



SECTION X Nos. 145—160

Steam power group, first engine, various types of steam engines and steam turbines, engine governor, reverse motions for stationary engines and locomotives.

## Section X

**145.** First steam engine. Date 130 B. C. Heron's engine, is now regarded as the first steam engine. Steam is generated in the lower vessel, or boiler and conducted into the globular vessel above by two bent tubes. These tubes also serve as pivots on which the globe revolves. Its rotation is caused by the steam escaping from the four bent arms and its direction is opposite to that of the steam travel.

**146.** Trunk type engine. This is a simple form of the early type of trunk or atmospheric engine. Steam is admitted in bottom part of cylinder A through part B causing piston to rise. At end of up stroke a jet of cold water is thrown into cylinder A through D, cooling steam and causing vacuum to draw piston down. The inertia stored in heavy fly wheel on shaft during up stroke of piston, causes crank C to travel over center for down stroke. It is now obsolete but was generally used before the introduction of the slide valve engine (See No. **154**).

**147.** Oscillating cylinder engine. This engine is not a very efficient type. The cylinder is pivoted at its center to the engine frame, turning on pivot with an oscillating motion. Note the upper and lower parts in the back face of the cylinder to admit and exhaust the steam. As piston travels up, steam pressure is admitted through lower right port and exhausts through upper left port. As piston descends, steam is admitted through upper right port and exhausted through lower left port. The action of the piston rod drives the fly wheel to which it is

attached by means of a crank. The inertia of the fly wheel carries the crank over the centers.

**148.** Oscillating piston engine. Steam enters at the top from the boiler and is admitted into the piston chamber A through steam ports by the action of the slide valve, B. The steam alternately strikes against the sides of the oscillating piston and passes through the exhaust port into the atmosphere. The crank C is attached to the piston shaft at bottom and is connected by a pitman rod D to the fly wheel. The crank pin operating in slot of valve rod E strikes the end of slot alternately and moves the up-right valve arm F causing slide valve B to open and close steam ports.

**149.** Double quadrant steam engine. This model is called the double quadrant steam engine because the two piston rods are attached to arms, which move in a quadrant or area equal to one quarter of a circle. Steam enters from the boiler at the top. The inlet valve A is attached to crank B on under side by a cam. Valve A allows steam to enter steam ports moving each piston arm alternately in a quadrant, turning crank B. On return stroke of red arms steam escapes into interior chamber C and through exhaust port into the air.

**150.** Rotary engine or pump. This is a very common form of rotary engine or pump. Steam entering at inlet on right exerts a pressure on the eccentric piston rotating in center of cylinder causing it to revolve until the longest point from the center indicated by arrow, passes the outlet, where steam passes into atmosphere. The slide

A follows the piston and acts as a barrier against high pressure steam entering inlet. When used as a pump, piston is driven by power, water enters at boiler pressure inlet and is forced out exhaust port as piston revolves.

**151.** Elliptical gear engine or pump. Elliptical gears were explained briefly in No. **67**. Steam enters at top from boiler and by exerting pressure on the arms of gears, the pistons rotate. As arms pass exhaust pipe entrance in turn, steam passes into the air. When used as a pump, the action is the same as in No. **150**.

**152.** Vertical engine. Marine type. The slide valve which regulates the flow of steam into the piston chamber, is operated in this engine by a cam mounted on drive shaft. It is sometimes called a cam valve engine. The piston rod being driven by the force of the steam in cylinder turns the crank shaft attached to the cam causing it to revolve as in No. **154**.

**153.** Spring type engine governor. A governor is a device to regulate the speed of an engine and was invented by James Watt. In this type the balls are attached to springs, having their upper ends fastened to a collar fixed on the central shaft and their lower ends fastened to a collar on a sliding sleeve. The springs are of such a tension that they will remain in one position for a required speed of the engine. When the engine exceeds this speed the balls are thrown outward by centrifugal force raising the sleeve stem and closing the valve so that the steam pressure is shut off. This keeps the speed of the engine constant.

**154.** Horizontal slide valve engine. This is the well known type of reciprocating slide valve engine in universal use. Steam entering steam ports alternately by action of sliding valve, operates piston in cylinder. Attached to the piston rod is a crank and crank arm which drives the fly wheel. An eccentric on drive shaft operates the sliding valve through eccentric rod.

**155.** Triple expansion engine. Steam enters the cylinder on the right at high pressure causing piston rod to operate in regular way as in No. 152 and No. 154. After it performs its work, it is exhausted into low pressure cylinder in center and in turn into third low pressure cylinder on left. From here it is exhausted into atmosphere.

**156.** Aero radial engine. This is a radial engine of the airplane type. The vertical connecting rod with a disk type head is directly attached to the drive shaft crank A. This rod revolves completely with the crank. Note how the other four rods are connected to the disk. They are not rigid but oscillate as the disk turns. Valve actions and ignition are omitted as they are fully shown in Auto engine model No. 102. Firing rotation is every other cylinder in the 5, 7, or 9 cylinder types of engines.

**157.** Steam turbine. Pelton wheel type. High pressure steam entering five steam inlets drives against the outside surface of the wheel making it revolve at a high speed. The speed is regulated by the opening of the steam port or inlet. Steam escapes through exhaust ports in casing.

**158.** Valve gear. Hand or automatic. This is the first type used on stationary slide valve engines. Horizontal arm or handle is designed to be disconnected by hand from green head of valve rod. If this is done, vertical arm controls valve stem by hand operation. This change is necessary to enable the engineer to stop his engine off center or in a position where it will start again. This is done by watching crank shaft and closing both steam ports by action of vertical lever causing engine to stop in that position. Rods are then connected for automatic starting.

**159.** Steam engine reversing links. This is another type of valve gear called the reversing type and is most commonly used on locomotives. As you will note in the automatic action of this model, when the hand lever is thrown forward or backward it changes the position of the slide valve through action of slotted link motion, admitting steam in either end of cylinder as desired in order to start the engine forward or backward.

**160.** Steam turbine. This type of turbine is an improvement over No. 157. Through the multiple arrangement of the bucket wheels, steam enters through control valve striking first wheel fixed to shaft causing both to rotate. As this steam passes through, it strikes the stationary wheel in center and is deflected so that it strikes the third wheel, also fixed to shaft, again furnishing power to drive shaft.