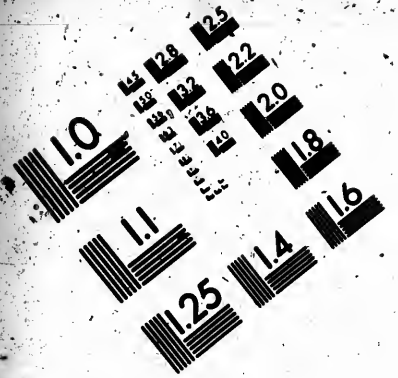

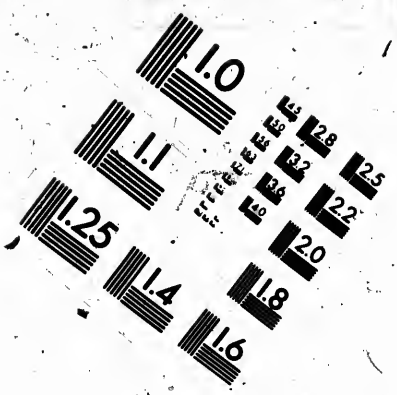

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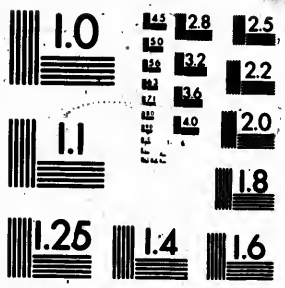

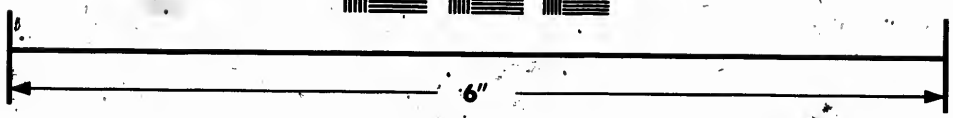

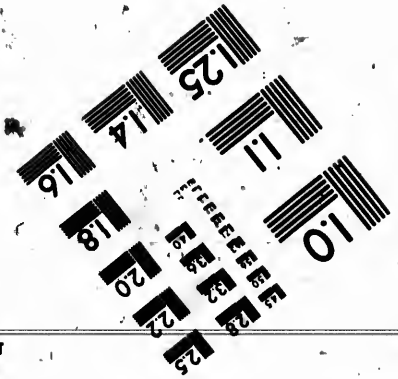

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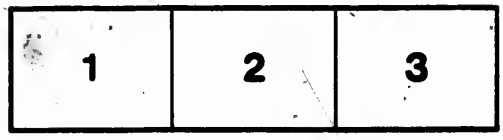

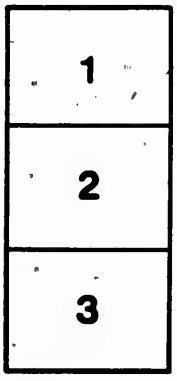

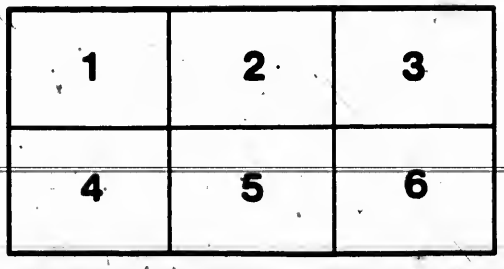

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SPECIFICATION

OF

THE NEW PUMPING APPARATUS

OF THE

MONTREAL WATER WORKS.

MONTREAL:

PRINTED BY J. STARKE & CO.,

33 St. François Xavier Street.

1863.

PHILADELPHIA, July 11th, 1863.

NEW PUMPING APPARATUS FOR THE MONTREAL WATER WORKS.

SPECIFICATION OF TURBINE.

1st. FOUNDATION PLATE.—The foundation plate is to be made in cast iron, and in the shape of a ring of 9 feet 9 inches outside diameter, and 7 feet inside diameter, the section of said ring is 2½ inches thick when finished on top and bottom. Said ring is to have an inside and outside rim of one inch width and depth in addition to the plate. Said foundation plate is to have six arms and a centre of the same thickness as the plate, namely—2½ inches. Each arm is to be 8 inches wide near the centre and 6 inches on the outside. The centre is to be 14 inches diameter. The top and bottom of this plate is to be faced, and is to have 12 foundation holes of 1¼ inch diameter. The plate is to be put down level with 12 foundation bolts, each 10 inches long, in the shape of wood screws, and to have fitted on it the stands and gate. After being levelled said foundation plate is to be under-run with sulphur.

2nd. GATE STANDS.—The gate stands are to be 6 in number, and are to be of cast iron. They are to be of the form shewn on plan, and the main body and feet are to be of 1½ inch thickness of metal. The bottom or feet are to be 12 inches square, the top is to be in the shape of an L, 8 inches wide. Said stands are to be planed, fitted, and secured by means of proper bolts to foundation plate and turbine cylinder.

3rd. TURBINE GATE.—The turbine gate is to be made in cast iron, of 9 feet 4 inches inside diameter, 27 inches inside height, or 28½ inches total height when finished. It is to be of the form represented on the plan, with 2 ribs, 2 inches wide and 1 inch thick, also 2 bosses which are to be fitted to receive the gate rods. Said gate rods are to be 10 feet 3 inches from centre to centre, the bottom and inner side of top flange are to be faced true, and are to be made

to fit to foundation plate and turbine cylinder so as to form as tight a joint as it is practicable, bearing in view that the gate has to slide up and down.

4th. TURBINE CYLINDER.—The turbine cylinder is to be made in cast iron, of the shape shewn on plan. Its total height is to be 6 feet 9 inches, and its diameter when finished where the turbine revolves is to be 8 feet $\frac{3}{4}$ inch full, both bottom and top flanges are to be round. Inside of said cylinder there are to be 4 lugs, so arranged as to be able to receive a cross bridge. Six perpendicular strips are to be cast on the outside of cylinder, and they are to be fitted so as to serve as guide to the gate when going up or down. Said cylinder is further to be provided with a man-hole and plate, as shewn on plan. The work on said cylinder is that it should be bored true to receive a movable and stationary wheel; that it should be fitted and bolted securely to the gate stands; and that it be made so as to fit to the gate in the manner described under the head of turbine gate; that it should receive the cross bridge so fitted as to present a level surface for the step.

In conclusion, there are to be cast on the outside and fitted two brackets, 20 inches wide, which are to be made as shewn on the plan, and fitted and secured with 2 bolts, $1\frac{1}{2}$ inch diameter, to iron girders, to be described hereafter.

5th. STATIONARY OR GUIDE WHEEL.—Said wheel is to be composed of an inside rim in cast iron, 18 inches high and 5 feet 6 inches outside diameter, thickness of said rim $1\frac{1}{8}$ inch. Said rim is to be strengthened by means of a plate of form and thickness shewn on the plan, and to have further 8 arms of 1 inch thickness. On said rim there should be firmly secured 18 wrought iron buckets, of $\frac{1}{4}$ inch thickness of metal, of the form shewn on the plan, as the curve required, at the outside diameter of the cast iron rim; the surface of the buckets is to be formed by lines running horizontally from the axis to the cone of the turbine cylinder, wherein said buckets are to be carefully fitted. Said buckets after being made to the curve required are to be ground smooth. The bottom and top of rim and buckets are to be fitted true.

6th. MOVABLE WHEEL.—Said wheel is to be composed of an inside rim of cast iron, of 5 feet 6 inches outside diameter, $11\frac{1}{2}$ inches high, and double disk, as shewn on the plan. The centre is to form a hub, which is to be bored and fitted with key seat and keyed to the turbine shaft.

The sections of metal of said rim are stated on the plan. On said rim there are to be firmly secured 45 wrought iron buckets of $\frac{1}{4}$ inch thickness, made carefully to the curve shewn on the plan, which

curve is to be extended to the outer perifery by horizontal lines radiating from the axis; said buckets are to be ground smooth after they are bent to the proper curve, and after being firmly secured they are to be made still more solid by shringing four wrought iron bands on the outside of said buckets—said bands are, when finished, to occupy the height of the movable wheel, or 11½ inches; before shringing them on the buckets are to be made true to the diameter of eight feet. Said wrought iron bands after being shrung on are to be turned off to 8 feet ¾ inch scant; the bottom and top of rim and buckets are also to be made true, and both movable and stationary wheels are to be gauged to the number of square inches given on the plan.

7th. TURBINE SHAFT.—The Turbine Shaft is to be made of wrought iron, 14 feet 4 inches total length, and in its main part 8½ inches diameter, when finished; said shaft is to be turned all over, and fitted first, to the moveable wheels; second, to the upper part of step; third, to the stuffing box of Turbine cover; fourth, to the bevel pinion; fifth, to the pedestal over the bevel pinion.

8th. STEP ARRANGEMENT.—The step arrangement is to be composed of upper and lower part in cast iron and centre in *lignum vitæ*, said centre to be 15 inches diameter, and the whole to be of the dimensions shewn on the plan. The base and working parts, and also that part that is to fasten to the shaft, are all to be turned and fitted also with *lignum vitæ*. The upper part is to be fastened on the shaft by means of steel pointed set screws. The *lignum vitæ* is to have two deep grooves across the face and through the centre, one inch diameter hole that connects with one inch diameter wrought iron pipe brought in connection with the ascending main. Said pipe is also to be provided with a filtering apparatus and stop cocks. The lower part in cast iron is to be firmly secured to the cross-bridge by means of 8 bolts ¾ inch diameter.

9th. CROSS-BRIDGE.—The cross-bridge is to be of cast iron, and is to be formed of 4 arms 1⅜ inch thick, and of the form shewn on the plan, said cross-bridge is to have a top plate 24 inches in diameter, which is to be set horizontally in the 4 lugs of the turbine cylinder, where in said 4 arms are to be secured by means of set screws tapped into the turbine cylinder. The lower part of the step is to be set central to turbine cylinder.

10th. COLUMN.—The column under the cross-bridge is also to be made in cast iron, of the dimensions shewn on the plan, the bottom and top to be faced true and to be fitted and bolted to the bottom or foundation plate, also to the cross-bridge.

11th. GIRDERS.—There are to be two girders in cast iron of the section shewn on the plan, and to be each 17 feet 6 inches, they are to be fitted and bolted to the two brackets cast on the turbine cylinder. Said brackets are to be so placed as to bring the girders 9 feet 6 inches from centre to centre. The ends of these girders are to rest and to be secured to four iron plates 36 inches long, 12 inches wide, 1¼ inch thick, with two anchor bolts 3 feet long, 1 inch diameter for each plate secured in the wall.

12th. INLET CHAMBER.—This inlet chamber is to be in cast iron, and owing to its size, may be made in two pieces should it be found necessary to do so, the separation should then be made horizontally. Its dimensions are 9 feet 6 inches inside diameter, 7 feet high between bottom and top flanges. The thickness of metal, except in the flanges, is to be ¾ inch, and in the flanges 1⅛ inch. The outside diameter of flanges, bottom and top, is to be 10 feet. There are to be two horizontal ribs, ¾ inch thick by 2½ broad, as shewn on the plan. On one side there is to be an inlet of a square section with rounded corners. The outside of the flange of said inlet is to be 5 feet 4 inches from the centre of the chamber. The section of inlet is to be 9 feet 6 inches wide, 6 feet high, with rounded corners of a radius of 24 inches. The vertical flange is to be 5 inches wide outside to the dimensions given and to be 1¼ inch. The work on said inlet chamber is, that the top, bottom and side flanges should be made true and fitted with holes to bolt thereon: 1st. The turbine cylinder; 2nd. The cover; 3rd. The inlet pipe; 4th. The two girders. The dimensions of flanges given are the dimensions when finished.

13th. CHAMBER COVER.—The cover of chamber is to be in cast iron, and to be 1 inch thick in the main body; its outside forms a flange of 10 feet diameter, which flange is to be 1⅛ inch when finished; the main body is to be slightly arched as shewn on the plan, with 8 ribs of 1 inch thickness, and of the form shewn on the plan. Said cover is to be arranged with a stuffing-box and follower to suit the turbine shaft, and also two seats 19 inches by 21 inches square, setting opposite to the inlet of chamber, and somewhat out of centre as shewn on the plan; said two seats are raised, when finished, 7½ inches over the bottom flange. The distance from inside to inside of said seats is 4 feet 5 inches.

The section of iron forming said seats is not to be less than 1½ inch when finished, and may be cast full, as shewn on plan. This cover is to be fitted on top of the inlet chamber, after being faced; the two seats are to be faced, and the stuffing-box is to be bored and fitted with follower to suit the turbine shaft —the cover is te be bolted to the flange of inlet chamber, with ¾ inch bolts 6 inches apart. It is also to be fitted with a man-hole 15 by 20 inches.

14th. GATE MOTIONS.—The Gate motion is to be composed of two wrought-iron rods $\frac{1}{4}$ inch diameter each, 16 feet 6 inches long, fitted with keys into the two bosses at the gate. At the other extremity of each of said rods there is to be attached an eye-bolt, $1\frac{1}{4}$ inch thick, which is to connect with 800 lbs. of counter-weight for each rod; this is to be done by means of $\frac{5}{8}$ inch chain, with sheaves and stands; 6 inches from the end of said rods there is to be attached a rack of 36 inches length. Pitch, $\frac{1}{2}$ inch—width of teeth, $\frac{1}{4}$ inches. Two pinions are to gear in said racks, of 7 inches diameter at pitch line, which pinions are to be of 5 inches total width, and to be keyed or pinned to a $2\frac{1}{2}$ inch horizontal wrought iron shaft, 12 feet long—which shaft is to be held with proper stands against the back of the racks and to be bolted on the top of cover of chamber.

Said shaft is to be provided with a worm-wheel of about 20 inches diameter, which wheel is to gear in a worm about 5 inches diameter, secured to a short horizontal shaft held by a substantial stand; at the other extremity of said horizontal shaft there is to be a 36 inch diameter hand-wheel, 2 inches round in the rim, to be turned and polished.

SPECIFICATION OF GEARING.

1st. PEDESTAL FOR TURBINE SHAFT.—This pedestal is to be $8\frac{1}{2}$ inch bore scant to suit the turbine shaft, its bearing is to be 15 inches long. The bearing part is to be in Babitt metal. Its base is to be 2 feet 6 inches long, by 12 inches wide and 2 inches thick when finished. The cap is to be made as shewn on the plan, but provided with a side tallow cup, which is not shewn on the plan. The pedestal is to be bored, faced, and [illegible], and to be secured to the bridge on top of the turbine chamber by means of four bolts, $1\frac{1}{2}$ inch diameter, and wrought iron wedges. The cap is to be secured by 4 bolts, $1\frac{1}{8}$ diameter, with double nuts.

2nd. BRIDGE ON TOP OF TURBINE.—This bridge is to support the pedestal of turbine shaft and the pedestal for the horizontal or counter-shaft. It is to be in cast iron, and to have 2 feet, each 18 by 20 inches square. Which feet are to be 4 feet 6 inches apart in the inside. The peculiarity of these feet is that they have each to have a projection of $1\frac{1}{2}$ inch depth or thickness, and 20 inches long, which by means of wrought iron wedges are to be secured in the corresponding depressions in the cover of the chamber. The width of these projections on the bridge is to be $3\frac{1}{2}$ inches, and the depression in cover 6 inches. In addition to this mode of securing the bridge to the cover there are to be 6 bolts in each foot, of $1\frac{1}{4}$ inch diameter, finally a "dowel pin."

The bridge is to be 3 feet 9½ inches total height, and in its section is to be of the shape of an H, of which the width is 14 inches at the top, and sloping out to the width of the feet or 20 inches. The thickness of metal is to be 1½ all over, except at the feet, and the seats of the two pedestals, where it is to be 2 inches when finished. The base where the pedestal of turbine shaft is to be secured is to have on each side a "lug," though not shewn on the plan, to which the sides of the base of the pedestal are to be keyed with wrought iron keys. It is further to be remarked that the side of said bridge nearest the pumps is to have a foot or plate cast on, that will come, when made true, flush on one side. Said plate or foot to be 15 inches square, as shewn on the plan. This plate is to be bolted with 6 bolts, 1¼ diameter, to the foundation plate of the crank shaft pedestal. The thickness of said plate is to be 2 inches finished.

3rd. BRIDGE ON TOP OF FOUNDATION PLATE FOR CRANK SHAFT.—This bridge is also to be made in cast iron, its base is 5 feet long and 18 inches wide, its height is 18 inches, the thickness of metal is 1½ inches, except the base and top face which are both to be 2 inches when finished. The top face is to have a depression of 6 inches wide and running the breadth of said bridge, or 18 inches; its depth to be 1⅝ inch. This depression is to receive the projection at the pedestal and 2 wrought iron keys. This bridge is to be bolted down by 8 bolts, 1¼ inch diameter.

4th. PEDESTALS FOR HORIZONTAL OR COUNTER SHAFT.—These pedestals are two in number and are to be made in cast iron, lined with Babitt metal. They are to be 12 inches bore, and 20 inches length of bearing, the base is to be 3 feet 6 inches long, 14 inches wide, 2½ inches thick, the pedestals are lined with Babitt metal, secured in moveable boxes as shewn on plan. The caps are made to project over the sides where they are made to fit, they are to have on top a good sized tallow holder (with brass cover) cast on, though not shewn on the plan. The pedestals are held to the bridge, each by 4 bolts, 1½ inch diameter, and the caps are also held down each by 4 bolts, 1¼ inch diameter, these pedestals are to be fitted and faced to the bridges and the counter shaft.

5th. FIRST HORIZONTAL OR COUNTER SHAFT.—This shaft is made in cast iron, it is to be cast on end with the sinking head of the same diameter as the shaft, and not less than 3 feet long. The total length of this shaft when finished is 10 feet 8 inches, and its diameter from 12 to 14 inches, as shewn on the plan, it is to be turned all over and to be fitted and key seated and keyed to the parts marked thereon, namely, mortice bevel wheel and spur pinion.

6th. BEVEL WHEELS.—These wheels are to be of the kind called mortice wheels, and are to be 4½ inches pitch, and 18 inches length or face of teeth, which teeth are to be shaped to the form shewn on a working drawing made for the special construction of these wheels. The wheels are to be made as follows: 1st. Bevel Pinions.—This wheel is to have 38 iron teeth, and is to be 51½ inches in diameter at pitch line. The teeth are to be carefully dressed on the working side to a templete to be furnished, it is to be bored out true, and by means of a wrought iron key and two steel pointed set screws is to be firmly secured to the turbine shaft. The wheel is to be shaped in the rim as drawn, and to have 5 arms, of 1⅛ inch thickness, and of the shape shewn on the working drawing. 2nd. Mortice Bevel Wheel.—This wheel is to have 60 wrought iron teeth, and is to be 80 inches diameter at pitch line, and the rim is to be 23½ inches breadth. Its depth at the outside diameter is to be 4½ inches, radiating to the centre line. The said rim is to contain a bridge in the middle of the length of each tooth, 1½ inch wide, and the depth of 3½ inches. The wheel is to be bored and turned on the rim and face of rim. The teeth are to be made out of sound, well-seasoned hickory, thoroughly soaked in tallow, and to be dressed down to a template, to be furnished, after being firmly driven home into the mortices and there secured by means of wedges. The hub of said mortice bevel wheel is to be bored to 14 inches, and is to be fitted and firmly secured to the counter-shaft by means of two wrought iron keys, each 2 inches wide, placed at right angle to each other.

7th. SPUR WHEELS.—These wheels are also to be of the kind called mortice wheels. They are to be 5 inches pitch and 24 inches face of teeth. They are to be made as follows:—1st. The spur pinion is to have 29 iron teeth, its diameter at pitch line is to be 46 1-5th inches, the teeth are to be carefully dressed on the working side according to a template, to be furnished. The pinion is to be bored out true to 14 inches, and by means of two wrought iron keys, 2 inches wide, is to be firmly secured to the countershaft. The large wheel, or mortice spur wheel, is to have 77 teeth, and its diameter at pitch line 122 23-100th inches. The rim of the wheel is to be 30 inches total width. In the middle there is to be a bridge 7 by 2½ inches. The number of arms, and sections of same, of both these wheels are fully represented on a working drawing of said wheels. Thereon also is given the depth of rim and bridge and thickness of hub.

Regarding the teeth of wood in this wheel, they are to be made of solid well-seasoned hickory, soaked in tallow, and after being firmly driven home into the mortices, they are to be secured by means of wedges. In both these mortice wheels, the bevel and spur,

the wooden teeth are to be made in two pieces, but fitted together over the central bridge. It is to be keyed with two keys, $2\frac{1}{2}$ by $1\frac{1}{2}$ in.

8th. CRANK SHAFT.—This shaft is to be made in cast iron, and is to be cast on its end, with a sinking head of the diameter of the shaft, and not less than 3 feet long.

Its total length when finished is to be 14 feet 2 inches, and its diameter varies from 14 to 17 inches, as shewn on the plan. The shaft is to be turned all over, and to be particularly sound in the bearings. A core may be cast in it of $5\frac{1}{2}$ inches diameter.

9th. CRANK SHAFT PEDESTALS.—These pedestals are to be 2 in number, and are to be made in cast iron with movable boxes, lined with Babitt metal, according to a working drawing to be furnished. They are to have a base 4 feet 2 inches long by 18 inches wide, $3\frac{1}{2}$ inches thick, with a projection 3 by $1\frac{1}{2}$ inch, which is to be set in a corresponding depression in the bed plate. From centre to base the distance is to be 13 inches. The boxes are to be 2 inches thick, made round with square flanges, and are to be filled with white metal, as shewn on the working drawing. The pedestal caps are to overlap and are to fit well the sides of the pedestals, and are to be held down each with 4 long bolts, 2 inches diameter. The pedestals themselves are to be held down each with 6 bolts, 2 inches diameter. On the sides there are to be in each pedestal 4 set screws, $1\frac{1}{2}$ inch in diameter, with squared off ends, that are to be fitted in the moveable boxes so as to prevent them from turning.

The caps are to have tallow cups, as shewn on working drawing.

10th. CRANK WHEELS.—The crank wheels are to be two in number and are to be made in cast iron, they are to be 8 feet outside diameter when finished, and are to be made with double disks each $1\frac{1}{2}$ inch in thickness, joining in a rim as shewn on the plan of 8 inches width; these disks are united further by means of 6 ribs $1\frac{1}{2}$ inch thick, that radiate from the hub to the rim, and project on the back part of the hub as shewn on the plan. The hub in each crank wheel is to be 22 inches outside diameter, and is to be bored to 14 and 17 inches between two of the ribs; in each wheel there is to be a boss of metal prepared to receive the crank pin as shewn on the plan, which, when fitted, will present its centre 3 feet from the centre of the crank wheel.

The crank wheels are to be most carefully fitted on the crank shaft, and when turned and faced they are to be keyed on the said shaft each with two wrought iron keys $2\frac{1}{2}$ inches wide, $1\frac{1}{2}$ inch thick, they are to be turned on the outside and top of the rim, which parts are to be polished, also to be turned on both sides of the hub, the back part of which is to fit closely to the sides of the moveable parts of the crank shaft pedestals.

These crank wheels are to be secured to the crank shaft, in such a manner that the crank pins are at right angle to each other.

11th. CRANK SHAFT FOUNDATION-PLATES.—These foundation-plates are two in number, and are of different shape. 1st.—The first or the one nearest to the Turbine Chamber is to be 10 feet 9 inches total length, and is to be 15 inches high and 18 inches wide on top and bottom, its shape is that of a ⊐, arranged with ribs and filets as shewn on the plan; the section of metal is to be 1½ inch over, except those parts that fasten to the bridge on top of Turbine Chamber, and to the pump foundation-plate, also where the crank shaft pedestals rest upon; in all these parts it is to be 2 inches thick when finished. On the base where the crank shaft rests upon there is to be a depression 1⅝ inch deep by 6 inches wide.

This foundation-plate is firmly secured to the Turbine bridge as described in the article "Bridge on top of Turbine."

On the other extremity there is to be a projection as shewn on plan, with its face made true to the inclined position of the pump foundation-plate.

This foundation-plate is to be held to its position on the stone foundation by means of 3 foundation bolts, described in the article "Foundation Bolts," and at the lower base of the foundation-plate there are to be provided three bosses 6 inches diameter and 2 inches thick, independent of the thickness of the base plate, provided with 3 inches holes through them.

These holes may be cast in. All other holes in Pedestals and Caps, though not mentioned above, will have to be bored and fitted to the bolts. 2nd The second foundation plate, or the one furthest from the Turbine Chamber, is to be 15 feet 9 inches total length, 15 inches high, 18 inches wide, and is to be made like the other in the shape of a ⊐, arranged with ribs and filets as shewn on the plan; the sections of metal are also to be 1½ inch all over, except at those parts which fasten to the pump foundation-plate, or whereon the bridge for counter shaft and crank shaft pedestals rest on; on those parts the iron is to be 2 inches thick when finished. On the extremity furthest from the Turbine there is to be a projection as shewn on plan, with a face made true to the inclined position of the pump foundation-plate. This foundation-plate is to be provided in its base with 5 bosses, 6 inches outside diameter, 2 inches thick in addition to the thickness of the base, and each is to have a 3-inch hole to receive a foundation bolt. Both these foundation-plates are to be set so as to present a level surface at those parts which receive the pedestals, and before being finally bolted down, a substantial bed of sulphur is to be run between the base and the stone foundation so as to secure a good junction between foundation and plates.

12th FOUNDATION BOLTS.—These bolts are to be 8 in number for the plate making part of the gearing; they are to be 6 feet 6½ inches long between head and nut, 1¾ inch diameter, furnished with anchor-plate 10 inches square, 3 inches thick, with levelled corners. The keys forming head at one extremity are to be not less than 3½ inches broad, ½ inch thick, and inserted not less than 3½ inches from the extreme end.

The other extremity of these bolts is to be provided with substantial 6 sided nuts and wrought iron washers.

13th OIL CUPS AND FACE PLATES.—Each horizontal pedestal, and they are 4 in number, is to be provided with a brass cover to fit over the tallow cups, and thereon is to be secured an automatic oil cup also made of brass polished. Both ends of the counter shaft and the two ends of the crank shaft, and the two crank wheels are to be provided with polished brass heads according to working drawing.

SPECIFICATION OF PUMPS.

1st. FOUNDATION PLATES.—These plates are four in number, they are to be in cast iron, and to be made somewhat in the shape of an H. The base of said plate is to be 13½ inches broad, the top 10 inches, height of plate 12 inches, thickness of metal 1½ inch, except where the guides and the valve chests rest, also the 2 inner plates fasten to the foundation plate of gearing, in all these parts the thickness is to be 2 inches when finished; the fillets of these plates are to be made heavy, and the upright plate to be put on and inclined as shewn on the plan. Independent of each end there are also 9 ribs 1½ inch thick, that unite the bottom and top plate. Two of these plates are finished alike on both ends and do not connect with anything, they are the two exterior plates for pumps, one is right and one left. The finish at each end is to be like the section of the plate itself. Total length 28 feet 9½ inches. The two inner plates are also to be right and left; one end, that one where the valve chests are on, is to be furnished like the ends of the two exterior plates, and the two other ends are to be made flat and dressed true and fitted and secured each with 4 substantial bolts 2 inches diameter to the gearing plates.

Each of these 4 foundation plates is to have 6 holes 2½ inches diameter, that may be cast in, for the foundation bolts placed at the distances named on the general drawings; these holes have to pass through the whole depth of the plates, and to add to the strength of the plates, there are to be hollow tubes or passages cast as shewn

on the plan. When faced on top and the ends fastening to other plates these foundation plates have to be fitted and secured to the valve chests, the guides and ends of other plates, then they are to be set at the angle shewn on the plan, at such distance from each other, on stone foundations prepared for the purpose, that will bring the centre lines of each pump 15 feet apart. When properly set the foundation and iron plates are to be united by means of a sulphur bed.

2nd. FOUNDATION BOLTS.—These bolts are to be 24 in number, they are to be 7 feet 3 inches between head and nut, $1\frac{3}{4}$ inch diameter, furnished with anchor plates 10 inches square, 3 inches thick, with bevelled corners. The keys forming head at one extremity are to be not less than $3\frac{1}{4}$ inches broad $\frac{1}{2}$ inch thick, and inserted not less than $3\frac{1}{2}$ inches from the extreme end; the other side is to be provided with a six-sided substantial wrought iron nut and washer.

3rd. GUIDES.—These are the guides for the two cross heads and are to be 4 in number; they are to be made in cast iron, presenting when finished, a surface free of scoria, which may be attained by casting them on end; they are to be each 7 feet 2 inches total length, and are to be made in the shape of an L; the base is to be 10 inches wide, height $15\frac{1}{2}$ inches when finished, breadth of top when finished $12\frac{1}{2}$ inches, thickness of metal at base when finished 2 inches, the upright part $1\frac{1}{2}$ inch with heavy fillets as shewn on the plan; the top is also to be $1\frac{1}{2}$ inch thick with 2 projections towards the cross heads, which are to serve as guide groper to said cross heads; these projections are to present a perfectly true surface of $2\frac{5}{8}$ inches width and $2\frac{1}{2}$ inches thickness. Immediately over the top of the upright plate of said guides there is to be at each guide a projection as shewn on the plan. The bottom and top plates of these guides are united at each end with a rib of $1\frac{1}{2}$ inch thick with fillets the same as the guides themselves, and inside these are to be 3 additional ribs $1\frac{1}{2}$ inch thick, which are to assist in uniting the top and bottom; each of said guides is to have the bottom faced and the top faced and polished, and are to be held to the foundation-plates each by means of 4 hold-down bolts 2 inches diameter; the bolts must be turned and fit the holes exactly, the same as at all other joints though it may not be mentioned above, excepting but one kind of bolt holes, that is the foundation bolt holes.

4th. CROSS HEADS.—These cross heads are to be 2 in number; they are to be of wrought iron, made with detached cheeks $12\frac{1}{2}$ inches long and put on as shewn on the working drawing. The centre piece is to be 11 inches thick through the hub, which is to be

bored conical $3\frac{5}{8}$ inches and $3\frac{3}{4}$ inches diameter. The places of attachment of the connecting rods to the said cross heads are to be $4\frac{1}{2}$ inches diameter and $4\frac{1}{2}$ inches long, and 13 inches from centre to centre. Inside the cheeks and both top and bottom there are to be brass gibs as shewn on the plan, which when fitted together are to bring the bearing surfaces of the inner gibs 2 feet 6 inches apart when placed on the cross head, and the space between top and bottom of the inside of the said gibs to $2\frac{1}{2}$ inches.

The outside part of the hub and cheeks at said cross head is to be fitted and polished.

5th. CONNECTING RODS.—These connecting rods are to be made two in number; they are to be made of wrought iron, with wrought iron straps and keys, and brass boxes. Each is to be 15 feet from centre to centre, and that end nearest the pumps and connecting to the cross heads is to be forked with brass bearings $4\frac{1}{2}$ inches diameter, $4\frac{1}{2}$ inches long. and at a distance of 13 inches from centre to centre. The other extremity connecting with the crank pin is to present a brass box 5 inches in diameter 8 inches width. All these boxes in each connecting rod are to be secured to their position by means of wrought iron straps fitted as shewn on plan, and keys with set screws and gibs. The main body of each connecting rod is to be $4\frac{3}{4}$ inches diameter round at each end, and $6\frac{3}{4}$ inches diameter in the centre. In addition to this increase of diameter so as to increase the firmness of the rods there are to be at each connecting rod and secured to the flat part of each head a set of braces in wrought iron $1\frac{1}{2}$ inch diameter, spreading at the centre to 27 inches. The whole outside part of these connecting rods, including straps, keys, gibs, and braces, are to be fitted to the parts they belong to or connect with and pollshed.

6th. CRANK PINS.—These pins are two in number; they are to be made of tool steel, and present a diameter of 5 inches as bearing, where the connecting rod connects with; said bearing to be 8 inches width; on each side of said bearing there is to be a collar 7 inches diameter and 1 inch breadth. The whole length of each pin is 24 inches, and is to be turned conical 5 inches and $4\frac{1}{2}$ inches, for which the holes in the two crank wheels are to be most carefully prepared. Each pin is to be secured to its crank wheel by means of a wrought iron key 1 inch thick $2\frac{1}{2}$ inches wide and 10 inches long, with strongly rounded corners; this key has to be fitted also into a slot to be made into a boss at the back part of the crank wheel. All the work on the hole for pin on the crank wheel, in addition to the mere boring of a conical hole, is to be part of the pump work.

All the corners of bearings in cross heads, crank pins, also in crank shaft and counter shaft are to be rounded off, though it is not mentioned before.

7th. VALVE CHESTS.—These valve chests are 4 in number; they are to be made in cast iron. It is of particular importance that every part should be sound and cast to the thickness called for on the plans and specifications. The thickness of metal at the 4 flanges at each chest where they connect to other parts of the pumps, also the 2 flanges at each chest where the valve bonnets bolt on, finally, the 4 feet at each chest which bolt to the foundation-plates are all to be 2½ inches when finished; all other parts of said chests are to be 1¾ inch metal, this also includes all the ribs on said chests. Total length of each chest 9 feet, inside breadth 2 feet 9 inches, inside height 20 inches; total outside breadth, over flanges 3 feet, over bonnet flanges 3 feet 8 inches. The flanges are to be secured to the other parts of pumps, such as inlet and outlet pipe, pump barrel, barrel-head and cover, also valve bonnets by means of 1¼ inch bolts or stud bolts put about 5½ inches apart as it may come to divide the spaces equally at each flange; these bolts have all to be carefully fitted into the bolt holes. The bolts for the above named purpose are to be provided with substantial six-sided heads and nuts, made true, and wrought iron washers. The two chests are to be held at each pump by 8 bolts 1½ inch in diameter and firmly secured to the foundation-plates.

Each valve chest is to have two recesses 7¾ inches wide, prepared to receive the valve seats, sockets, and keys; they are to be placed at the angle of 45°, and are formed by side pieces 1½ inch thickness, 4 inches breadth being cast on said chest in addition to the regular thickness of metal; said side pieces are also placed at an angle of 45°.

The bottom is to form a recess 3 inches wide, to receive the valve seat. There is no fitting to be done on these seats, except the getting the surface tolerably true, the valve seats being set on an India-rubber joint.

8th. VALVE SEATS.—These valve seats are 8 in number, and are to be made of cast iron, presenting a sound surface to the valves. These seats are each divided by a longitudinal and transversal bar 4 inches wide, arched in the back as shewn on working drawing, the thickness on the outward bearing being 2 inches when finished, and in the centre 4 inches when finished. The seats are faced and fitted perfectly true to the valve.

9th. VALVE SOCKETS AND KEYS.—The valves are 16 in number, 8 being extra valves; they are made of a good quality of tough brass of the dimensions shewn on the working drawing, carefully fitted to the valve seats; they set in brass sockets and rods held to their places by means of wrought iron keys, sockets and keys fitting in the recesses formed at each valve chest.

10th. PUMP BARREL.—These barrels are 2 in number; they are to be made in cast iron, cast on end, with 18 inches sinking heads of the diameter and thickness of the body of the barrel. Inside diameter when finished 18 inches, outside diameter 21½ inches, giving 1¾ inch metal when finished. Total length 7 feet, diameter of flange 2 feet 4 inches, thickness of flange when finished 2¼ inches. The centre of barrel is to come 15½ inches from the face of the foundation-plate when secured to the two valve chests.

11th. BARREL HEADS.—There are two heads planed, fitted, and bolted on the back part of each rear chest of pump; they are 2 feet 4 inches diameter and 2¼ inches thickness of metal, and shaped converse to the pressure as shewn on the plan. These barrel heads are to be held down by wrought iron bolts 1¼ inch diameter, placed about 5¼ inches apart with substantial six-sided nuts.

There are further two heads for the front with stuffing boxes. Said barrels are also to be secured to the valve chests by bolts 1¼ inch diameter placed about 5¼ inches apart. The diameter of said front heads are the same, also the thickness of metal, as those heads above mentioned.

The stuffing boxes are to be held each by 4 stud bolts 1 inch in diameter; bore of stuffing boxes to be slightly more than the diameter of piston-rods. The flanges and outside parts of these front heads; also the stuffing boxes and nuts, are to be polished. The packing is to be of a combined form of hemp bands and brass cloth saturated in tallow.

12th. VALVE BONNETS.—The bonnets are to be made of cast iron; they are to be 8 in number and of the form shewn on the plan, with flanges 3 feet 8 inches total width, and 3 feet 3¼ inches total breadth; the thickness of metal when finished is 2 inches; and they are to be held down each by 28 tap bolts of 1¼ inch diameter with six-sided nuts.

13th. PISTON HEADS.—They are two in number; to be 12¾ inches long, and follower 2¼ inch thick; hub of piston 9 inches diameter with ribs on which a conical ring 8¾ inches long is to slide. On this conical ring are to be arranged wooden segments with the end of the grain outwards. This wood is to be "apple wood," thoroughly soaked in tallow. This wood is to be made in 4 layers of blocks, 8 pieces in each layer 2¼ inches thick; the blocks to be fitted to the bevel and curve of the cone and so arranged that when the cone is thrust in by 4 screws 1 inch diameter tapped into the follower, all the blocks are forced outwards. The follower to be secured to the piston head by 4 one inch diameter tap-bolts. The hub of the piston heads are to be bored 4 inches diameter at the front and 5 inches at the back.

14th.—Piston Rods.—There are to be two of these rods; they are to be made out of the best Bagnal (English) iron; they are $3\frac{7}{8}$ inches diameter when finished at the main body, reduced to $3\frac{1}{4}$ inches where they enter the cross heads, and $3\frac{5}{8}$ at the other end of the cross heads; they are to be 4 inches diameter where they enter the piston and 5 inches in the other end. Total length 12 feet 9 inches. A substantial flat key is to secure each rod to its piston.

15th. Outlet Pipes.—These pipes are two in number; the first one which connects the two front valve chests is to be in the shape of a T. The two branches to be 6 feet from outside to outside of the flanges; said flanges to be square 3 feet 8 inches by 2 feet 7 inches outside, and to be $2\frac{1}{4}$ inches thick when finished.

These flanges are to be jointed with bolts $1\frac{1}{4}$ inch diameter placed about $5\frac{1}{2}$ inches apart, to the corresponding flanges at the valve chests. This T outlet pipe is to be shaped from the square flanges into a round form of 30 inches inside diameter, and $33\frac{1}{2}$ inches outside diameter as soon as it leaves the flanges. At the base, which is 5 feet from the centre line of the inlet flanges, there is to be a round flange at right angle to the inlet flanges; said flange to be 40 inches outside diameter and 2 inches thick. The second outlet pipe is to be in the shape of a cross; its total length is to be 11 feet 6 inches, breadth 6 feet; at the extremity forming the length there are to be at each end a round flange of 40 inches outside diameter. The body of the pipe forming the length is to be 30 inches inside and $33\frac{1}{2}$ inches outside diameter. At the extremities of the cross forming the breadth there is to be at each end a square flange 3 feet 8 inches long, by 2 feet 7 inches breadth; all these flanges on both outlet pipes are to be $2\frac{1}{4}$ inches in thickness when faced; they are to be fitted and bolted to the corresponding flanges at the two back chests and front chests in such a manner as to present a water-tight joint when the pumps are working. In this second outlet pipe the body is to shape itself into a round form immediately after leaving the square flanges; said round form to be 30 inches inside diameter.

On the top of this second outlet pipe, at 9 feet 3 inches from the end joining the first outlet pipe, there are to be two branches with flanges; one, on which a large air vessel is to be set upon, is to be of 30 inches in diameter, with a flange 42 inches in diameter, $2\frac{5}{8}$ inches in thickness. The face of this flange is to be slightly inclined as shewn on plan, presenting, when the outlet pipe is set in its place, a horizontal face. Owing to the weight to be sustained there are also to be 4 ribs as shewn on the plan. On the bottom of said outlet pipe there is to be a second branch, and 9 feet 3 inches from the extremity named; said branch is to be 12 inches diameter, with flange to bolt on a 12 inch pipe.

16th. FOOT VALVE.—This valve, composed of cast iron, chest and seat for valve, also 2 brass valves, also bonnets, keys, and bolts, is to set and connect to the furthest end of this second outlet pipe from the pumps. Its total length is to be 6 feet. It is to be provided at one end with a round flange 30 inches inside diameter, and 40 inches outside diameter; said flange, like all other bolted flanges, are to be faced, though it may not be especially mentioned above in the description of the other parts; it is to be bolted to the outlet pipe. At the other end there is to be a detached sleave, in two parts, bolted together to receive a 30 inch pipe. The width of said foot valve in the inside is to be 40 inches, height in the inside 30 inches; this foot valve is to have the same kind of valve seat, valves, and bonnets as those of the valve chests at the pumps, with this difference only of being of proportionably larger dimensions as shewn on the working plans. The thickness of metal is also to be the same. The whole valve and chest to be made according to a working plan furnished.

17th. CONNECTING PIPES WITH EXISTING MAIN.—These pipes are to be made in cast iron, 8 in number; the first 5 are to be 30 inches in diameter inside, $1\frac{1}{8}$ inch thickness of metal; four of which are to be arranged with bell-mouth connections. They are to form a total length of 45 feet, or less, but made so as to connect with existing main. They are to be made and laid according to the plans.

Two other ones are to be arranged each with a double mouthpiece at one end, one 30 inches and the other 24 inches inside diameter; they are to be secured together, and to connect with the 30 inch main from these new works, also to the existing ascending mains. The thickness of metal is to be $1\frac{1}{4}$ inch, strengthened with ribs, the area, and form to be made as shewn on the plan. The eighth pipe is to be 30 inches diameter, total length 9 feet, or less, but made so as to connect with the receiving main from the existing works. All these 8 pipes have to be connected together and to the different mains and parts named so as to form perfect joints. The excavations are to be prepared by other parties.

18th. INLET PIPE.—This pipe is to be of cast iron, $\frac{3}{4}$ inch thickness of metal; its total length, in straight pieces, is to be 86 feet 6 inches. Of this length 57 feet are to be 33 inches inside diameter, and 29 feet 6 inches are to be 30 inches inside diameter; 3 feet of the 33 inch diameter pipe is to form the seat of a throtle valve, and to have on each extremity a square flange faced with bolts. In this said seat there is to be a throtle valve, in cast iron, $1\frac{1}{4}$ inch face at the circumference, well fitted into the the seat, which is to be bored out for that purpose; said throtle valve is to be secured to a wrought iron stem $2\frac{1}{4}$ inch diameter, which stem is to

form pivot at the lower extremity, and at the other end to project through a stuffing box, prepared in the valve seat, for at least 12 inches, and thereon is to be secured a worm wheel about 12 inches in diameter 3 inches on the face; which worm wheel is to be fitted to a worm band wheel, held to their respective places by means of a stand fastened on the valve seat. With the exception of the joint connecting the said valve seat to the inlet pipe, which joint is to be made with flange and bolts, all the other joints of the 33 inch pipe are to made with bell-mouth.

At the extremity furthest from the pumps there is to be a grating, secured to a small stone wall, to be made with wrought iron bars $1\frac{1}{2}$ by $\frac{3}{8}$, placed $1\frac{1}{2}$ inch apart, secured into a cast iron frame of 4 feet square, arranged with anchor bolts.

The excavation, masonry, and work necessary to enable men to lay these pipes are not part of these specifications.

The 29 feet 6 inches diameter inlet pipe are, as stated above, to be 30 inches inside diameter; they are to be provided with square flanges 40 inches outside diameter, and with $\frac{3}{4}$ inch bolts placed about 6 inches apart, are to be made to connect to the valve seat above named, and to parts to be named hereafter. On the inlet pipe there are to be two branches.—1st. One of 12 inches inside diameter, with bell-mouth, jointed to the 33 inches diameter part as shewn on the plan. 2nd. One of 30 inches diameter, with square flanges $1\frac{1}{8}$ inch thick, and 38 inches outside diameter, of which the face is 24 inches from the centre of pipe as shewn on the plan. The whole of this inlet pipe is to be so placed as to form a descent of 12 inches from the extremity where the grate-bars are to be placed to the place where the valve seat makes part of the pipe.

19th. Inlet Pipe Connections.—As stated above, in the article "Inlet pipe," there are to be two branches.—The first of 12 inches diameter is required to have an ordinary plug put unto it which will resist 10 lbs. pressure per square inch; on the branch of 30 inch inside diameter there is to be placed and connected therewith a T pipe, in cast iron, 30 inches inside diameter, $\frac{3}{4}$ inch thickness of metal—said pipe to be 4 feet 5 inches long between the flanges; said flanges to be 38 inches outside diameter and $1\frac{1}{8}$ inch thickness of metal when faced. Said T pipe is to have a branch in the middle of 30 inches inside diameter, with flange of the same sizes as the above—said flange to come to a height of 24 inches from the centre of the pipe. It is to be in a position at right angle to the stem.

20th. Branch Pipes of Inlet Pipe.—At the extremity of the 30 inch pipe, which does not connect with the valve seat above named, there is to be a quarter turn, in cast iron, 30 inch inside

diameter, with a centre radius of 24 inches, with flanges 38 inches diameter, to be faced, fitted and bolted to the said inlet pipe and parts to be named hereafter: these flanges are to be 1⅛ inch thick when finished. 2nd. On the top of the flanges of the quarter turn, which does not connect with the inlet pipe there is to be a second T pipe 4 feet 5 inches breadth between the flanges, exactly of the same dimensions as the one described in the preceeding article of "Inlet pipe." It is to be in cast iron and to be connected to the flange of the quarter turn as shewn on the plan—3rd. On the top of the branch of the T pipe described in the preceeding article there is to be placed, at right angle to its axis, a third T pipe in cast iron 30 inches diameter, 4 feet 5 inches breadth between the flanges, and presenting a flange at right angle 30 inches inside diameter, 38 inches outside diameter, and 24 inches from the centre of said pipe.

Between the four square flanges 3 feet 8 inches by 2 feet 7 inches outside dimensions described in the article "Valve Chests," and the flanges of the branches of the two last named T pipes there are to be four cast iron quarter turns, as shewn on the plan, presenting and connecting, to the same kind of flanges to which they are to be bolted—the flanges of the valve chests being square, the main body of said turns has to be brought gradually, from the round to a square form, of the dimensions given in the outlets and inlets of valve chests.

21st. Turbine Flume.—This flume is to be made in boiler iron ¼ inch thickness of metal, strengthened with angle iron 3 by 4 inches average thickness ½ inch, rivited every two feet length of the flume. Total length at centre line 34 feet; inside area 9 feet 6 inches by 6 feet, with rounded corners of 24 inches radius. The top to be slightly rounded to an increased height of 8 inches in the centre at the first 12 feet of its length nearest the inlet. At the extremity nearest the Turbine there is to be a cast iron angle iron, or flange, which present a face 5 inches wide, 1¼ inch thick when faced, the other part of said flange, or angle iron, is to be riveted to the wrought iron part of the flume. The first named part of this angle iron is to be bolted with ¾ inch bolts, placed 6 inches apart, to a corresponding flange of the Turbine Chamber, so as to form a tight joint. At the other extremity of taid Turbine flume there is to be another angle iron, of which the part fastening to the wrought iron part of the flume is to be 10 inches wide, and to be secured by a double row of rivets. The other side of said angle iron is to be made square on the outside, 12 feet long by 9 feet wide, and to have 14 holes one inch diameter provided with anchor bolts, 12 inches long ⅞ inches diameter, said bolts to be firmly secured to the wall. Thereto is also to be secured the cast iron angle piece. Owing to the inclined position of the Turbine flume, the two outside sheets are to be fitted to a bevel shewn on the plan. The joints of said iron flumes

are to be held together by means of $\frac{5}{8}$ inch rivets $3\frac{1}{2}$ inches apart. It is to be placed on masonry prepared for it, and is to resist an inside pressure of 20 lbs. per square inch.

22nd. RACKS.—These racks are to be formed with wrought iron strips, 3 inches by $\frac{5}{8}$ inch length, 12 feet 6 inches, with additional parts 9 inches long at each end, put at right angle; these strips are to be placed $2\frac{1}{8}$ inches from centre to centre. They are to have an inch hole in the middle of their length and one hole of $\frac{3}{4}$ inch diameter at the upper part, and 2 holes $\frac{3}{4}$ inch diameter in the lower part. They are to be put together in 4 sections by means of 4 bolts $\frac{3}{4}$ inch diameter, and to keep the strips at their respective distances; there is to be placed on each of said bolts between the strips small pieces of gas pipe one inch inside diameter, $1\frac{1}{2}$ inch long These 4 sections are to form a total length of 22 feet, and are to be placed at the same distance on top and bottom, and there to be secured by 8 inch wood screws $\frac{5}{8}$ inch diameter, to timbers secured into the walls in the position shewn on the plan.

23rd. WASTE PIPE.—This pipe is to be in cast iron, 12 inches inside diameter, $\frac{5}{8}$ inch thickness of metal; it is to be put on an inclined position as shewn on the plan. At one extremity there is to be a round flange 21 inches outside diameter; at a distance of 20 feet from the said flange there is to be another flange of 18 inches outside diameter, with $\frac{3}{4}$ holes to bolt to other parts. This length is to be made in two pieces, and may be joined with bell-mouth joint. At the flange, of 18 inches diameter, there is to be bolted a cast iron valve seat for throtle valve 12 inches diameter; said seat to be 18 inches long, and to have a flange on each end 18 inches diameter, provided with bolt holes, $\frac{3}{4}$ inch diameter, 6 inches apart and bolts. It is to be bored out true, and a throtle valve, carefully turned and fitted, with a wrought iron stem, and stuffing box, and small lever. To this valve seat there is to be bolted an additional length of 12 inches pipe of 42 feet 6 inches of straight pipe, and 6 feet of a curved pipe as shewn on the plan; the joints of this last pipe can be made with bell-mouth joints.

24th. HEAD GATES.—These head gates are four in number; they are to be made in cast iron, and are to be of the kind called "wicket gate." Each is to be 4 feet wide by 5 feet high in the clear, and are to be provided with a strong cast iron frame, the sides of which are to be in the shape of angle iron, 9 inches by 9 inches, thickness of metal 1 inch. The bottom and top are to be made in the shape of a T, of which both parts are to be 9 inches by 9 inches. On this bottom and top part there is to be a slightly projecting rib $1\frac{1}{4}$ inch wide, which is to

be made true. The sides are also to be made true, and on them there are to be fitted and bolted cast iron strips on each side presenting a beveled surface made perfectly true as shewn on the plan.

Each of said strips are to be held to its position by means of 6 tap bolts, $\frac{3}{4}$ inch diameter. One $\frac{1}{2}$ inch from the middle of the bottom flange, of the breadth of gate frame, there is to be a hub $5\frac{1}{2}$ inches diameter forming sockets as shewn on the plan.

The centre of said hub is placed 3 inches from the outside of the horizontal part of the iron frame. On the top there is to be also a hub $5\frac{1}{2}$ inches in diameter, with $2\frac{1}{2}$ inches hole, made perfectly true and at right angle with the faced part of said frame.

The outside flange on each of said gate frames is to have 8 holes 1 inch diameter (2 on top, 2 at bottom, and 2 at each side). Said gate frames are all 4 to be firmly secured to the walls by means of 8 anchor bolts, 12 inches long, $\frac{3}{4}$ inch diameter, for each frame, and made water tight with a cement joint.

Into each said frames there is to be fitted a cast iron wicket gate, fitting most accurately, thickness of metal 1 inch in the main body, one $\frac{1}{2}$ inch from the centre is to be a vertical boss $5\frac{1}{2}$ inches outside diameter, which with strong fillets, is to unite with the main body of said gate. With a view to strengthen the said gate there are to be 4 horizontal ribs, 1 inch thick, $2\frac{1}{2}$ inches wide, near the hub, and tapering to 1 inch at the points of bearing of said gate. This hub or boss is to be bored out true, and at right angle to the outer surface of the gate, to $2\frac{1}{2}$ inches, which is to receive at the lower end a wrought iron pivot of $2\frac{1}{2}$ inches diameter, put on from below and keyed to said hub. The bottom, top, and sides are to be made perfectly true and fitted into the frame on each gate as described.

Each of the above named gates is to receive in its central boss a stem, in wrought iron, that is to reach to the top of the pivot described above. This stem is to be secured to the gate by means of 3 flat keys 2 inches wide $\frac{5}{8}$ inch thick. Said stem is further to fit into the boss of the top flange of the iron frame, and to extend vertically and within $\frac{1}{2}$ inch from the wall to a height of 13 feet from the lower end.

On the upper part of each of said valve stem there is to be a cast iron frame, with boss $5\frac{1}{2}$ inches outside diameter, said frame is to be of the shape shewn on the plan, and is to have holes to receive anchor bolts and setting pins with small chain. Immediately on top of said frame, and secured to the stem, there is to be a wrought iron needle, with arms to fit into the holes of the frame.

The wrought iron [illegible] after extending through both these parts is then to be formed [illegible] square section, and to have fitted thereon a wrought iron lo[illegible] diameter, 6 feet long from the centre of the hub and sl[illegible]

The whole to be made according to a working drawing to be furnished.

GENERAL SPECIFICATION.

1st.—There is to be made one extra step for Turbine, including the lower part resting on cross-bridge, the upper part fitted on Turbine shaft, also the *lignum vitæ* part.

2nd—On each upper cross head cheek, and on the upper part of each of the three straps of the two connecting rods there is to be an automatic oil-cup in brass, polished.

3rd.—There is to be furnished one complete extra set of hickory teeth, made ready to be driven into the mortices, for the mortice bevel wheel and the mortice spur wheel.

4th.—As soon as the castings of all parts belonging to Turbine gearing, pumps, &c. described in these specifications, are made all the patterns which were used to cast from are to be handed over to the Superintendent of the City Water Works, re-varnished after being used, and in such a condition that they are to be ready to cast from without requiring further work or repairs; said patterns thereby becoming the exclusive property of the City of Montreal.

5th.—All the valve chests, pump barrels, inlet pipes into ascending mains, air vessels, foot valves are to be tested at the expenses of the contractor, to resist a pressure of 173-lbs. to the square inch; said test to be made in the presence of the Engineer having the superintendence of this work, or his agent.

6th.—That all the machinery and other castings are to be painted before being delivered on the ground of the City Water Works, and to receive two more coats of paint after being put up; the third or last coat to be put on only after the castings have been rubbed down and made smooth with pumice stone and putty; after this third coat is put on, the whole work that is exposed to the view is to receive a coat of varnish. The tints of the last coat to be given by the Engineer.

7th.—The working plans and drawings furnished at the date of signing the contract must be implicitly followed; and all parts of the work must be conformable to the plans and specifications and to the directions of the Engineer. Any doubt as to the meaning of these specifications, or any obscurity as to the wording of them, will be explained by the Engineer; and all directions and explanations required or necessary to complete any of the provisions of these specifications to give them due effect, will be given by the Engineer, whose interpretation of the plans and specifications shall be binding.

8th.—The machinery comprised in the above named specifications must be begun immediately after the signing of the contract by both contracting parties, and must be put up and made ready for operation on or before the first day of September, A.D. 1864.

The Committee hereby reserve to themselves the right to retain such sums out of the Engineer's estimates, in addition to the sums or parts hereinafter named, as they may deem necessary to secure the City against any loss that the City may incur, should the Contractor fail to have the work sufficiently early on the ground, in the opinion of

their Engineer, to enable the Contractor to have the work ready on the date specified; which sums, should the Contractor fail to have the work ready and in operation on the date specified, namely —September 1st, 1864, will then be used to pay such damages as the City may have incurred, according to the Committees' estimate of such loss.

9th.—All the parts passing through walls or foundations should be delivered on the ground in time to be walled-in when said walls and foundations are ready to receive them. All these parts must be set to their proper positions by the contracting parties of the machinery.

10th.—No allowance will be made for extra work, except upon a written agreement, signed by the Contractor and the Engineer and approved by the Committee.

11th.—The work is to be paid for in Canada currency, upon monthly estimates made by the Engineer having the superintendence of said works, upon all the work delivered on the ground of the City Water Works, less 20 per cent., which is to be retained upon each estimate, until the whole work is put up and in operation, and approved by the Engineer and accepted by the Committee on Water of the City of Montreal.

12th.—No proposal will be considered by the Committee unless it is made on blank printed forms, to be had at the office of the Superintendent of the City Water Works, and be signed as therein specified and sealed. Each proposal is to be handed to Mr. Glackmeyer, City Clerk, and is to contain a bounty of one hundred dollars, Canada currency, to be forfeited should the party to whom the contract has been accorded by the Committee, or his sureties, fail to sign the contract within the time named in the advertisement. Nine days after the Committee have received the proposals all the bounties are to be returned to those parties whose proposals have not been accepted by said Committee, and also to the party who signed the contract.

13th.—Should the contracting parties for this pumping apparatus require additional working plans, in addition to the list to be seen at the office of the Superintendent, the expense caused thereby to the Corporation is to be borne by the Contractor.

14th.—The Engineer having charge of the superintendence, and with a written approval from the Committee on Water of the City of Montreal, may at any time direct such alteration of location or dimensions of any part that he may deem to be to the interest of the Corporation, with the understanding that the value of all such alterations will be estimated by the Committee on Water after hearing the Contractor's and Engineer's views on the subject, and be considered binding.

15th.—The Contractor is to pay the Corporation Notaries their charge for making this contract and a copy of it; which copy will remain on record in the Superintendent's Office.

EMILE GEYELIN,
Hydraulic Engineer.

LIST OF CONTRACT PLANS

OF THE

NEW PUMPING APPARATUS

FOR THE

MONTREAL WATER WORKS.

No. 1.—Plan of Foundations	Scale,	¼	inch to 1 foot.
2.—Side view of Foundation	"	¼	" "
3.—Cross Section of Turbine and Longitudinal Section of Pump	"	1	" "
4.—Cross Section of Pump	"	1	" "
5.—Plan of Turbine and Pumps	"	1	" "
6.—Mortice Spur Wheels	"	3	" "
7.—Cross Section of Bevel Wheels and Bridge.	"	3	" "
8.—Plan, Section and Elevation of Crank Shaft Pedestal	"	3	" "
9.—Plan and Section of Crank Wheel	"	3	" "
10.—Plan and Elevation of Foundation Plates for gearing	"	3	" "
11.—Plan and Section of Discharge Pipe and Air Vessels attached	"	1½	" "
12.—Plan of Valve Chest	"	3	" "
13.—Guides, Cross Heads, Piston and Piston Rod, Connecting Rod	"	2	" "
14.—End view of Discharge Pipe	"	3	" "
15.—Drawing of 12 inch Throtle Valve	"	3	" "
16.— Do. 33 do.	"	3	" "
17.— Do. Head Gates	"	3	" "
18.— Do. Foot Valve	"	3	" "
19.— Do. General Cross Section of Machinery, including building	"	½	" "
20.—Elevation shewing ascending main	"	½	" "
21.—Plan of ascending main	"	½	" "
22.—Elevation of Inlet main	"	½	" "
23.—Plan of Inlet main and waste pipe	"	½	" "
24.—Drawing of foundation plate of Turbine	"	3	" "
25.— " of Turbine Gate motion	"	3	" "

ERRATA.

Page 1.—2nd line from below read "10 feet 5 inches," instead of "10 feet 3 inches."

" 4.—24th line add "with $\frac{3}{4}$ bolts 6 inches apart."

" 5.—2nd line and 8th line, instead of "$\frac{1}{2}$" read "$1\frac{1}{2}$."

" 6.—16th line, instead of "crank shaft" read "counter shaft."

" 6.—30th line, add to "moveable boxes in cast iron."

" 7.—6th line, instead of "$54\frac{1}{2}$ inches" read "$54\frac{1}{3}$."

" 7.—13th and 14th lines, instead of "wrought iron teeth" read "wooden teeth."

" 7.—14th line, instead of "80" read "86."

" 8.—34th line, after inches should be a period (.), commencing "Between" new sentence.

" 10.—4th line, instead of "levelled" read "bevelled."

" 13.—5th line from below, "8 being extra valves" is to be left out.

" 15.—9th line from below add "including said air vessel as per plan 11."

" 16.—4th line, instead of "6 feet" read "7 feet."

" 16.—29th line add "and 3 tie bolts 2 inches diameter, with jam nuts inside so as to be used as a stay to the pipes."

" 16.—36th line, instead of "86" read "71."

" 16.—37th line, instead of "57" read "37 feet 3 inches."

stead of

shaft."

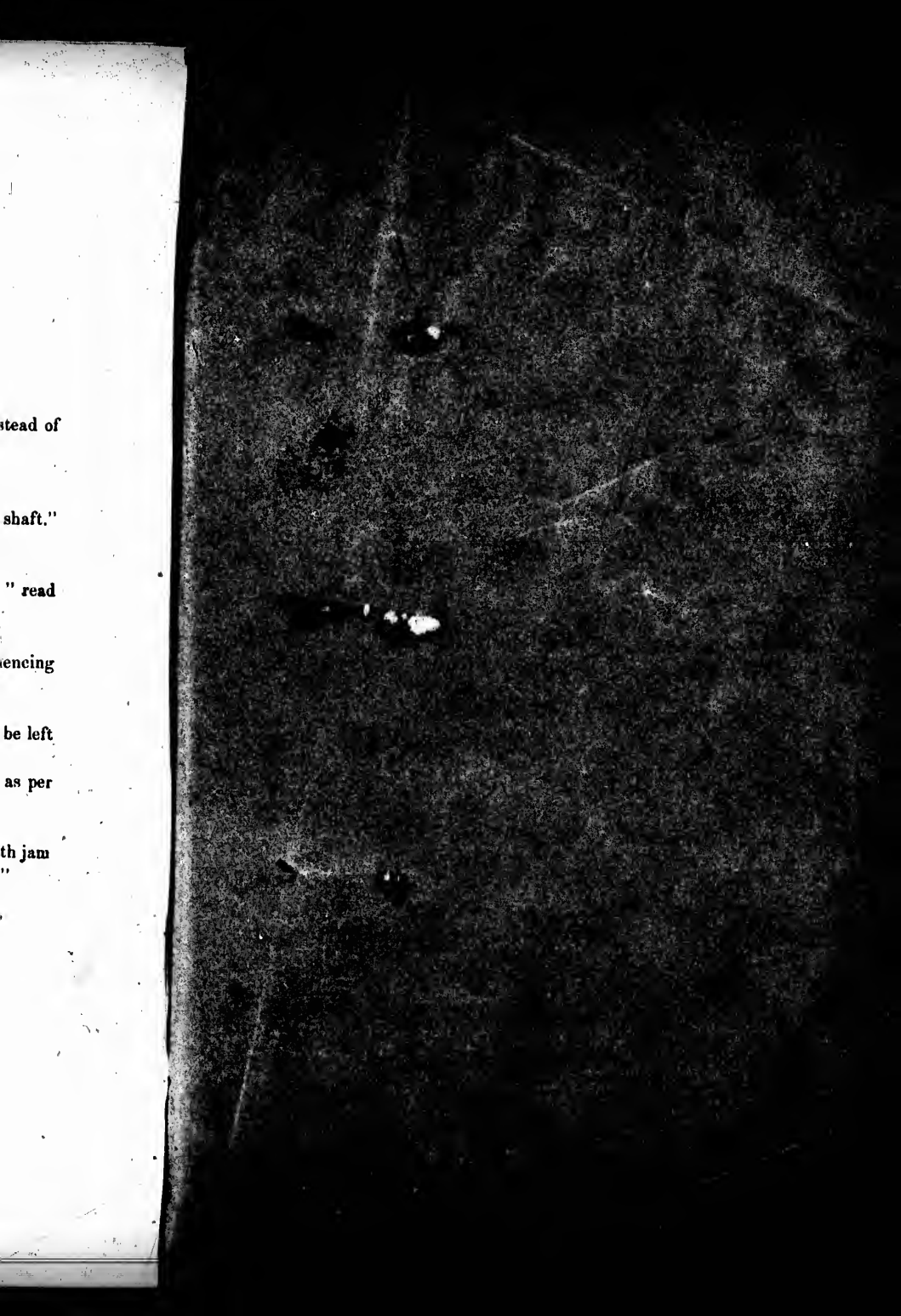
" read

encing

be left

as per

th jam
"



CORPORATION OF MONTREAL,

WATER WORKS DEPARTMENT.

Sealed Tenders endorsed "Tender for New Pumping Apparatus," and addressed to CHAS. GLACKMEYER, City Clerk, will be received at the City Clerk's Office, City Hall, until NOON of the 15th of OCTOBER next, for the construction and erection of a new Pumping Apparatus for the Montreal Water Works, in accordance with the conditions, plans and specifications of the same to be seen at the Office of the undersigned, City Hall, where printed forms for the tenders may be obtained as no others will be admitted.

Each tender must contain a sum of one hundred dollars currency, to be forfeited should the party or his securities to whom the contract has been awarded by the Committee fail to sign the contract within the time specified.

Each tender to contain the *bona fide* signatures of two responsible persons willing to go security for the due fulfilment of the contract.

The Water Committee do not bind themselves to accept the lowest or any of the Tenders.

(By Order,)

LOUIS LESAGE,

Supt. of the M.W.W.

MONTREAL, September 8th, 1863.