THE IRON AGE.

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Louisville Pumping Engines.

With Supplementary Sheet of Engravings.

The engine of which we herewith present drawings of the principal parts was designed by E. D. Leavitt, of Cambridgeport, Mass., and Charles Hermany, of Louisville, Ky., and is now being built by the I. P. Morris Company, of Philadelphia, for the Louisville Water Company.

The engine is of the balanced "inverted beam" type, which is now used by Mr. Leavitt in all his designs of pumping-engines, as well as in a number of his large mining-engines. Both cylinders are vertical and inverted, the high-pressure working on one end of the beam and the low-pressure on the other end. The pump plungers have a shorter stroke than the steam pistons, being worked from nearer the beam center than the point of application of the steam links. The fly-wheel shaft is centered to one side of the main part of the engine, and is worked by a connecting rod from the upper part of the beam. It will be noticed that the whole arrangement is such that all parts of the engine are almost perfectly balanced in all positions, and at the same time friction is reduced to a minimum, both by this balancing and by substituting pin friction for slide friction wherever possible. The engine is designed for a duty of 16,000,000 U. S. gallons for 24 hours, the maximum head being about 185 feet. The steam pressure to be used is 140 pounds per square inch. The speed of engine at regular working capacity will be 18 revolutions per minute.

The high-pressure cylinder is 27 inches in diameter and the low-pressure 54 inches, each having a piston stroke of 10 feet. Both cylinders are jacketed on the plan covered by Mr. Leavitt's patents. It will be seen in Fig. 4 that each cylinder and its jacket is cast in one piece. The jacket is not continuous, however, but has an opening about 3 inches wide all around it at about the middle of the length. This opening is covered by a copper expansion ring which is bolted tightly to both parts of the jacket. This method of jacketing has the advantage over the method of using a separate-working lining inserted into the cylinder jacket that in the latter case the clearance at ends of cylinders and in steam passages is not increased above that which would exist in an unjacketed cylinder. At the same time the difference of expansion of the inner and outer walls is perfectly provided for, and the expansion arrangement is on the outside of the cylinder, where any breakage can be easily detected and remedied.

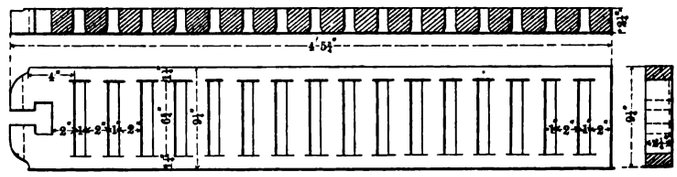

Fig. 6.—Low-Pressure Inlet-Valve.

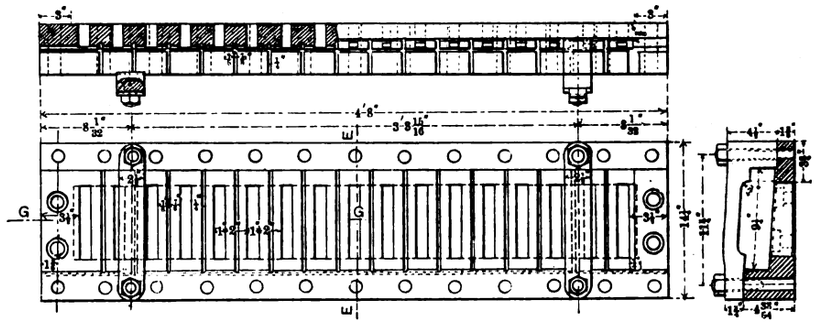

Fig. 7.—Low-Pressure Inlet-Valve Seat.

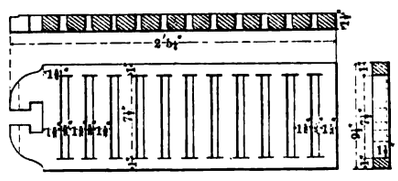

Fig. 8.—High-Pressure Inlet-Valve.

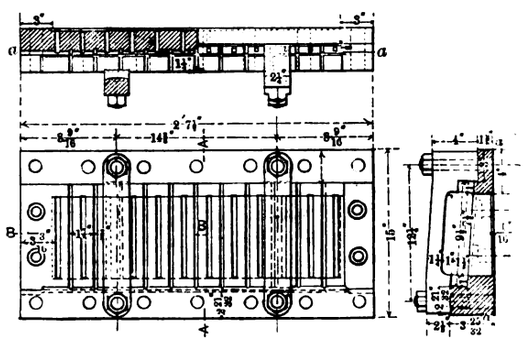

Fig. 9.—High-Pressure Inlet-Valve Seat.

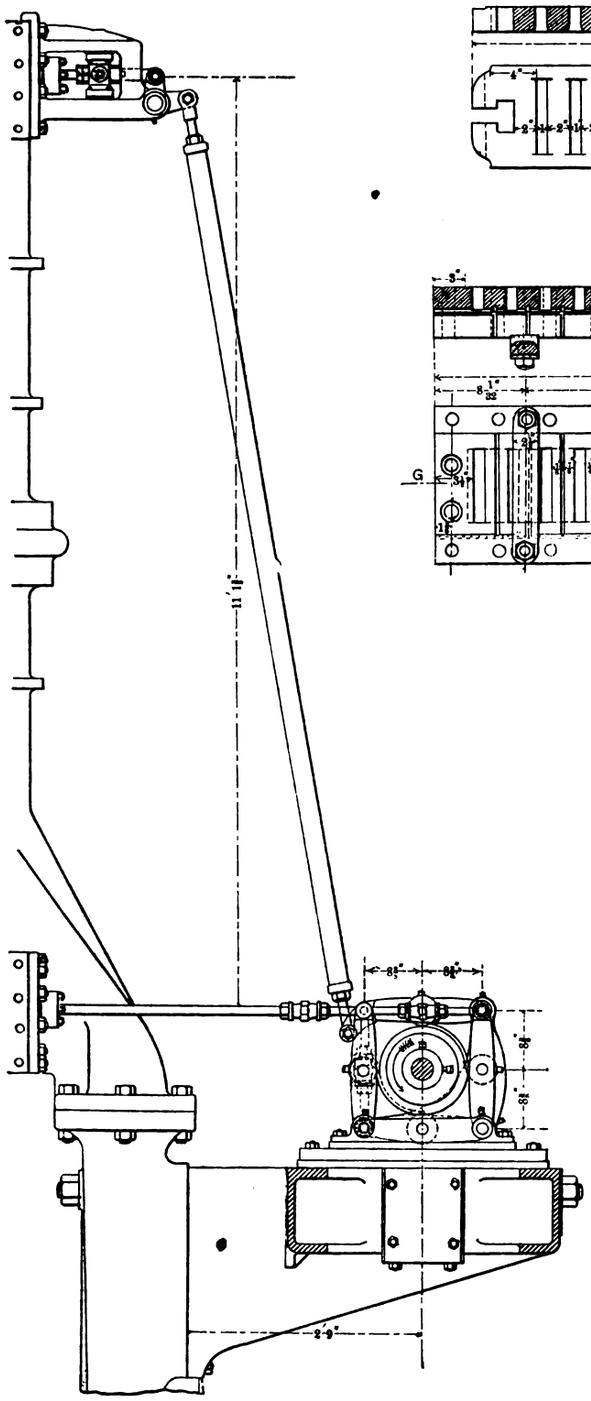

Fig. 10.—Valve-Gear.

There are separate gridiron steam (Figs. 6 to 9 inclusive) and exhaust valves for each end of each cylinder, worked by cams. The high-pressure valve-gear is shown in Fig. 10. These cams are placed on shafts which derive their motion by gearing from the crank-shaft. The low-pressure cut-off is fixed, and the high-pressure regulated by a centrifugal governor. In the Leavitt cut-off the valves always have the same travel, no matter how much the point of cutting off may be changed. The steam valve is opened by one cam and closed by another, the point of cut-off being determined by the position of the cut-off cam on its shaft, this position being regulated by the governor. The cut-off being a positive one is applicable to engines of any speed as well as to slow-speed engines like the one here described. The arrangement of the valves is such as to give a very small clearance, amounting to only about 1.6 per cent. of the piston displacement. The effect of the constant length of valve travel is to make the wear very even and to make the valves keep tight. Valves designed by Mr. Leavitt on this principle were recently examined after 16 years' constant use and found as tight as when first fitted.

The exhaust from the high-pressure cylinder on its way to the low-pressure valve-chests passes through reheaters which contain an aggregate of 2900 copper tubes $\frac{5}{8}$ inch outside diameter and 2 feet 6 inches long between tube sheets. Live steam from the boilers passes through the tubes and the water of condensation is led directly back to the boilers, the same as water drained from the jackets.

The connecting rod, forged of open-hearth steel, is 14 feet long between centers. The boxes are Eureka steel castings with babbitted wearing-surfaces. Both rods are fitted with adjusting bolts and wedges. The boxes are bored at beam end 9 inches diameter and 15 inches long, and at crank end $13\frac{1}{2}$ inches diameter and $15\frac{1}{4}$ inches long. The crank-shaft is built up with a double throw-crank of 3 feet 6 inches

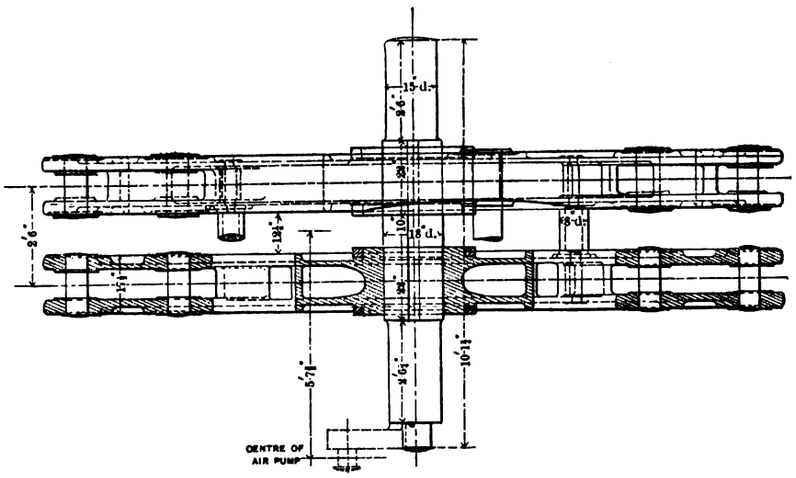

Fig. 11.—*Beam.—Sectional Plan at Center Line A A.*

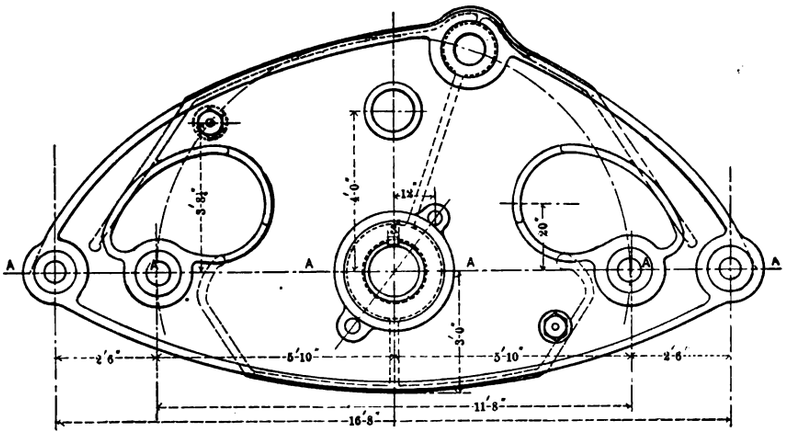

Fig. 12.—*Beam.—Side.*

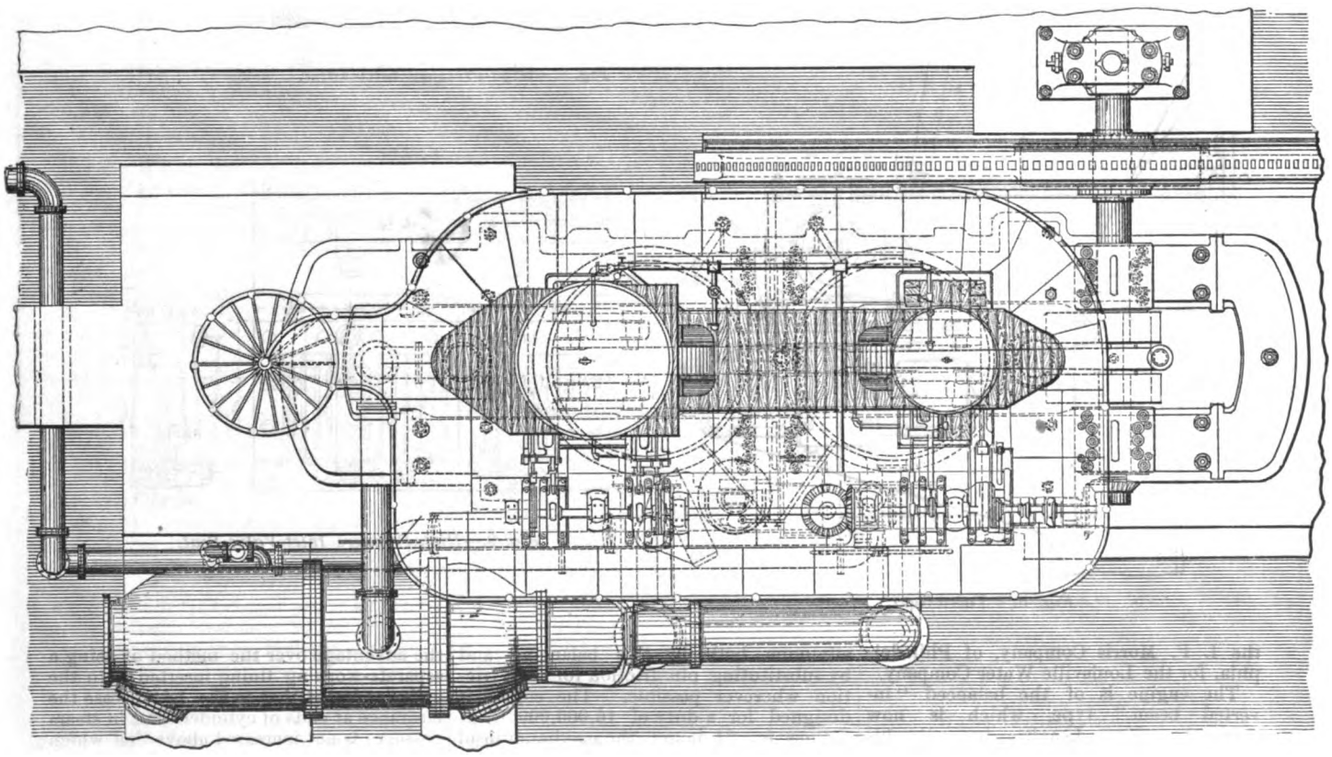

Fig. 8.—*Plan.*

radius. The shaft and crank-pin are of open-hearth steel and the cranks forged of best selected scrap-iron. The crank-pin has a 4-inch hole drilled longitudinally through its center, and the shaft has similar 5-inch holes. The shaft has three journals, one on each side of the crank and one beyond the fly-wheel; all 17 inches diameter. The main journals are 33 inches and the outboard journal 32 inches long. These journals work in four-box pedestals with babbitted bearing-surfaces.

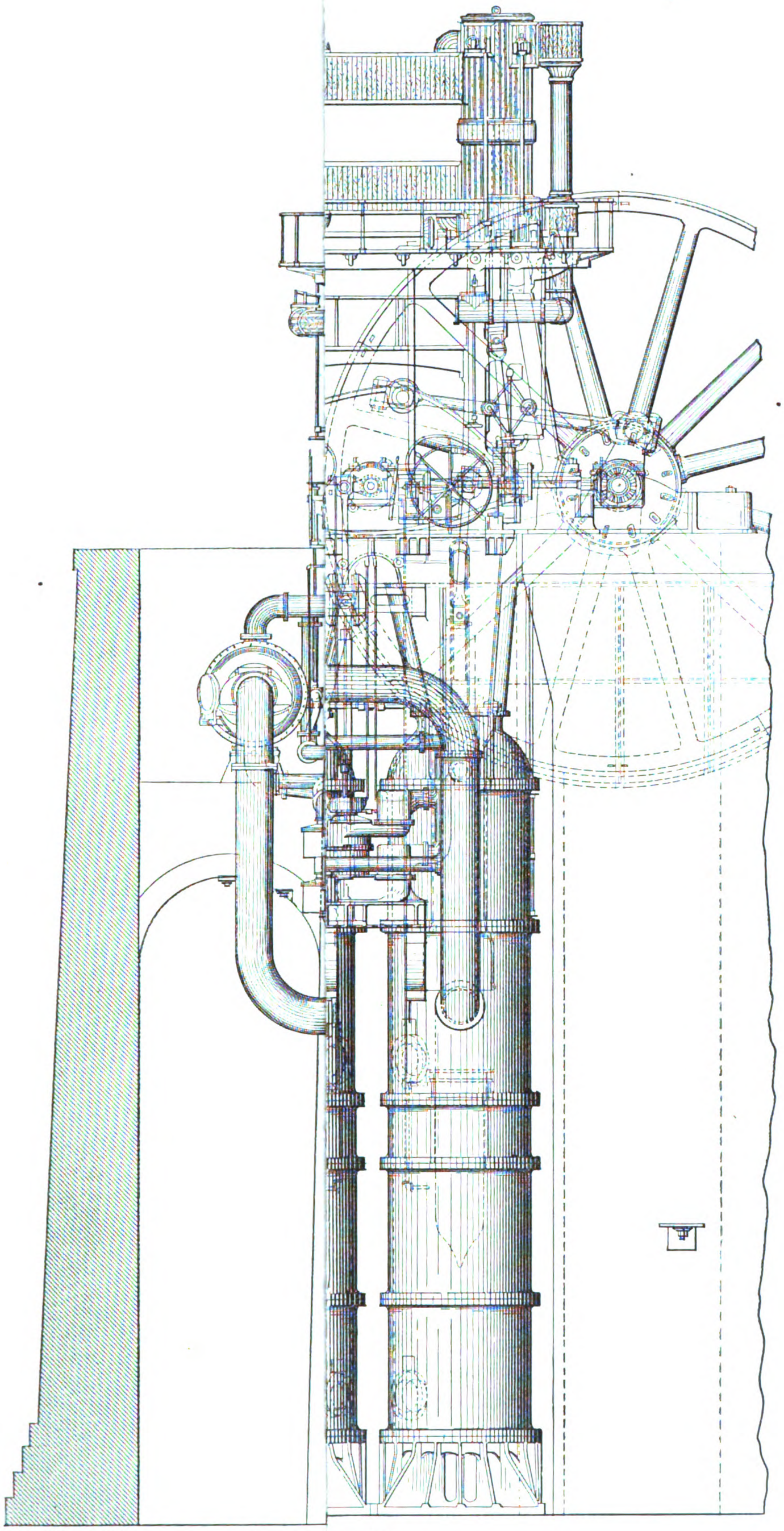

FIG. ELEVATION.

The boxes are adjustable in all directions, and those of the outboard bearing are self-adjusting by means of swivel-blocks.

The beam (Figs. 11 and 12) is made of two massive hollow gun-iron castings, with steel pins forced in for the various connections. The beam center-pin has two bearings, 15 inches diameter and 30 inches long. The beam pedestals are similar to those for the crank-shaft. The fly-wheel is made of cast-iron in 12 segments. It is 36 feet in diameter and 15 inches wide on the face and weighs about 57 tons. The two main pumps (Fig. 13) are exactly alike in all respects and are of the differential plunger type. The plungers are of cast-iron, turned to a diameter of 24 1/16 inches for the upper and 34 inches for the lower plungers. Both plungers have a stroke of 7 feet. Each plunger and of the same stroke as the air-pump for forcing air into the air-vessels of the main pumps.

There are three boilers (one being spare) of the Belpain fire-box, horizontal tubular type, each having 52½ square feet of grate surface and 2241 square feet of heating surface, making a ratio of 42.7 to 1. Each boiler has two furnaces opening into a combustion chamber common to the two. There are 159 tubes in each boiler, 3 inches outside diameter and 16 feet long between tube sheets. The boilers are built of the best open-hearth steel that can be procured. The ash-pits, smoke-boxes, &c., are of cast-iron, so that each boiler is self-contained, and no brick-setting is required.

An overhead traveling-crane of 35 tons

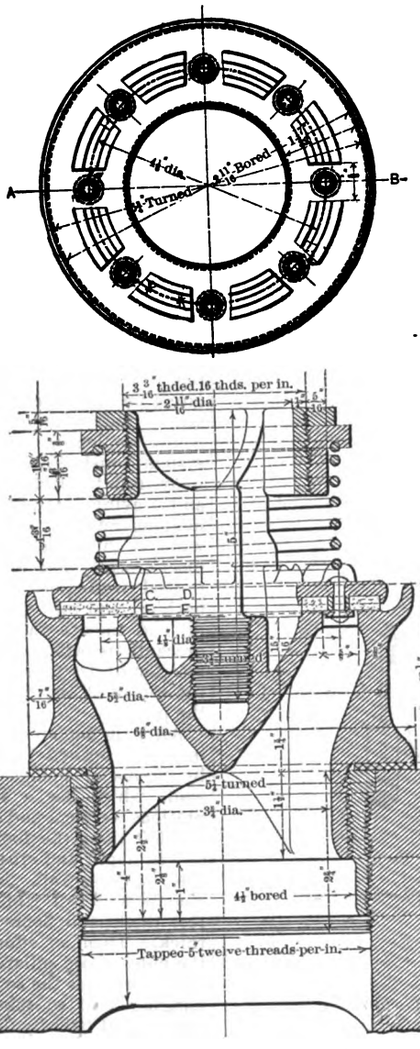

Fig. 14.—Pump-Valve.

pump has 143 suction-valves and 124 delivery-valves. The valves (Fig. 14) are of composition working under bronze springs. They are of annular shape, 5½ inches external and 2⅞ inches internal diameter, arranged for a lift of 1/16 inch. The valve-seats are of composition and are screwed into composition bushings, which in turn are screwed into the cast-iron valve-plates.

There is a surface condenser having 1306 brass tubes 1½ inches outside diameter and 5 feet 6½ inches long. The water discharged from the main pumps passes through the tubes, and the exhaust steam around the outside. The air-pump is vertical double-acting, 30 inches diameter, with a plunger stroke of 24.6 inches. The pump is worked by an arm on the beam center-pin. There is a pump of 4 inches diameter of capacity is provided for erecting the engines and for subsequent use in overhauling and making repairs. A crane of this sort worked by hand power is always provided for by Mr. Leavitt for his large engines. The crane about pays for itself in the erecting of the machinery, and is then on hand to save time and labor in work which may afterward be found necessary.

The drawings from which these large pumps are being built form 78 large sheets, while the specifications fill a volume of 150 printed pages.

England has received from the Sultan of Zanzibar a concession of 600 additional miles of coast which will be opened to trade.

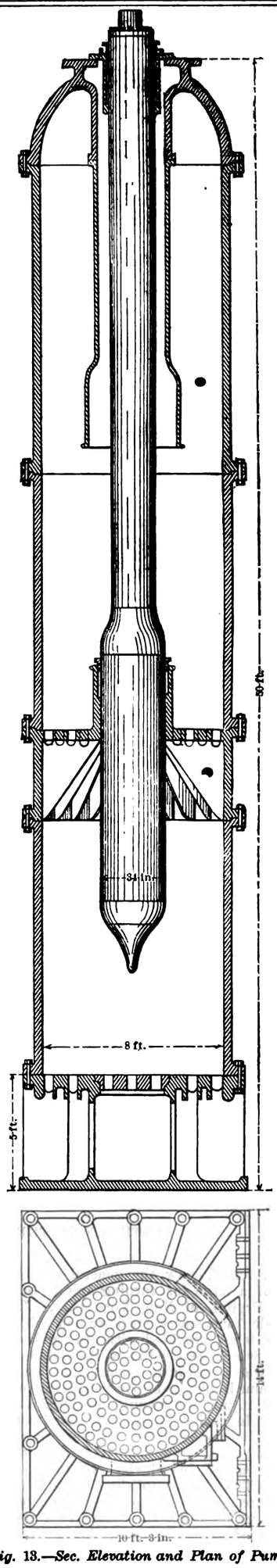

Fig. 13.—Sec. Elevation and Plan of Pump