderate-sized turbo-motor there may be from thirty to eighty successive rings, and when the steam arrives at the last ring the expansion has been completed. On the left side of the steam inlet J are the driving or rotating pistons, which are fixed to and rotate with the shaft. On their outsides are grooves and rings, which project into corresponding grooves in the case. By means of the thrust bearing of the motor the longitudinal position of the shaft is adjusted and grooves and projecting rings kept nearly touching, so as to make a practically tight joint. The object of these pistons is to steam balance the shaft and relieve end pressure on the thrust bearing. Fig. 3 shows a 350 kilowatt turbo-alternator, thirteen of which size are now at work in the London stations.

With compound condensing turbines a steam efficiency comparable with the best compound or triple expansion condensing engines was at length reached, and it was then resolved to test the application of the turbine to the propulsion of ships, for which purpose it seemed well suited, provided that as good an efficiency could be obtained from fast running screw-propellers as with ordinary ones, and to test the system it was determined to build the *Turbinia*, which is 100 feet in length, 9 feet beam, and 44½ tons displacement. One compound condensing turbine engine of 2000 I.H.P. was at first fitted, but it was found that long before this power was developed the screw began to tear the water, forming vacuous spaces and vortices behind the blades, and causing great loss of propulsive effect. The single large engine was then replaced by three separate ones, high pressure, intermediate pressure, and low pressure, each driving a screw shaft at the same speed of rotation as before; but the blade area was by these means trebled, and this trouble ceased. The efficiency of the screws approached closely to the best results of ordinary screws. The *Turbinia's* engines are similar to those for the driving of dynamos described, but they are necessarily larger and of lighter construction, and the expansion of the steam is carried to 170-fold at full speed. Prof. Ewing's tests have shown a consumption of 14½ lb. of steam per I.H.P. at a speed of 32¾ knots, and the maximum speed so far obtained has been about 35 knots.

It is anticipated that this turbine engine can be successfully applied to all the faster class of vessels, including those of the largest size; in fact, it appears that the relative advantages are greatest in the largest sizes.

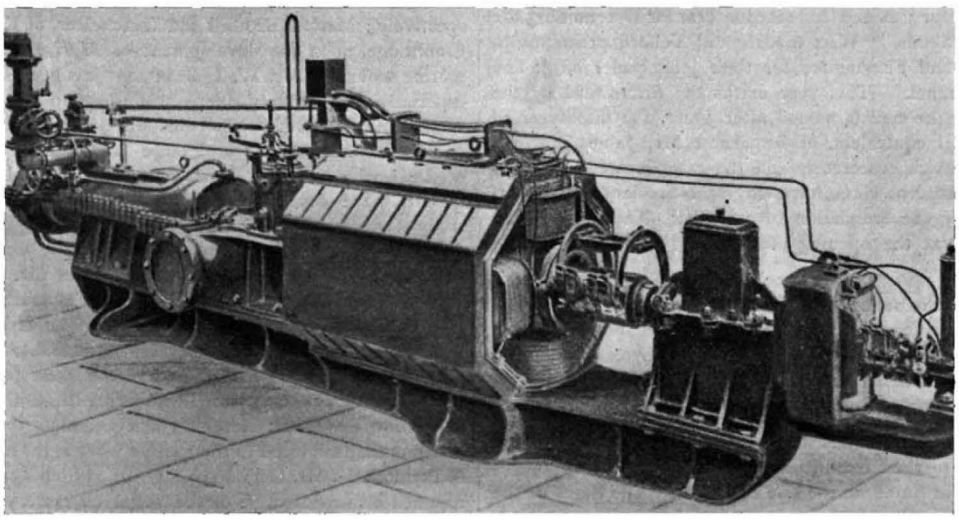

FIG. 3.—A 350-kilowatt Alternator and Turbine.

NOTES.

THE new Government Laboratory, which has been about two years in course of erection, is now completed, and will be formally opened to-morrow (October 1). We hope to be able to give a description of the building in our next issue.

THE Paris correspondent of the *Times* states that an anniversary service was held on Tuesday at the Pasteur Institute in honour of the great investigator. A number of his disciples and the members of his family who are in Paris assembled in the crypt of the Institute at his tomb, and placed upon it garlands of flowers from the Garches gardens. The subscription for the Pasteur monument now exceeds 300,000 francs.

AN epidemic of typhoid fever has broken out at Maidstone, Kent. More than nine hundred cases have been notified, and up to Tuesday night twenty-one deaths from the disease had occurred since the beginning of the outbreak. The epidemic is due to polluted water, and is confined to the area of the town supplied with water from springs at Farleigh, all of which have been condemned by the medical officer of health.

IT is much to be regretted that the splendid male Giraffe, presented to the Queen by the Chief Bethoen, of Bechuanaland, died so soon after reaching this country. The difficult task of bringing it home was entrusted by the Colonial Office to the Zoological Society, who selected for the work one of the most experienced men in Europe in moving large living animals—Herr Windhorn, of Alfeld. The Giraffe was led from Kanya to Lobatsi by road, and safely lodged at the railway station in a box, which had been specially constructed for it at Cape Town. It was placed on board the s.s. *Roslin Castle* (in which a free passage had been most liberally granted to it by Sir Donald Currie), and left Cape Town on September 1. The passage was a stormy one, and after the first week the Giraffe declined to eat anything but bread. A few days later it left off feeding altogether,