WORTHINGTON

PUMPING ENGINES,

STEAM PUMPS,

AND

HYDRAULIC MACHINERY.

AUGUST 1st, 1883.

With but one exception, the Worthington Pumping Engines illustrated in this Catalogue are of the well-known Duplex type, that was invented and patented by Henry R. Worthington.

HENRY R. WORTHINGTON,

86 & 88 LIBERTY ST.

AND

145 BROADWAY,

NEW YORK.

D. S. HINES.
W. A. PERRY.
C. C. WORTHINGTON.

BRANCH OFFICES.
70 KILBY ST., BOSTON.
414 N. THIRD ST., ST. LOUIS.
95 LAKE ST., CHICAGO.

Dear Sir:

We respectfully call your attention to the accompanying revised catalogue of Worthington Steam Pumping Machinery.

On pages 6, 10 and ~~19~~ 21 are described the patterns that are usually selected for Railway Tank Supply.

These pumps are now adopted by nearly all the principal Railroads of this country and Canada.

To insure their more general introduction, we are prepared from this date to quote to Railway Companies a special discount from the lists.

This reduction will be found to bring the cost of the Worthington much below that of any other first-class steam pump in the market.

HENRY R. WORTHINGTON.

HENRY R. WORTHINGTON

HYDRAULIC WORKS,

ESTABLISHED 1845.

D. S. HINES. W. A. PERRY. C. C. WORTHINGTON.

OFFICE AND WAREROOMS,

145 BROADWAY, 86 & 88 LIBERTY STREET,

NEW YORK.

BRANCH OFFICES:

BOSTON, 70 KILBY STREET.
CHICAGO, 95 LAKE STREET.
ST. LOUIS, 414 NORTH THIRD STREET.

WORTHINGTON STEAM PUMPING ENGINES.

COMPOUND, CONDENSING OR NON-CONDENSING, FOR CITY WATER WORKS. BOILER FEED PUMPS.
WRECKING PUMPS. MINING PUMPS. PUMPS FOR HYDRAULIC PRESSURE. FIRE PUMPS.
PUMPS SPECIALLY ADAPTED FOR OIL PIPE LINES AND HYDRAULIC ELEVATORS.
AIR AND CIRCULATING PUMPS, WATER PRESSURE PUMPING ENGINES
OR MOTORS. HYDRAULIC CRANES AND HOISTING MACHINERY.
CHECK AND FOOT VALVES, FITTINGS, ETC. IRON
AND BRASS CASTINGS. WATER METERS.
OIL METERS.

INTERNATIONAL EXHIBITION,

PHILADELPHIA, 1876.

The United States Centennial Commission has examined the Report of the Judges, and accepted the following reasons, and decreed an award in conformity therewith.

REPORT ON AWARDS.

PRODUCT.—The Duplex System of Steam Pumping Engines, patented and exhibited by

HENRY R. WORTHINGTON,

NEW YORK.

The undersigned having examined the product herein described, respectfully recommends the same to the United States Centennial Commission for award for the following reasons, viz:

The Duplex System of pumps is of well-established excellence, and is considered a positive advance in the art of moving water under pressure by means of pistons. The system permits of remarkable simplicity of construction, and ensures smoothness of working, efficiency of action, and reliability for extended use whatever the pressure or length of the water column or the size of the apparatus employed. For pumping engines, compound steam cylinders are provided to secure economy of fuel.

W. H. BARLOW, *Judge.*

Approval of Group Judges:

N. PETROFF, HORATIO ALLEN, EMIL BRUGSCH,
CHAS. E. EMERY, CHAS. T. PORTER, F. REULEAUX.
JOSEPH BELKNAP.

A true copy of the Record.

FRANCIS A. WALKER,
Chief of the Bureau of Awards.

Given by Authority of the United States Centennial Commission.

J. L. CAMPBELL,
Secretary.

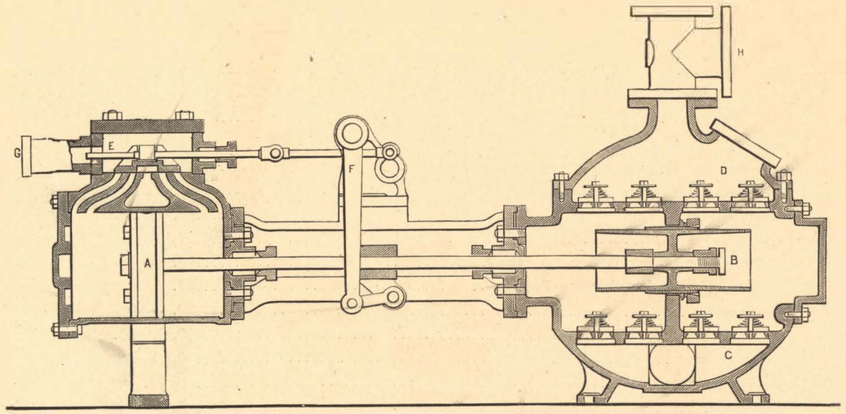
A. T. GOSHORN,
General Director.

L. S.

J. R. HAWLEY,
President.

INDEX.

THE WORTHINGTON STEAM PUMP.



The above is a sectional view of one side or half of a WORTHINGTON HIGH PRESSURE STEAM PUMP, of ordinary construction. Its object is to exhibit the great simplicity of its interior arrangement, especially that pertaining to the steam valve.

This, as may be seen at **E,** is an ordinary slide-valve, working upon a flat face over ports or openings. Its simplicity and durability, in contrast with any other form of steam valve, are well-known. Although numerous attempts have been made to supercede it, it still maintains its place on locomotives and other forms of high-pressure crank engines. No matter how long the engine may stand inactive, a slide valve will not rust or adhere to its seat, and is always ready to start when required. No water can collect in its cavities to produce trouble by freezing. In a word, it may be called the simplest and most reliable steam valve known to engineers.

In the WORTHINGTON ENGINE, the motion of this valve is produced by a vibrating arm, seen at which swings through the whole length of the stroke, with long and easy leverage. As the moving parts are always in contact, the blow inseparable from the tappet system is avoided. Even the motion of the well-known eccentric upon crank engines is not comparable to this for moderate friction and durability.

Attention is also directed to the arrangement of the double-acting plunger, shown at **B.** It works through a deep metallic packing ring, bored to an accurate fit, being neither elastic nor adjustable. Both the ring and the plunger can be quickly taken out, and either refitted or exchanged for new ones at small cost, and if it be desired at any time to change the proportions between the steam pistons and pumps, a plunger of somewhat larger size, or decreased to any smaller diameter, can be readily substituted. As exact proportions between the power and work are always desirable, if not necessary, this is a very important advantage.

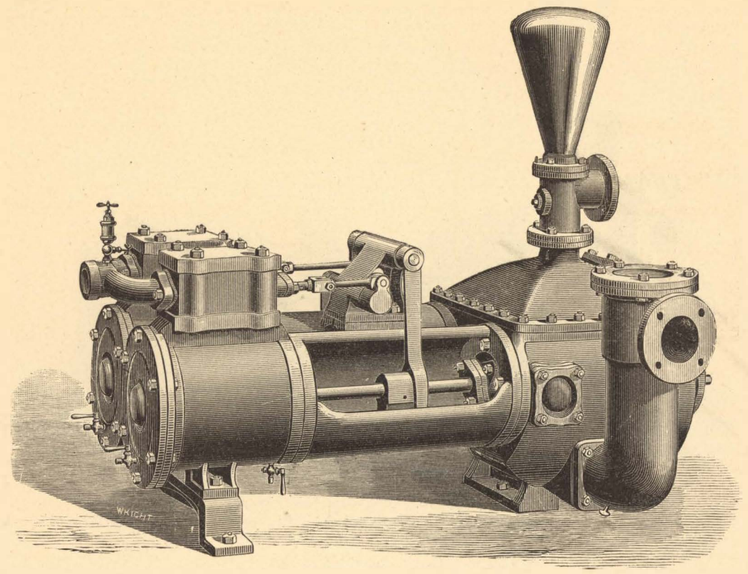
This system of renewal of the working parts has been proved by long experience to be the least expensive and most satisfactory for ordinary work. The plunger is located some inches above the suction valves, to form a subsiding chamber, into which any foreign substance may fall below the wearing surfaces. This enables it to work longer without renewal than the usual form of piston pump, especially in water containing grit or other solid material. (For arrangement of plungers, with external and adjustable packing, see pages eleven, sixteen, eighteen and twenty-four). The water enters the pump from the suction chamber, **C,** through the suction valves, then passes partly around and partly by the end of the plunger, through the force valves, nearly in a straight course, into the delivery chamber, **D,** thus traversing a very direct and ample water way. The bottom and top plates furnish a large area for the accommodation of the valves. These consist of several small discs of rubber, or other suitable material, easy to examine, and inexpensive to replace.

It is claimed that this machine is distinguished for great simplicity and strength of construction, having few moving parts, with no harsh motions, and not subject to fracture or other derangement.

The steam valve motion is fully described on the opposite page. To effect it, two steam cylinders and two pumps are cast together to form one machine. The right hand division moves the steam valve of the left hand one, and *vice versa.* Under this arrangement one pump takes up the motion when the other is about to lay it down, thus keeping up an uniform delivery, without pulsation or noise. As the work is divided between two engines, the wear is also divided, and the lifetime of the machine doubled.

Added to its durability, the smooth and noiseless action of this type of WORTHINGTON STEAM PUMP, makes it preferable on many important services, where the jar of a single cylinder pump would be objectionable or destructive.

THE WORTHINGTON STEAM PUMP.



(Worthington Pump. Size, 12 x 7 x 10. With extra Side-Pipe and Strainer attachment.)

The valve motion is the prominent and important peculiarity of this Pump, as being that to which it owes its complete exemption from noise or concussive action. Two steam pumps are placed side by side, and so combined as to act reciprocally upon the steam valves of each other. The one piston acts to give steam to the other, after which it finishes its own stroke, and waits for its valve to be acted upon before it can renew its motion. This pause allows all the water valves to seat quietly, and removes everything like harshness of motion.

As one or the other of the steam valves must be always open, there can be no dead point. The pump is, therefore, always ready to start when steam is admitted, and is managed by the simple opening and shutting of the throttle valve.

In its application to steam pumps for ordinary service, as well as to Water Works Engines of the largest class, a combination of reliability, with economy in first cost, and in running expenses, is attained, not realized by any other type of pumping machinery,

In the arrangement of the Worthington Steam Pump, special care has been taken to have the parts easily accessible for inspection or repairs. All the moving pieces being made to gauge, can be readily renewed. The successful application of a pump depends much upon its proper selection from among many patterns differing from each other in size, proportion, material and general arrangement. When ordering a pump, therefore, the following questions should be answered:

1st.—To what service is it to be applied?

*2d.—The quality of the liquid to be pumped, whether salt, fresh, acid, clear or gritty; and whether it is to be pumped cold or hot?

3d.—To what *height* is the water to be lifted *by suction,* and what is the length and diameter of the suction and discharge pipes?

4th.—Of what material is the suction pipe, and what is its general arrangement as regards other pipes leading into it, etc.?

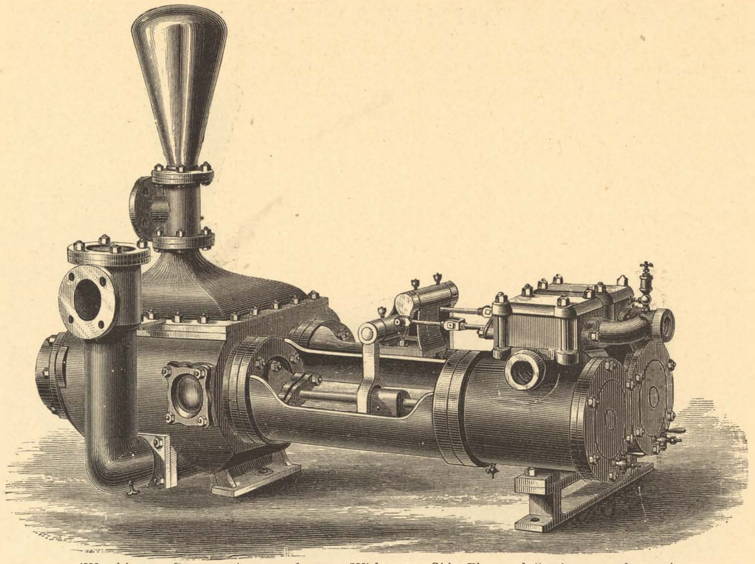
5th.—To what height, or against what pressure is the water to be pumped?

6th.—What is the greatest quantity of water needed per hour?

7th.—What pressure of steam is used?

* When hot water is to be pumped, the difficulty of lifting it by suction increases with the temperature. It should therefore be arranged to flow into the pump chamber, if so hot as to vaporize when the pressure of the atmosphere is removed.

THE WORTHINGTON STEAM PUMP.



(Worthington Pump. Size, 9 x 5¼ x 10. With extra Side Pipe and Strainer attachment.)

Ordinary Pattern, having two double-acting plungers. Designed for boiler feeding, fire and general service, where the water pressure does not exceed 130 pounds. Water Valves of Rubber or Metal, as required. See list of "Low Service" Pumps, page 10, for proportions suitable for moderate resistances.

The stated capacities of the pumps given below are based upon a piston speed of from 50 to 84 feet per minute. In case of fire or other emergency, this can be considerably increased. Their capacity at a piston speed of 100 feet per minute, is given in "Table of Comparison," on the opposite page.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Gallons per stroke of *one* plunger.	Proper Strokes per minute of *one* plunger.	Gallons delivered per minute by *both* plungers at stated number of strokes.	PRICE.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
								Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
4½	2¾	4	.1	75 to 150	15 to 30	$125.	4 ins.	½	¾	1½	1
6	4	6	.33	75 to 125	50 to 80	220.	5⅝ "	1	1½	2½	2
7½	4½	10	.69	50 to 100	70 to 140	345.	6⅜ "	1½	2	4	2½
9	5¼	10	.93	50 to 100	90 to 185	395.	7½ "	1½	2	4	3
10	6	10	1.22	50 to 100	125 to 245	430.	8½ "	2	2½	4	3
12	7	10	1.66	50 to 100	165 to 335	550.	9⅞ "	2	2½	5	4
14	7	10	1.66	50 to 100	165 to 335	610.	9⅞ "	2½	3	5	4
12	8½	10	2.45	50 to 100	245 to 490	635.	12 "	2	2½	6	5
14	8½	10	2.45	50 to 100	245 to 490	690.	12 "	2½	3	6	5
16	8½	10	2.45	50 to 100	245 to 490	750.	12 "	2½	3	6	5
18½	8½	10	2.45	50 to 100	245 to 490	810.	12 "	3	3½	6	5
12	10¼	10	3.57	50 to 100	355 to 715	720.	14¼ "	2	2½	7	6
14	10¼	10	3.57	50 to 100	355 to 715	775.	14¼ "	2½	3	7	6
16	10¼	10	3.57	50 to 100	355 to 715	835.	14¼ "	2½	3	7	6
18½	10¼	10	3.57	50 to 100	355 to 715	890.	14¼ "	3	3½	7	6
14	12	10	4.89	50 to 100	490 to 980		17 "	2½	3	8	7
16	12	10	4.89	50 to 100	490 to 980		17 "	2½	3	8	7
18½	12	10	4.89	50 to 100	490 to 980		17 "	3	3½	8	7
18½	14	10	6.66	50 to 100	665 to 1330		19¾ "	3	3½	10	8
17	10	15	5.1	50 to 90	510 to 920		14 "	3	3½	8	7
*20	12	15	7.34	50 to 90	735 to 1320		17 "	4	6	12	10
20	15	15	11.47	50 to 90	1145 to 2065		21 "	4	6	12	12

Pumps fitted with Brass Plungers and Piston Rods, 10 per cent. extra; Bed-plates extra, except for sizes marked*.
To designate the sizes, give the diameters of Steam Cylinders and Water Plungers.

TABLE OF COMPARISON.

The following table is arranged for the purpose of readily comparing the capacity of the Worthington with that of any single cylinder steam pump. In making this comparison, it should be remembered that the Worthington pump, being, in fact, two double-acting steam pumps working together side by side, has double the capacity per minute of any single cylinder steam pump of the same diameter of plunger; and that a single cylinder pump must have a plunger or water piston twice the area of one of the plungers of the Worthington pump, in order to equal it in capacity.

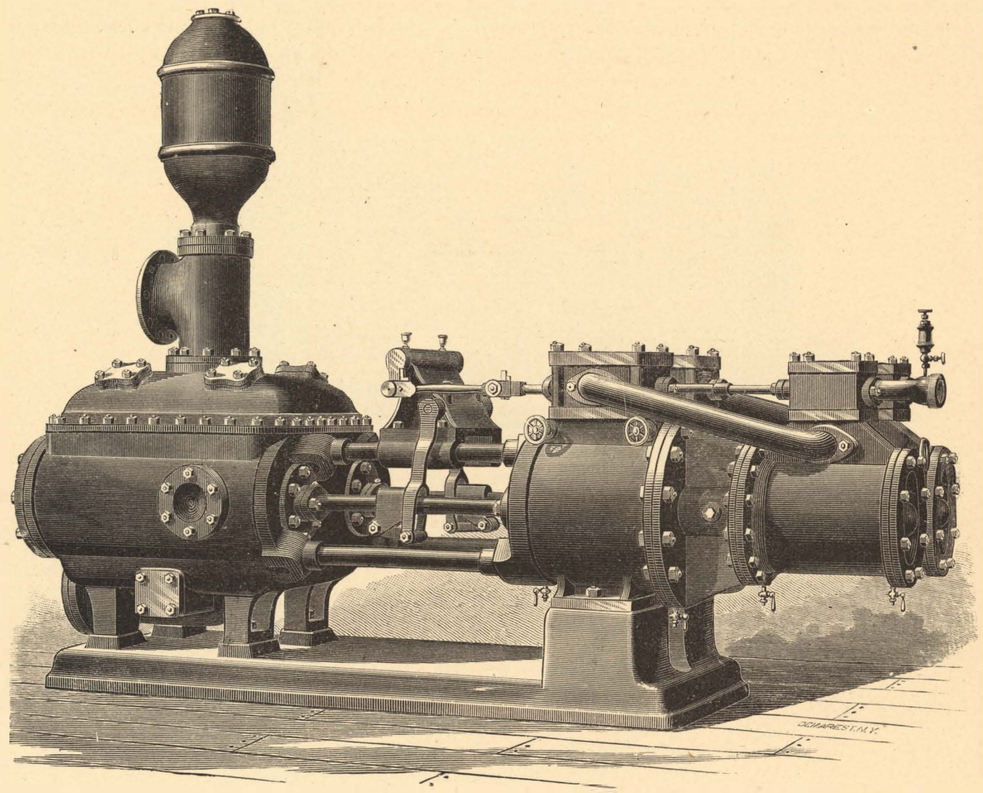
The Sizes of Worthington Pumps given in the lists on the opposite, ninth and tenth pages.			Diameter of Plunger and Length of Stroke required in any Single Cylinder Steam Pump, to do the same work.	Gallons delivered per minute at a speed that can be taken as a basis of comparison.
Diameter of Steam Cylinder in inches.	Diameter of Water Plungers in inches.	Length of Stroke in inches.		
4½	2¾	4	4 inch Plunger, 7 inch Stroke.	50 feet travel, 30 gallons.
4½	3¾	4	5¼ " " 7 " "	50 " " 55 "
6	4	6	5⅝ " " 10 " "	50 " " 65 "
6	5¾	6	8⅜ " " 10 " "	50 " " 135 "
7½	4½	10	6⅜ " " 16 " "	100 " " 165 "
9	5¼	10	7½ " " 16 " "	100 " " 225 "
	6	10	8½ " " 16 " "	100 " " 295 "
	7	10	9⅞ " " 16 " "	100 " " 400 "
	8½	10	12 " " 16 " "	100 " " 590 "
	10¼	10	14¼ " " 16 " "	100 " " 855 "
	12	10	17 " " 16 " "	100 " " 1175 "
	14	10	19¾ " " 16 " "	100 " " 1600 "
	10	15	14 " " 24 " "	100 " " 815 "
	12	15	17 " " 24 " "	100 " " 1175 "
	15	15	21 " " 24 " "	100 " " 1835 "
	16	18	22⅝ " " 36 " "	100 " " 2085 "

Varying with kind of work and steam pressure.

It should also be remembered, that the peculiar valve motion of the Worthington pump allows it to attain a higher rate of speed, without noise or hurtful concussion, than can be reached by a steam pump of any other form; and to do the same work, single cylinder pumps must have, practically, a greater length of stroke, (as given in the above Table,) and for the following reasons: In their valve motions, the steam valve is thrown open at the end of the stroke by a blow upon a tappet, or direct upon the valve. This blow becomes more violent as the speed increases. Their water valves are also dangerously concussive at a high speed, being slammed to the seats by the sudden reciprocation of the plunger. By increasing the length of stroke, the number of these blows in a given length of piston travel, is of course decreased, and the action of the machine is made less harsh. With the valve motion of the Worthington steam pump, these difficulties are avoided. It has no tappets. It neither strikes a blow, nor operates suddenly upon the plunger. The piston cushions quietly upon steam at the end of the stroke, pauses for an instant until the water valves have closed, and then starts on the return stroke gradually, as its steam valve is opened by the motion of the opposite piston, (see description on fourth and fifth pages.)

The number of strokes given in the tables is limited to that which insures ease of performance under all usual conditions, but in any emergency the speed can be considerably increased.

THE WORTHINGTON "COMPOUND" STEAM PUMP.



(Worthington Compound Pump. Size, 14 and 20 x 12 x 15.)

This arrangement of steam pump is intended for using the steam expansively, which cannot be done in the ordinary form. The steam having exerted its force through one stroke, upon the smaller steam piston, expands upon the larger, during the return stroke, and operates to drive the piston in the other direction. This is, in effect, the same thing as using a cut-off on a crank engine, only with the great advantage of uniform and steady action upon the water.

It is recommended in any service where the saving of fuel is an important consideration. In such cases, its greater first cost is fully justified, as it requires 30 to 33 per cent. less coal than any high pressure form, on the same work.

On the larger sizes a condensing apparatus, either operated by the main engine, or by an auxiliary one, is often added, thus securing the highest economic results.

Any of the ordinary forms of Worthington Steam Pumps can be fitted with these compound cylinders, and in proportions to suit any service.

This modification is extensively applied to hydraulic elevator pumps, tank pumps, fire pumps, pressure pumps, mine pumps, and to engines designed for the water supply of small cities and towns.

It should be remembered that, as the compounds use less steam, their boilers may be reduced materially in size and cost, compared with those required by the high pressure form.

This principle of expansion, without condensation, cannot be used with advantage where the steam pressure is much below fifty pounds.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Gallons per stroke of *one* Plunger.	Proper strokes per minute of *one* Plunger.	Gallons delivered per minute by *both* Plungers at stated number of strokes.	PRICE.	Diameter of Plunger required in any single cylinder pump, to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
								Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
8 & 12	7	10	1.66	50 to 100	165 to 335	$825.	9⅞	2	2½	5	4
8 & 12	8½	10	2.45	50 to 100	245 to 490	910.	12	2	2½	6	5
10 & 16	8½	10	2.45	50 to 100	245 to 490	1125.	12	2	3	6	5
12 & 18½	8½	10	2.45	50 to 100	245 to 490	1410.	12	2	3½	6	5
8 & 12	10¼	10	3.57	50 to 100	355 to 715	1000.	14¼	2	2½	7	6
10 & 16	10¼	10	3.57	50 to 100	355 to 715	1220.	14¼	2	3	7	6
12 & 18½	10¼	10	3.57	50 to 100	355 to 715	1500.	14¼	2	3½	7	6
8 & 12	12	10	4.89	50 to 100	490 to 980		17	2	2½	8	7
10 & 16	12	10	4.89	50 to 100	490 to 980		17	2	3	8	7
12 & 18½	12	10	4.89	50 to 100	490 to 980		17	2	3½	8	7
10 & 16	14	10	6.66	50 to 100	665 to 1330		19¾	2	3	10	8
12 & 18½	14	10	6.66	50 to 100	665 to 1330		19¾	2	3½	10	8
*12 & 17	10	15	5.1	50 to 90	510 to 920		14	2	3½	8	7
*14 & 20	10	15	5.1	50 to 90	510 to 920		14	3	6	8	7
*14 & 20	12	15	7.33	50 to 90	735 to 1320		17	3	6	12	10
14 & 20	15	15	11.47	50 to 90	1145 to 2065		21	3	6	12	12
18½ & 29	16	18	15.66	50 to 90	1566 to 2815		22⅝				

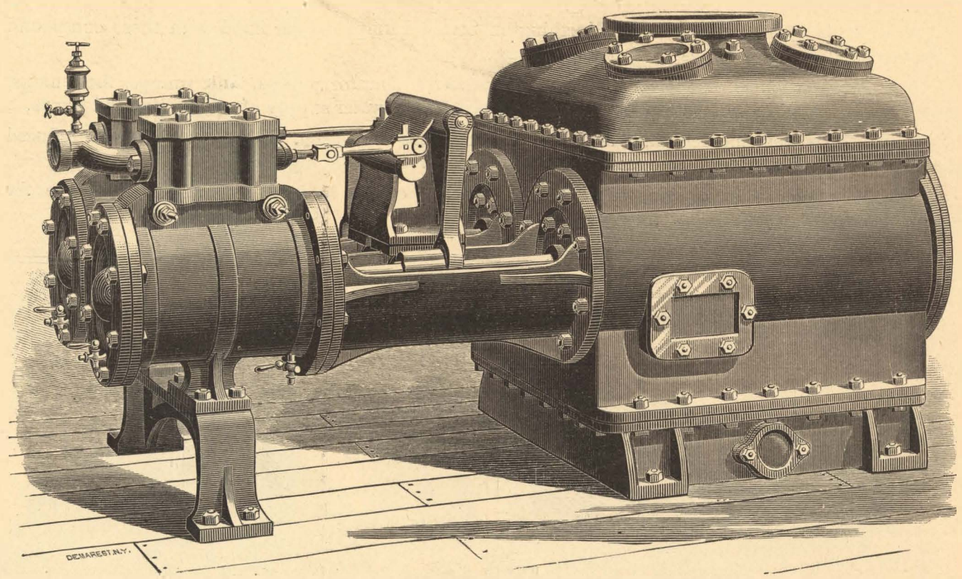
Pumps fitted with Brass Plungers and Piston Rods, 7 per cent. extra; Bed Plates extra, except for sizes marked*.

If desired, the above sizes can be made with a water end, having plungers with external and adjustable packing, as shown on page eighteen. The cost of this arrangement is somewhat greater. They can also be fitted with an extra pipe connection, whereby steam may be admitted directly from the boiler to the low pressure cylinder, thus securing a greatly augmented water pressure for fire or other emergency.

When required the speed of the pumps may be considerably increased beyond the figures stated in the list. Their capacity at a piston speed of 100 feet per minute, is given in "Table of Comparison," page seven.

To designate the sizes, give the diameters of steam cylinders and water plungers.

THE WORTHINGTON "LOW SERVICE" PUMP.



(Worthington Low Service Pump. Size, 14 x 15 x 15. Without Air Chamber.)

For Railroad Water Stations, Oil Tanks, and other places where fluid is to be raised to a moderate height with ordinary steam pressure. See page twenty for Pumps and Boilers combined suitable for this service.

These patterns are of the same general form and interior construction as those shown on page four, but have plungers or water pistons nearly or quite the diameter of their steam pistons. They cannot, therefore, feed their own boilers, but can be fitted, at small additional cost, with a "side-feed" or plunger, driven by an arm on one piston rod.

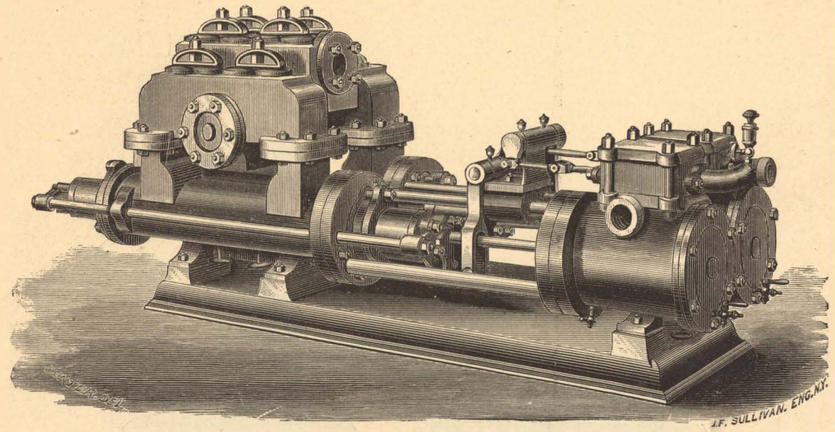
Prices of Worthington Low Service Pumps of any desired capacity or proportion, furnished on application.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Gallons per stroke of *one* Plunger.	Proper Strokes per minute of *one* Plunger.	Gallons delivered per minute by *both* Plungers at stated number of strokes.	PRICE.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
								Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
4½	3¾	4	.22	75 to 150	35 to 65	$185.	5¼ ins.	½	¾	2½	1½
6	5¾	6	.67	75 to 125	100 to 170	315.	8⅛ "	1	1½	4	2½
7½	6	10	1.22	50 to 100	125 to 245	400.	8½ "	1½	2	4	3
7½	7	10	1.66	50 to 100	165 to 335	490.	9⅝ "	1½	2	5	4
9	8½	10	2.45	50 to 100	245 to 490	575.	12 "	1½	2	6	5
10	10¼	10	3.57	50 to 100	360 to 715	675.	14¼ "	2	2½	7	6
9	12	10	4.89	50 to 100	490 to 980		17 "	1½	2	8	7
12	12	10	4.89	50 to 100	490 to 980		17 "	2	2½	8	7
7½	14	10	6.66	50 to 100	665 to 1330		19¾ "	1½	2	10	8
12	14	10	6.66	50 to 100	665 to 1330		19¾ "	2	2½	10	8
14	14	10	6.66	50 to 100	665 to 1330		19¾ "	2½	3	10	8
14	15	15	11.47	50 to 90	1145 to 2065		21 "	2½	3	12	12

Pumps fitted with Brass Plungers and Piston Rods, 10 per cent. extra; Bed-plates extra.
To designate the sizes give the diameters of steam cylinders and water plungers.

In any emergency the speed of the pumps may be considerably increased beyond the figures stated in the list. Their capacity at a piston speed of 100 feet per minute, is given in "Table of Comparison," page seven.

THE WORTHINGTON "PRESSURE" PUMP.



(Worthington Pressure Pump. Size, 10 x 5½ x 10.)

This Pump has a water end constructed on the same principle as the one shown in section on page twenty-four. Each piston drives two double-acting plungers, which have external adjustable packing, readily renewed. It is designed for driving hydraulic lifts and cranes, for oil pipe lines, cotton presses, and for similar work demanding great water pressures. A modified pattern adapted for lighter pressures is described on pages sixteen and eighteen.

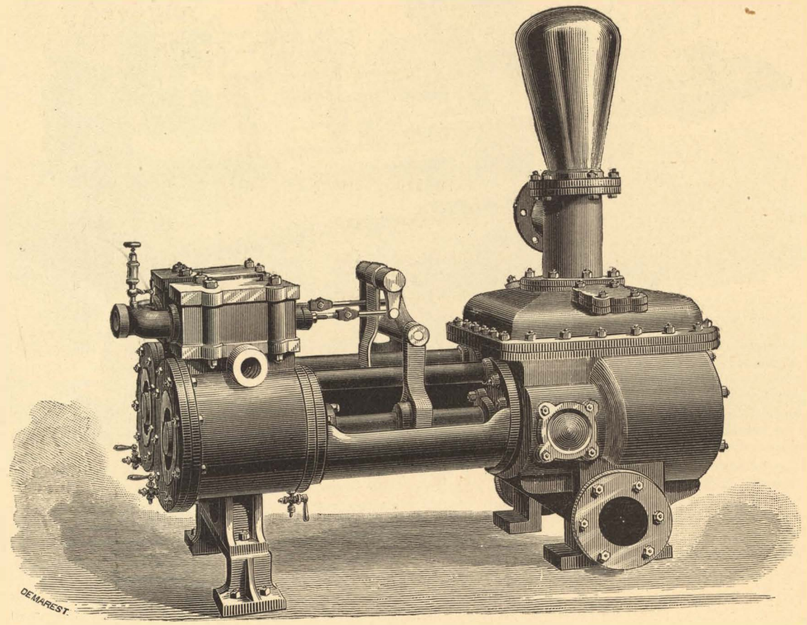
It is a form of steam pump especially desirable for mine pumping under heavy pressures. Its uniform success in this service has proven that the peculiar characteristics of the Worthington pump, of durability and quiet action, give it as much preëminence here as in other departments of hydraulics.

The arrangement of compound cylinders described on page eight, is often used to great advantage on this form of pump. Prices will be furnished on application.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Gallons per stroke of *one* Plunger.	Proper Strokes per minute of *one* Plunger.	Gallons delivered per minute by *both* Plungers at stated number of Strokes.	PRICE.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
4½	2	4	.05	40 to 100	4 to 10	$175.	½	¾	1½	1
*6	3½	6	.25	35 to 90	18 to 45	345.	1	1½	2½	1½
*6	2½	6	.12	35 to 90	9 to 22	400.	1	1½	2½	1¼
*7½	4¼	10	.61	25 to 75	30 to 90	575.	1½	2	3½	2
*10	5½	10	1.03	25 to 75	50 to 155	750.	2	2½	4	2½
*12	5½	10	1.03	25 to 75	50 to 155	900.	2	2½	4	2½
*12	1½	10	.07	25 to 75	2 to 7	900.	2	2½	1	¾
*12	3½	10	.41	25 to 75	20 to 60	925.	2	2½	2½	2
*12	4½	10	.69	25 to 75	35 to 105	1000.	2	2½	4	2½
16	3½	10	.41	25 to 75	20 to 60		2½	3	2½	2
*12	7	10	1.66	25 to 75	85 to 250		2	2½	5	4
*14	7	10	1.66	25 to 75	85 to 250		2½	3	5	4
17	5½	15	1.54	15 to 65	45 to 200		3	3½	4	4
17	7¾	15	3.	15 to 65	90 to 390		3	3½	5	4
18	5	18	1.53	15 to 65	45 to 195		3	4	6	3
20	3⅛	15	.5	15 to 65	15 to 65		4	6	2	1½
20	4¼	15	.92	15 to 65	25 to 120		4	6	3	2½
20	7¼	15	2.68	15 to 65	80 to 345		4	6	5	4
25	9	24	6.6	15 to 50	200 to 660		5	6½	5½	5
29	9½	36	11.04	15 to 50	330 to 1100					

In any emergency the speed of the Pumps may be considerably increased beyond the figures stated in the list. Pumps fitted with Brass Plungers and Piston Rods, 10 per cent. extra; Bed-plates extra, except for sizes marked*.
To designate the sizes, give the diameters of steam cylinders and water plungers.

THE WORTHINGTON "FIRE" PUMP.



(Worthington Fire Pump. Size F.)

In this pattern the valve areas and water passages are unusually large, to ensure the complete filling of the pump cylinders with water when the machine is running at its greatest speed.

The superiority of the Worthington valve motion is especially prominent in steam pumps applied to this service, for it enables them to run without jar, or danger of derangement, at the very high rate of speed that is sometimes required. With all forms of single cylinder pumps under such circumstances, the concussion of the water valves at each reciprocation of the plunger, and the blow upon the valve rod tappets, are dangerously severe, and render the machine and water pipes liable to fracture. To obviate this difficulty as far as possible, the length of stroke is often unduly increased, to reduce the number of these concussions in a given length of piston travel. It fixes, however, at a point that can be greatly exceeded by the Worthington, the practical limit of speed at which single pumps can be driven. There are no tappets in the valve motion of the Worthington pump. It neither strikes a blow, nor operates suddenly upon the plunger. The piston cushions quietly upon steam at the end of the stroke, pauses for an instant until the water valves have closed, and then starts on the return stroke gradually, as its steam valve is opened by the motion of the opposite piston. (See description on fourth and fifth pages.)

The steam cylinders of the larger sizes of Fire Pumps given in the list, can be compounded if desired. As this arrangement secures a saving of more than 30 per cent. of the fuel required by the high-pressure form, it is often of great advantage, especially where the machines are to be used on regular work. It does not in any way impair their efficiency for fire service. (See description, page eight.)

In the following list are given the ordinary sizes of Worthington fire pumps, with the proportions of steam and water cylinders that are usually adopted for such service. In all of them, however, the proportions can be changed if desired, without extra cost, by substituting plungers of considerably larger diameter for those given in the list. The capacity of the pumps in many cases can thus be increased 25 per cent.

The stated capacities of the pumps given below are based upon a piston speed of about 83 and 125 feet per minute.

LETTER SIZES.	Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Strokes per minute of *one* Plunger.	Gallons delivered per minute by *both* Plungers at stated number of strokes.	PRICE.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
								Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
A	7½	3¾	10	100 to 150	100 to 140	$345.	5¼	1½	2	4	4
AA	9	4	10	"	110 to 165	395.	5⅝	2	2½	4	4
B	9	4½	10	"	140 to 210	395.	6⅜	2	2½	4	4
BB	10	4½	10	"	140 to 210	430.	6⅜	2	2½	4	4
C	10	5	10	"	170 to 250	430.	7	2	2½	5	5
CC	12	5¼	10	"	190 to 280	550.	7½	2½	3	5	5
D	12	6	10	"	250 to 370	550.	8½	2½	3	5	5
DD	14	6	10	"	250 to 370	610.	8½	2½	3	5	5
E	14	7	10	"	335 to 500		9⅞	2½	3	6	6
EE	16	7½	10	"	380 to 575		10¼	2½	3	6	6
F	16	8	10	"	435 to 650		11¼	2½	3	6	6
FF	18½	8½	10	"	490 to 735		12	3	3½	6	6
G	18½	9¼	10	"	560 to 850		13	3	4	8	7

Pumps fitted with Brass Plungers and Piston Rods, 10 per cent. extra; Bed-plates extra.

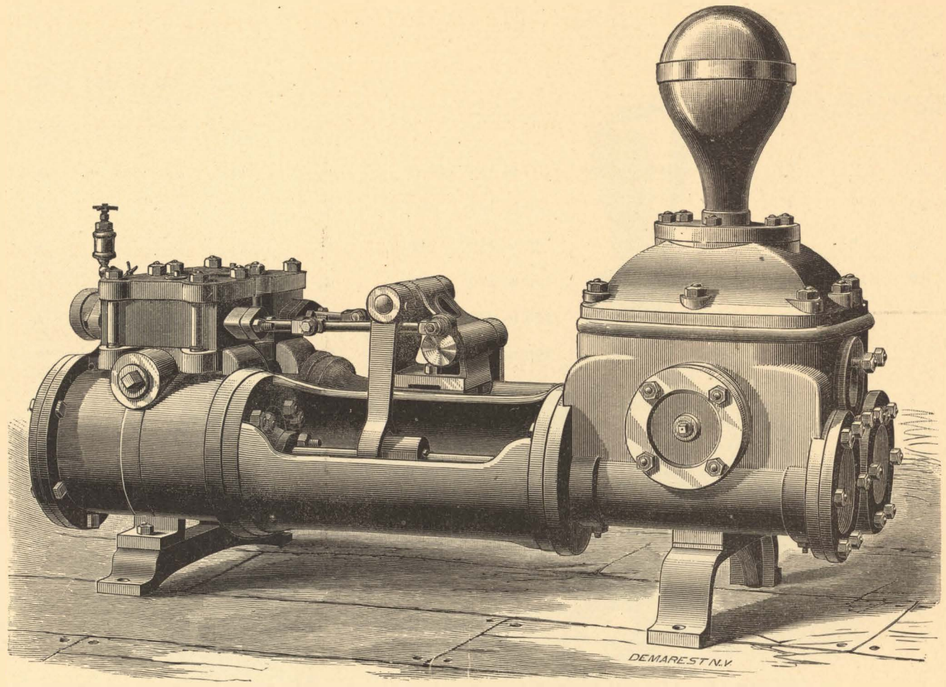
It must be remembered, in comparing these sizes with single cylinder pumps, that the Worthington pump has *two* double-acting plungers working together, and is, therefore, double the capacity of a single cylinder pump with a plunger of same diameter. (See description, page seven.)

The following Table is arranged for the purpose of showing what the dimensions must be of single cylinder pumps required to do the work of the Worthington fire pumps, given above.

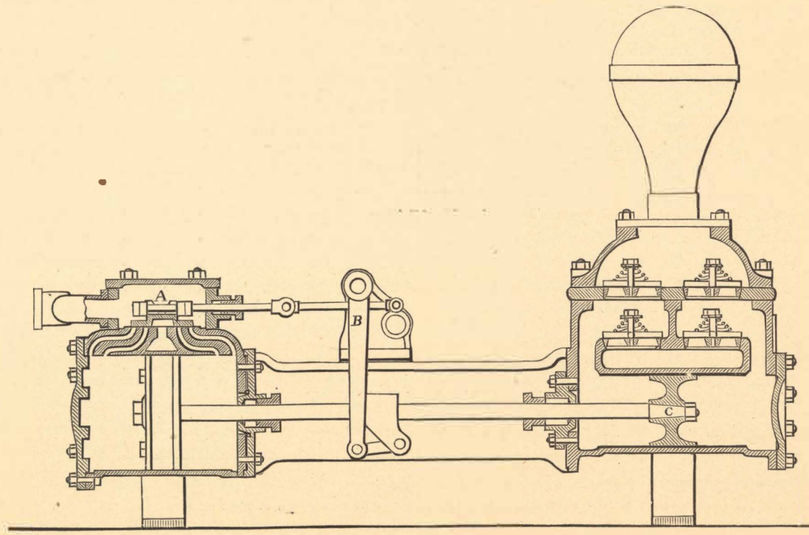
Dimensions of Worthington Pumps.	Dimensions required for Single Cylinder Pumps to do the same work.
7½ × 3¾ × 10	10½ × 5¼ × 16
9 × 4 × 10	12¾ × 5⅝ × 16
9 × 4½ × 10	12¾ × 6⅜ × 16
10 × 4½ × 10	14 × 6⅜ × 16
10 × 5 × 10	14 × 7 × 16
12 × 5¼ × 10	17 × 7½ × 16
12 × 6 × 10	17 × 8½ × 16
14 × 6 × 10	19¾ × 8½ × 16
14 × 7 × 10	19¾ × 9⅞ × 16
16 × 7¼ × 10	22⅝ × 10¼ × 16
16 × 8 × 10	22⅝ × 11¼ × 16
18½ × 8½ × 10	26 × 12 × 16
18½ × 9¼ × 10	26 × 13 × 16

Prices of Worthington fire pumps of any desired capacity or proportion, furnished on application. Two, four and six way hose connections fitted to these pumps when required, at cost.

THE WORTHINGTON "BREWERY" PUMP.



(Worthington Brewery Pump. Size, 10 x 6 x 10.)



THE WORTHINGTON "BREWERY" PUMP.

These patterns of Worthington steam pumps were designed with special reference to the requirements of Brewery service. The valve areas and water passages are made large to admit of pumping thick beer, mash, and tan liquor, cold or hot, without danger of the pump becoming clogged. The suction pipe can be connected to either or both sides. Special care has been taken to have all the parts easily accessible for inspection or repairs. The moving pieces being made to gauge, can be readily renewed.

The sectional view of one side or half of a Worthington Brewery Pump, shown on the opposite page, exhibits the great simplicity of its interior arrangement.

The plunger C works in a composition lined cylinder. As it is important, especially in lifting hot beer by suction, that the pump should be able to maintain a good vacuum, the amount of air space or clearance in this cylinder is reduced to a minimum.

The steam valve motion is fully described on the fourth page.

The following prices are for the pumps fitted with iron plungers, composition lined water cylinders, brass valve seats, and with rubber or metal valves, as may be preferred.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	PRICE.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
						Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
4½	3¾	4	40 to 65	$185.	5¼ ins.	½	¾	2½	1½
6	4	6	50 to 80	220.	5⅝ "	1	1½	2½	2
6	5¾	6	150 to 175	315.	8⅛ "	1	1½	4	2½
7½	6	10	200 to 245	400.	8½ "	1½	2	4	3
10	6	10	200 to 245	430.	8½ "	2	2½	4	3
7½	7	10	275 to 335	490.	9⅞ "	1½	2	5	4
9	8½	10	400 to 490		12 "	1½	2	6	5
7½	10¼	10	500 to 715		14¼ "	1½	2	7	6

Pumps fitted with Brass Plungers and Piston Rods, 10 per cent. extra.
To designate the sizes, give the diameters of steam cylinders and water plungers.

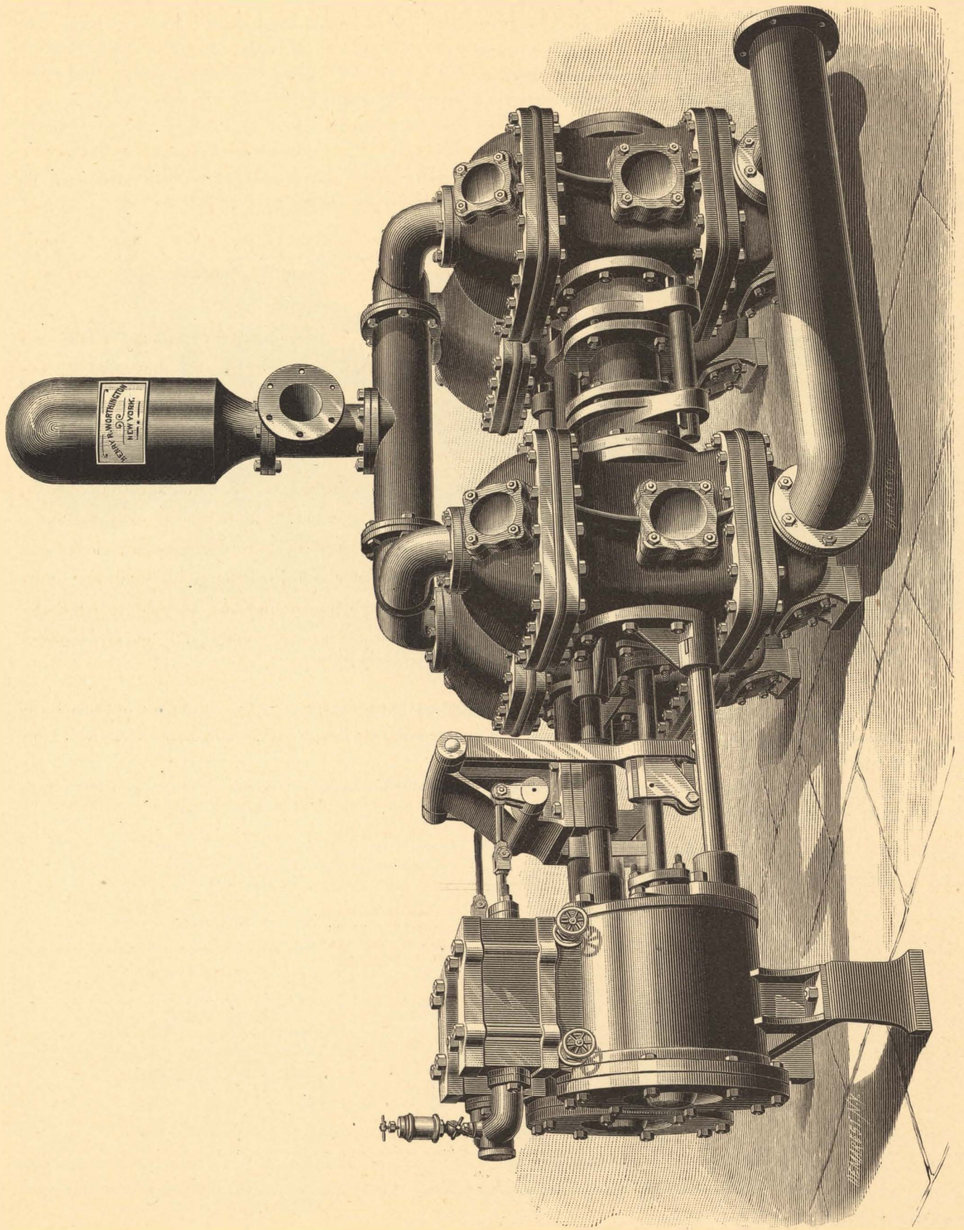
It must be remembered, in comparing these sizes with single cylinder pumps, that the Worthington pump has *two* double-acting plungers working together, and is, therefore, double the capacity of a single cylinder pump with a plunger of same diameter. (See description, page seven.)

The following Table is arranged for the purpose of showing what the dimensions must be of single cylinder pumps required to do the work of the Worthington Brewery Pumps, given above.

Ordinary Sizes of Worthington Brewery Pumps.	Dimensions required for Single Cylinder Pumps to do the same work.
4½ × 3¾ × 4	6⅜ × 5¼ × 7
6 × 4 × 6	8½ × 5⅝ × 10
6 × 5¾ × 6	8½ × 8⅛ × 10
7½ × 6 × 10	10½ × 8½ × 16
10 × 6 × 10	14 × 8½ × 16
7½ × 7 × 10	10½ × 9⅞ × 16
9 × 8½ × 10	12¾ × 12 × 16
7½ × 10¼ × 10	10½ × 14¼ × 16

The well-known smooth and noiseless action of these pumps makes them particularly valuable on any service where copper pipes are used, or when pumping into coolers. The concussion and water hammer of single cylinder pumps are destructive on such work, causing both the pipes and coolers to leak.

Prices of Worthington Brewery Pumps of any desired capacity or proportion, furnished on application.



(Worthington "Mine" Pump. Size, 16 x 7 x 10.)

THE WORTHINGTON "MINE" PUMP.

PATENTED 1883.

It is a difficult matter to design and construct a steam pump that will satisfactorily meet the very exacting requirements of mine pumping. The service is generally rough, severe and continuous. Great care must be exercised both in the selection and adaptation of the material used in construction, as the water to be pumped is often of a kind that will attack and quickly destroy it. The location of the mine is usually remote from supplies, and any necessity for renewals or repairs, unless they can be made with unskilled labor and with little delay, may be attended with serious consequences.

These considerations therefore, demand that a mine pump should be extraordinarily durable, simple and efficient, and have led to the construction of the form of Worthington Pumping Engine illustrated on the opposite page. In it are embodied the results of the best practice heretofore, together with some important improvements that have been recently secured by Letters Patent. The plungers of this machine work through central, exterior stuffing boxes, into four separate and distinct water cylinders. These cylinders are all precisely alike; sub-divided as much as possible, and having each part or attachment of the one an exact duplicate of the corresponding part or attachment of the other three. This duplication and sub-division greatly facilitates renewals or repairs. The valve areas and water passages are unusually large, so as to decrease the velocity and consequent destructive action of the water currents. The plungers, piston rods, stuffing boxes, and the entire suction and force valve plates are made of a metal composition that has been found best adapted to resist this action. Wherever natural wear will in time take place, the part so worn can be readily and quickly replaced without disturbing any adjacent part.

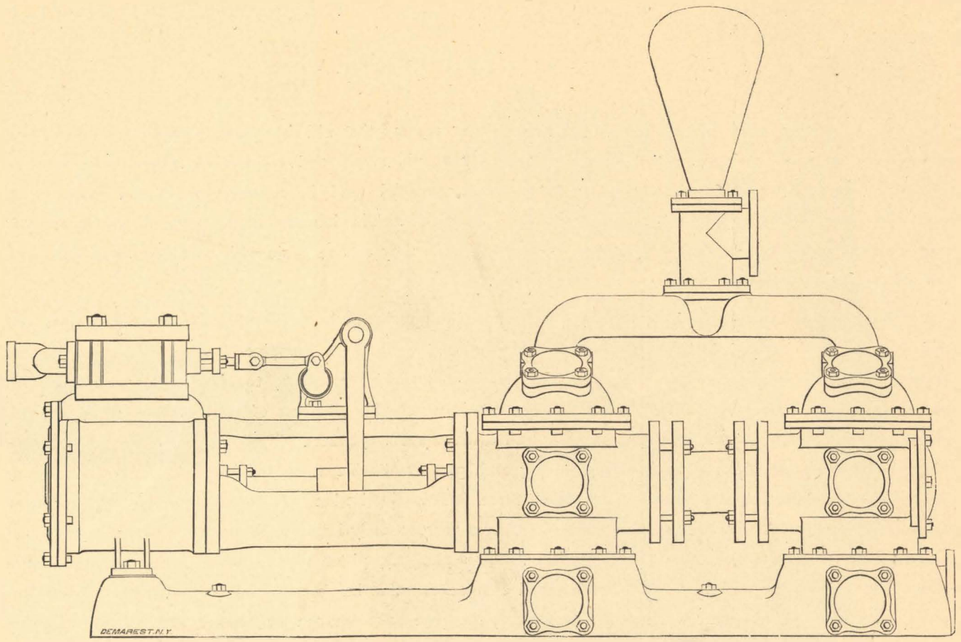
The pumps are designed to safely withstand a working pressure of 200 lbs. to the square inch, and all their attachments are especially strengthened with a view of meeting the rough usage and hard work to which, in this service, they are liable to be subjected.

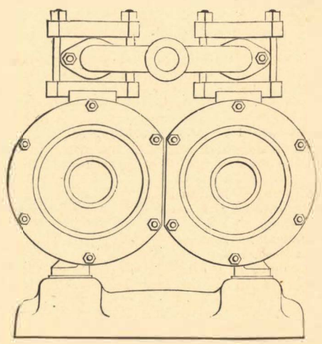
The following list contains those sizes that are kept in stock. Their prices will be furnished on application and also estimates of the cost of such as will meet the demands of any special case.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	PRICE.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			
						Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
14	7	10	175		$9\frac{7}{8}$	$2\frac{1}{2}$	3	6	5
16	7	10	175		$9\frac{7}{8}$	$2\frac{1}{2}$	3	6	5
16	$8\frac{1}{2}$	10	250		12	$2\frac{1}{2}$	3	8	6
$18\frac{1}{2}$	$8\frac{1}{2}$	10	250		12	3	$3\frac{1}{2}$	8	6
$18\frac{1}{2}$	$10\frac{1}{4}$	10	375		$14\frac{1}{4}$	3	$3\frac{1}{2}$	10	8

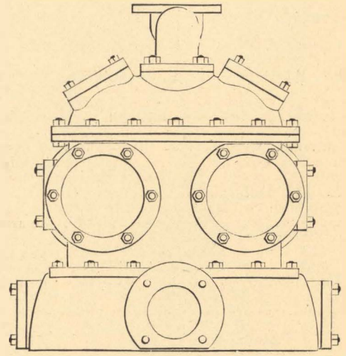
In any emergency the stated capacity of the pumps can be considerably exceeded.

THE WORTHINGTON "PACKED PLUNGER" PUMP.





END VIEW OF STEAM CYLINDERS.

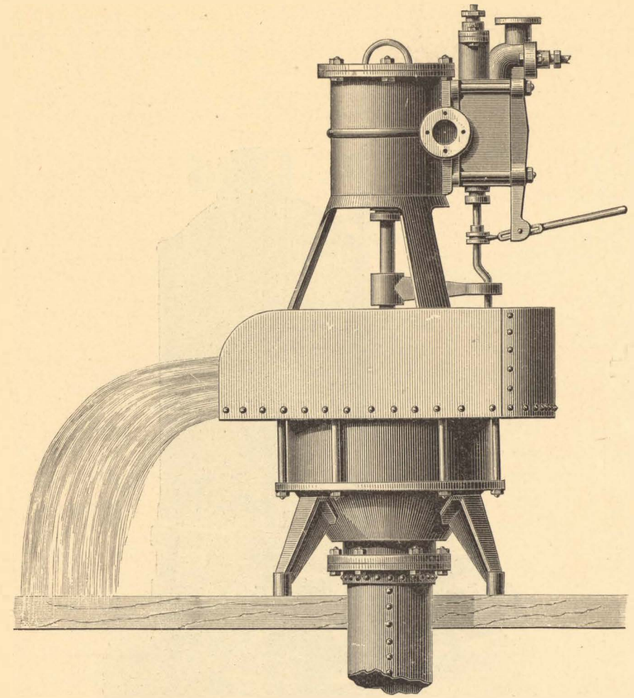


END VIEW OF WATER CYLINDERS.

At a somewhat increased cost over the list prices, the Worthington pumps described on pages six and nine can be furnished, when desired, with plungers having external adjustable packing, as shown in the above illustrations.

This modification has been designed to meet the preference occasionally expressed for a light and inexpensive water end of this form, for use where considerable pressure, combined with gritty water, is to be encountered. It is not, however, intended for any service where the water pressure exceeds 150 lbs. For such service the patterns shown on pages eleven, sixteen and twenty-four are adapted.

WORTHINGTON STEAM PUMP FOR WRECKING, DRAINAGE AND IRRIGATING.



This form of Worthington Pump was constructed many years ago, for Wrecking, Drainage, or Irrigating purposes, and has stood until now without any essential change, having proved itself to be remarkably well adapted to such service.

It is used generally by the Wrecking Companies on the Atlantic and Pacific coasts and the lakes, and is constructed with special reference to reliability, portability, and general efficiency.

It is equally well adapted for other services requiring the delivery of large quantities of water within the range of lift by suction.

It has no forcing power, the water being delivered over the top of the pump into the curb surrounding it.

It is single acting, although the discharge is practically constant, by reason of the quick return of the piston to the bottom of the cylinder, during which inactive stroke the water continues to flow by the momentum already acquired, thus producing almost the effect of a double acting pump.

In proportion to the work it will do, it is by far the lightest form of steam pump ever produced.

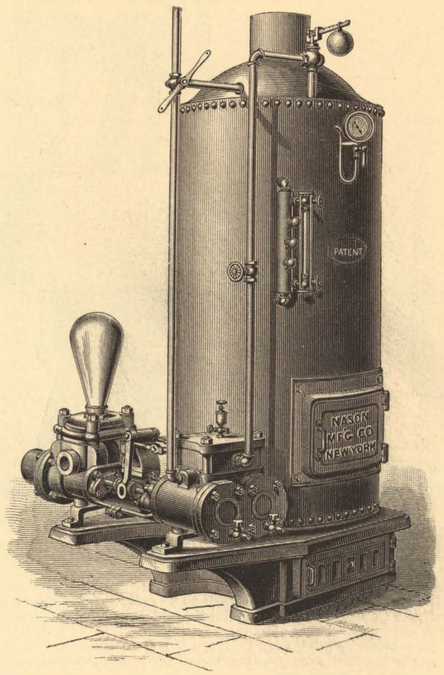
The ordinary slide valve is employed, moved by an arm striking against tappets on the valve rod. No auxiliary valves are used in connection with it.

The water valves are of rubber, the lower ones being upon a permanent plate at the bottom of the pump. The plunger also is covered with valves. These last open for the passage of water when the piston descends.

On account of its short stroke and large diameter, this pump is extremely efficient, running on comparatively low pressure of steam, and with a very small percentage of loss from friction or leakage. It is also in the highest degree simple and durable with few parts, and scarcely any liability to derangement or breakage.

Diameter of Steam Cylinder.	Diameter of Water Plunger.	Length of Stroke.	Diameter of Suction Pipe.	Gallons per Minute.	PRICES.	
					Fresh Water.	Salt Water, Brass Fitted.
6	12	9	6	350 to 400	$175.	$225.
12	20	9	9	1000 to 1200	425.	500.
16	25	9	11	1400 to 1600	550.	650.
18½	30	9	14	2000 to 2300		
19½	33	15	16	3200 to 3600		

WORTHINGTON STEAM PUMP AND BOILER.



(Combined Worthington Pump and Boiler, for general service. Size, $4\frac{1}{2} \times 2\frac{3}{4} \times 4$.)

COMPLETE WITH AUXILIARY FEED, BOILER BASE, SMOKE BONNET, SHAKING AND DUMPING GRATE, WATER COLUMN, GAUGE GLASS, GAUGE COCKS, STEAM GAUGE, SAFETY VALVE, GLOBE VALVES, TWO-WAY EXHAUST COCK, BLOW-OFF COCKS, STEAM AND EXHAUST PIPES, BOILER FEED CONNECTIONS, AND ALL NECESSARY FITTINGS.

THE WORTHINGTON STEAM PUMP AND BOILER.

In this combination, of the most approved form of Portable Boiler with the Worthington steam pump, particular attention is called to the following desirable features:

The Boiler Base, and Bracket upon which the pump rests, are made in one, and in such manner as to secure proper strength and stiffness with the least possible weight.

A shaking grate is used in the Boiler, and so constructed that the contents of the grate can be easily dumped without opening the fire-door.

The ash-pit door is made with sliding plate, in order that the draft may be more effectually controlled.

An important improvement is secured by the attachment of a two-way cock on the exhaust pipe. By simply turning this, steam may be discharged either directly into the open air, or into the chimney if desirable to force the draft.

A water column, in connection with the gauge glass and cocks, is furnished with the Boiler. The height of water can thus be determined with greater certainty and ease, and the chances of accident are lessened.

The pumps are fitted with an auxiliary side-feed, moved by an arm attached to one piston rod. This is the most durable, safe, and certain means of supplying the Boiler with water, that can be used.

The Low Service or Tank Pumps are suitable only for places where the water is to be forced not higher than 50 to 75 feet.

The following list contains sizes that are usually kept in stock, with particulars as to dimensions and cost. Prices of Steam Pumps of any desired capacity and proportion, with suitable Boilers, furnished on application.

PATTERNS FOR GENERAL SERVICE.

Diameter of Steam Cylinders in inches.	Diameter of Water Plungers in inches.	Length of Stroke in inches.	Proper strokes per minute of *one* Plunger.	Gallons delivered per minute by *both* Plungers at stated number of strokes.	DIMENSIONS OF BOILER. Diameter of Shell.	Height of Shell.	Tubes.	Length of Tubes.	PRICE. Complete.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases. Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.
$4\frac{1}{2}$	$2\frac{3}{4}$	4	75 to 150	15 to 30	24	60	29–2	42	$400.	$\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{2}$	1
6	4	6	75 to 125	50 to 80	30	75	42–2	54	600.	1	$1\frac{1}{2}$	$2\frac{1}{2}$	2
$7\frac{1}{2}$	$4\frac{1}{2}$	10	75 to 100	100 to 140	36	81	55–2	60	815.	$1\frac{1}{2}$	2	4	$2\frac{1}{2}$
9	$5\frac{1}{4}$	10	75 to 100	140 to 185	42	87	73–2	63	975.	$1\frac{1}{2}$	2	4	3
10	6	10	75 to 100	185 to 245						2	$2\frac{1}{2}$	4	3

LOW SERVICE OR TANK PUMPS.

$4\frac{1}{2}$	$3\frac{3}{4}$	4	75 to 150	35 to 65	24	60	29–2	42	$450.	$\frac{1}{2}$	$\frac{3}{4}$	$2\frac{1}{2}$	$1\frac{1}{2}$
6	$5\frac{3}{4}$	6	75 to 125	100 to 170	30	75	42–2	54	700.	1	$1\frac{1}{2}$	4	$2\frac{1}{2}$
$7\frac{1}{2}$	7	10	75 to 100	250 to 335	36	81	55–2	60	950.	$1\frac{1}{2}$	2	5	4
9	$8\frac{1}{2}$	10	75 to 100	370 to 490	42	87	73–2	63		$1\frac{1}{2}$	2	6	5

Water Valves of Rubber or Metal as may be required. Pumps fitted with Brass Plungers and Piston Rods, 3 per cent. extra.

It must be remembered, in comparing these sizes with single cylinder pumps, that the Worthington pump has *two* double-acting plungers working together, and is, therefore, double the capacity of a single cylinder pump with a plunger of same diameter. (See description, page seven.)

In the following table are shown what the dimensions of single cylinder pumps must be to equal the capacity of the Worthington pumps given above.

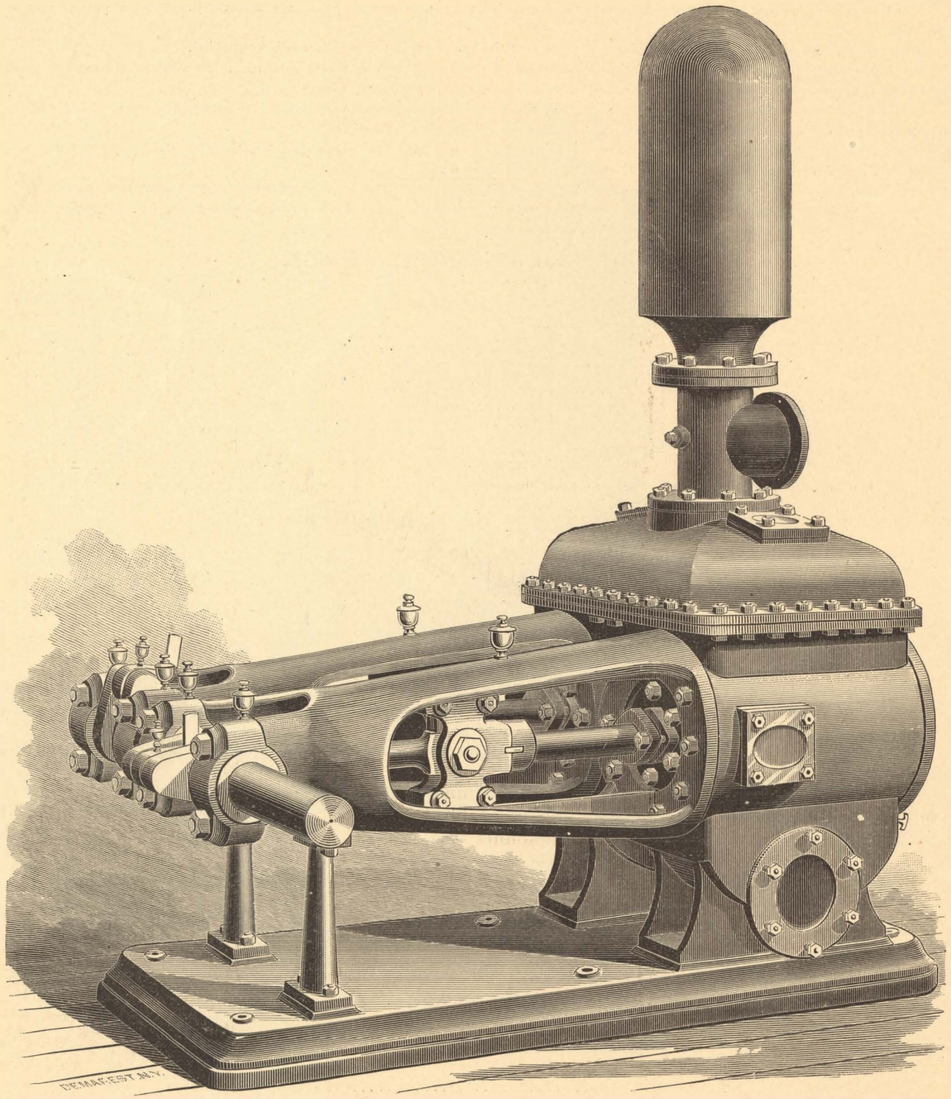
Dimensions of Worthington Pumps.	Dimensions required for Single Cylinder Pumps to do the same work.
$4\frac{1}{2} \times 2\frac{3}{4} \times 4$	$6\frac{3}{8} \times 4 \times 7$
$6 \times 4 \times 6$	$8\frac{1}{2} \times 5\frac{3}{8} \times 10$
$7\frac{1}{2} \times 4\frac{1}{2} \times 10$	$10\frac{1}{2} \times 6\frac{3}{8} \times 16$
$9 \times 5\frac{1}{4} \times 10$	$12\frac{3}{4} \times 7\frac{1}{2} \times 16$
$10 \times 6 \times 10$	$14 \times 8\frac{1}{2} \times 16$

TANK PUMPS.

$4\frac{1}{2} \times 3\frac{3}{4} \times 4$	$6\frac{3}{8} \times 5\frac{3}{8} \times 7$
$6 \times 5\frac{3}{4} \times 6$	$8\frac{1}{2} \times 8\frac{1}{8} \times 10$
$7\frac{1}{2} \times 7 \times 10$	$10\frac{1}{2} \times 9\frac{7}{8} \times 16$
$9 \times 8\frac{1}{2} \times 10$	$12\frac{3}{4} \times 12 \times 16$

The number of strokes given in the tables is limited to that which insures ease of performance under all usual conditions, but in any emergency the speed can be considerably increased.

THE WORTHINGTON "POWER" PUMP.



(Worthington Power Pump.—14 inch Plungers, 10½ inch Stroke.)

THE WORTHINGTON "POWER" PUMP.

These machines consist of the water end of a Duplex Pumping Engine, so connected by two quarter cranks to a shaft, as to be driven by gears attached to the motive power.

In the following list are given a few of the ordinary sizes, for general service, prices of which will be furnished on application. Patterns of much larger capacity than these are working on the water-works supply of a number of cities in this country and Canada.

The stated number of revolutions can be exceeded in emergency.

Diameter of Plungers, in inches.	Length of Stroke, in inches.	Gallons delivered per minute at 35 revolutions.	PRICE.	Diameter of Suction Pipe.	Diameter of Discharge Pipe.
2¾	4½	15.		1½	1
4	6½	48.		2½	2
4½	10½	100.		4	2½
6	10½	180.		4	3
8½	10½	360.		6	5
10¼	10½	520.		7	6
12	10½	720.		8	7
14	10½	980.		10	8
14	18	1680.			

Pumps fitted with Brass Plungers and Plunger Rods, 10 per cent. extra.

THE WORTHINGTON HYDRAULIC ELEVATOR PUMP.

The service of pumping for Hydraulic Elevators has of late years grown to be important and of extensive application. These pumps being absolutely positive and noiseless in their operation, were from the first recognized as having special advantages for this work.

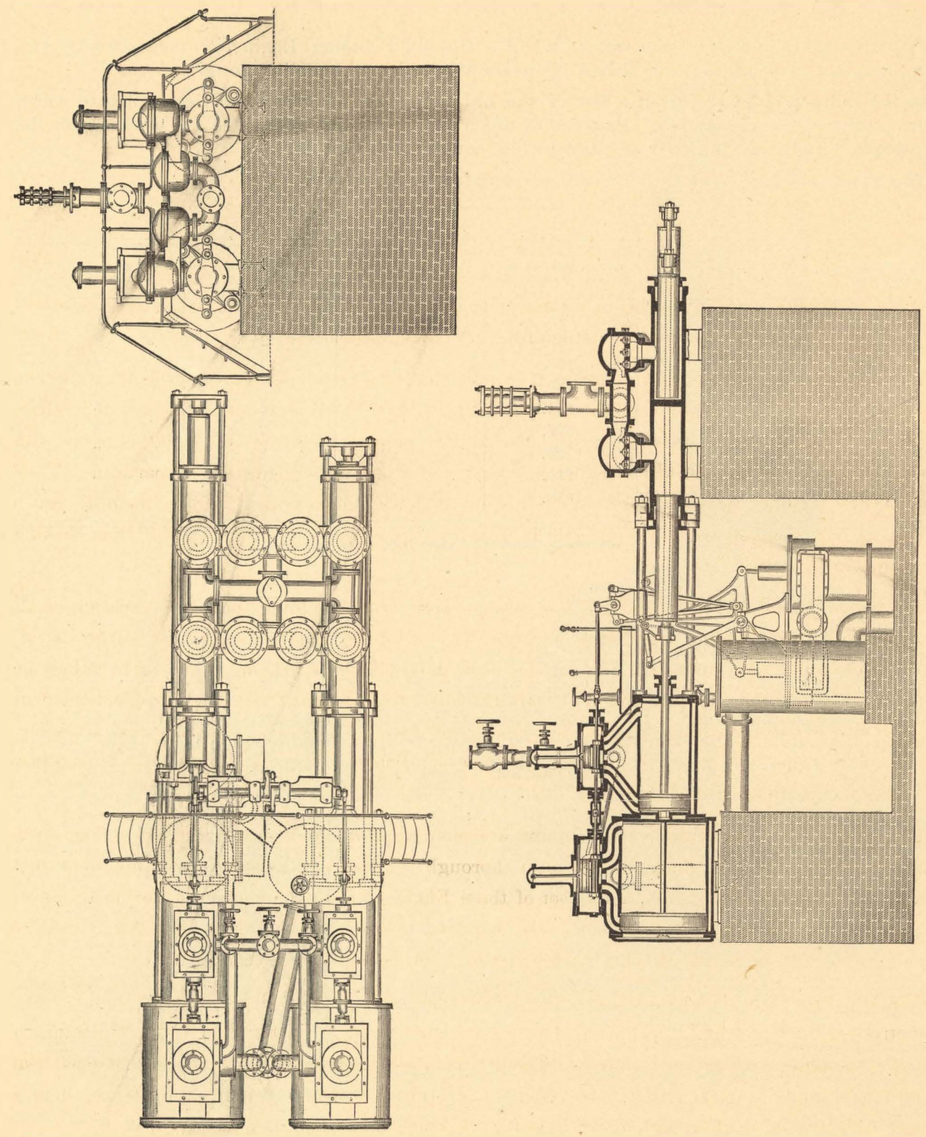
At present, with but few exceptions, all the Hydraulic Elevators in the country, where the water is required to be pumped, are run by the Worthington Machines.

The sizes used are shown on pages six and nine. As the pumps on such service are run nearly continuously during the day, it is generally advisable to use the compounds, especially on the larger sizes, as the saving in fuel by their use amounts to a large item in the course of the year.

THE WORTHINGTON "LOW STEAM PRESSURE" PUMP.

It occasionally happens, especially in apartment houses, that a pump is required to work with a very moderate pressure of steam. This necessitates different relative proportions of steam cylinders and water plungers from those ordinarily used. Special patterns are furnished, to meet every requirement of such service, and prices will be given on application.

The questions on page five should be carefully answered.



ELEVATION, PLAN AND SECTIONAL VIEW OF A WORTHINGTON COMPOUND CONDENSING PRESSURE PUMPING ENGINE.

THE WORTHINGTON

COMPOUND CONDENSING PRESSURE PUMP.

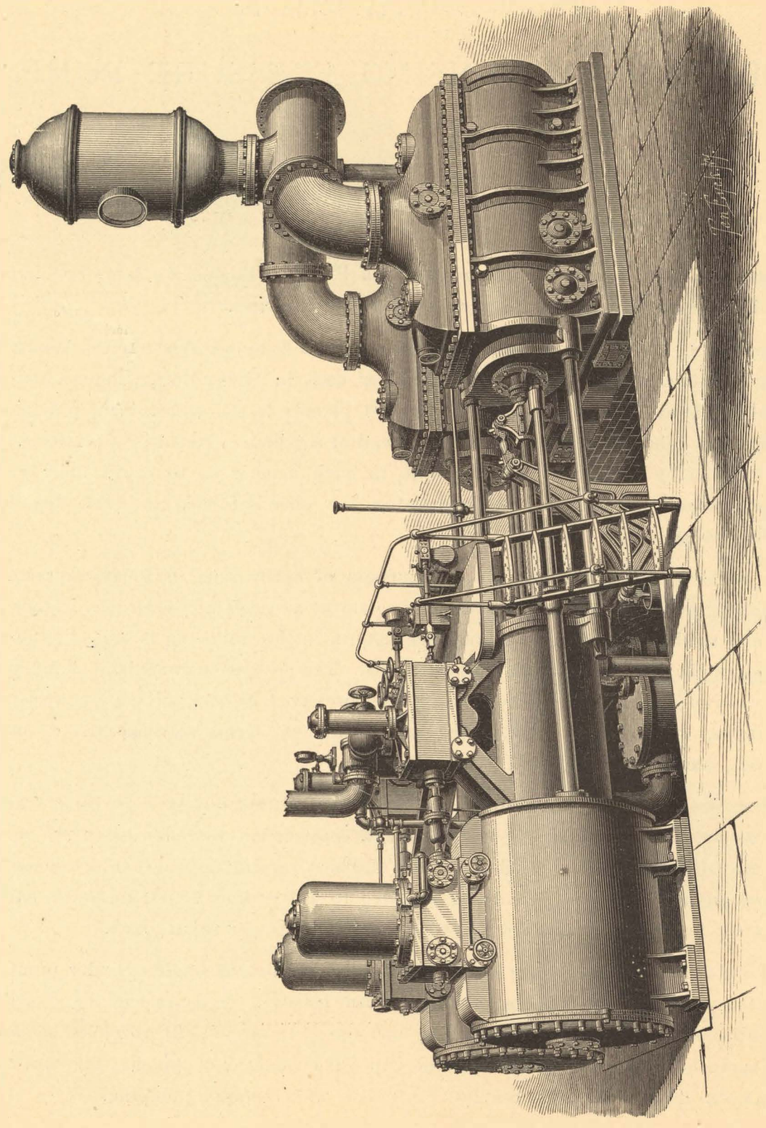
On the opposite page is shown an arrangement of a Pumping Engine, for large and important services, requiring the delivery of fluids against very heavy pressures.

The construction of the steam cylinders is exactly that of a first-class Worthington Water-works engine. Instead of the interior double-action Plunger used in Water-works Engines and others where the working head does not exceed 150 to 200 pounds to the square inch, plungers with exterior packings are substituted, working into each end of a cylinder divided by a partition. They are connected together by yokes and exterior rods, in such manner as to cause them to move together as one plunger, so that while one is drawing, the other is forcing the fluid, thus making the pump double-acting.

The valve boxes are also modified for the purpose of subdividing them into separate small chambers capable of resisting very heavy strains. The valves are metallic, sometimes leather faced, with low lifts and small surfaces. The arrangement shown in the engraving is subject to numerous alterations to adapt the pump to different requirements. The general characteristic of independent plungers with exterior packings is, however, in all cases preserved, as being not only more accessible in case of leakage, but also as allowing the use of different forms and material of packing. (See pages eleven, sixteen and eighteen.)

The severe works to which these Pumps are often applied, not less in some cases than 4,000 pounds to the square inch, demands the most thorough construction, and the use of the very best material. On the Oil Pipe Lines, a number of these Engines, varying from 200 to 500 horse power each, are in constant use, some of them being required to deliver from 15,000 to 25,000 barrels of oil per day against pressures varying from 1,000 to 1,500 pounds per square inch.

The Oil Pipe Line companies have found the concussive effect of single cylinder pumps very destructive on the pipes and attachments, causing constant leakage. In the case of the Worthington pump, its smoothness of action is not qualified by increase of resistance. If, therefore, the material of which it is made be strong enough to resist the rupturing tendency of unusual pressure, there is no more difficulty in dealing with the heaviest work than with ordinary pumping.



WORTHINGTON PUMPING ENGINE.

(WITHOUT LAGGING ON STEAM CYLINDERS.)

THE WORTHINGTON PUMPING ENGINE.

AS APPLIED TO WATER WORKS.

The following are some of the places at which Worthington Pumping Engines are in use for water-works purposes, the year in which they were delivered or put under contract, and their contract pumping capacity per day of 24 hours, stated in millions of gallons.

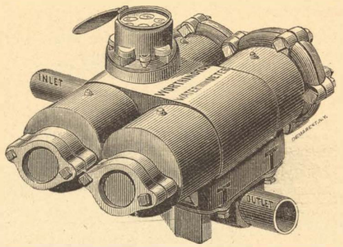
1860, Greenwood Cemetery.. ½
1861, Mt. Auburn, Mass..... ½
1863, Charlestown, " 5
1864, Wilmington, Del..... ½
1866, Annapolis, Md..... ½
1867, Charlestown, Mass.... 5
1868, Burlington, Vt..... ¾
1869, " " ..... ¾
1869, Prospect Park, L. I.... 1
1869, Norristown, Pa..... 1
1869, Newark, N. J..... 5
1869, Cambridge, Mass..... 5
1870, Newark, N. J..... 5
1870, Salem, Mass..... 5
1870, Phila., Belmont Station, 5
1870, Hudson River Hospital, 1
1870, Portland, Oregon 1
1871, Phila., Belmont Station, 5
1871, Philadelphia.....11
1872, Charlestown, Mass.... 8
1872, Wilmington, Del..... 5
1872, Philadelphia..... 2
1872, Providence, R. I..... 5
1872, Rahway, N. J..... 3
1872, Bowling Green, Ky.... 1
1872, Zanesville, Ohio..... 2
1872, Poughkeepsie, N. Y... 3
1873, Salem, Mass..... 5
1873, Phila., Belmont Station, 8
1873, Jersey City, N. J.....16
1873, Conshohocken, Pa..... 1
1873, Phœnixville, Pa..... 1½
1873, New Bedford, Mass.... 3
1873, Waltham, Mass..... 1½
1873, Woburn, Mass..... 2
1874, Newark, N. J..... 8
1874, Cambridge, Mass..... 5
1874, Baltimore, Md.....13
1874, Phœnix Iron Works... 2½
1874, Toledo, Ohio 10
1874, Toronto, Canada. 5
1874, Montgomery, Ala..... 1
1874, Buffalo, N. Y.....10
1875, Newark, N. J..... 3
1875, Zanesville, Ohio..... 3
1875, Fall River, Mass..... 5
1875, Bristol, Pa..... 1
1875, Montreal, Canada.....11
1875, Brookline, Mass..... 2
1875, Natick, Mass..... 1½
1875, College Point, L. I.... 2½
1875, Savannah, Ga..... 3
1875, Danville, Va..... 1
1875, Staunton, Va..... 1¼
1875, Bloomington, Ill..... 1
1875, Racine, Wis..... 1
1875, Michigan City, Ind.... 1⅓
1875, Yorkville, Canada..... 1¼
1875, Media, Pa..... ⅓
1876, Toronto, Ont.....10
1876, Buffalo, N. Y.....15
1876, Jamaica Pond, Mass... 2½
1876, Centen'l Water Supply, 7
1876, Sandusky, Ohio..... 5
1876, Lowell, Mass..... 5
1876, Cleveland, Ohio.....10
1876, Springfield, Ill..... 3
1876, Danvers, Mass..... 2
1876, Newton, Mass..... 6
1876, Bordentown, N. J..... 1½
1877, Portland, Oregon..... 3
1877, Baltimore, Md..... 3
1877, Syracuse, N. Y.....10
1877, Mt. Holly, N. J..... ½
1877, Pittston, Pa..... 2
1877, Kalamazoo, Mich..... 2
1877, Bridgeton, N. J..... 1
1877, Rochelle, Ill..... ¾
1877, Willard Asylum, N. Y.. 1½
1878, Paterson, N. J..... 3
1878, Boston, Mass..... 3
1878, Burlington, N. J..... ½
1878, DeKalb, Ill..... ⅓
1878, Peru, Ind..... 2½
1878, Norwalk, Ohio..... 2½
1878, Jacksonville, Ill..... 2
1878, Lancaster, Pa..... 3
1878, Haverhill, Mass..... 1½
1879, Jersey City, N. J..... 3
1879, Woburn, Mass..... 2
1879, Houston, Texas..... 3
1879, New York, N. Y.....15
1879, Edgar Thomson Steel Co 7
1879, Cambria Iron Works... 3½
1879, Plymouth, Mass..... 1½
1879, Jacksonville, Fla..... 3
1879, Youngstown, Ohio 3
1879, Brookline, Mass..... 1
1879, Pennsylvania Steel Co.. 6
1879, Alameda, Cal..... 2
1879, Norfolk, Va..... 6
1879, Union Stock Yard, Chicago, Ill..... 2
1879, Tewksbury, Mass..... ⅓
1879, New Carlisle, Ind..... ⅓
1880, Macon, Ga..... 1
1880, Alton, Ill..... 1½
1880, Brantford, Canada..... ¾
1880, Nantucket, Mass..... 1½
1880, Rochelle, Ill..... ¾
1880, Jamaica Pond, Mass... ¾
1880, Calumet & Hecla..... 3½
1880, Norfolk, Va..... 2
1880, Wheeling, W. Va..... 3
1880, Edgar Thomson Steel Co 3½
1880, Peoria, Ill..... 4
1880, St. Joseph, Mo..... 4
1880, East Boston..... ¾
1880, Canton, Ohio..... 2
1880, Akron, Ohio..... 2½
1880, Waltham, Mass..... 1½
1880, Cleveland, Ohio.....10
1880, Newark, N. J..... 5
1880, Yonkers, N. Y..... 3½
1880, Col. Coal & Iron Co... 1½
1880, Philadelphia, Pa 10
1880, Danvers, Mass..... 2
1880, Albany and Rensselaer Iron and Steel Co..... 3
1880, Lancaster, Ohio..... 1½
1880, Danville, Va..... 2
1880, Alton, Ill..... 1½
1880, Buffalo, N. Y.....15
1880, Haverhill, Mass..... 1½
1880, City of Boston Sewerage,50
1881, Auburn, Me ..... ¾
1881, Wilmington, N. C..... 2
1881, Wellsville, Ohio..... 1½
1881, St. Charles, Mo..... 1½
1881, Greenwood Cemetery.. ½
1881, Lowell, Mass..... ¾
1881, Somerville, N. J..... ½
1881, McKeesport, Pa..... 3
1881, Portland, Oregon..... ½
1881, Richmond, Va..... 6
1881, Chilicothe, Ohio..... 1½
1881, Keokuk, Iowa..... 1½
1881, Tombstone, Arizona... ½
1881, St. Louis, Mo..... ½
1881, Litchfield, Ill..... ½
1881, Otis Iron and Steel Co., Cleveland, Ohio..... ¾
1881, Edgar Thomson Steel Co.14
1881, Standard Oil Co., Cleveland.....10
1881, Peabody, Mass..... 5
1881, Savannah, Ga..... 5
1881, Hackensack, N. J..... 6
1881, Long Branch, N. J.... 2½
1881, Cambria Iron Works .. 5
1881, St. Joseph, Mo..... 3
1882, Mt. Vernon, Ohio..... 2
1882, New Haven, Conn.... 6
1882, Burden Iron Works,... 3½
1882, Winona, Minn..... 4½
1882, Atlantic City, N. J.... 3
1882, Pottstown, Pa..... 1½
1882, Springfield, Ill..... 4
1882, Lowell, Mass..... ¾
1882, Cambridge, Mass..... 1
1882, Hamilton, Canada..... 1¼
1882, Ishpeming, Mich..... ¾
1882, Gunnison, Col..... 1½
1882, Locust Mountain, Pa.. 4½
1882, West Chester, Pa..... 1
1882, Hot Springs, Ark..... 1
1882, Pernambuco, Brazil... 1½
1882, New Brunswick, N. J. 3
1883, New York, N. Y..... 6
1883, Standard Oil Co, Bayonne, N. J.....10
1883, Bradford, Pa..... ¾
1883, Olean, N. Y..... 1½
1883, Portland, Oregon.....10
1883, Phœnixville, Pa..... 1½
1883, Hackensack, N. J..... 4
1883, Portsmouth, Va..... 6
1883, Stratford, Ont..... 2½
1883, Yonkers, N. Y..... 1¼
1883, Milton, Pa..... 1
1883, Winfield, Kansas..... 1
1883, Alliance, Ohio..... 2
1883, Cambria Iron Works... 5
1883, Philadelphia, Pa.....37½

WORTHINGTON CRANK OR POWER PUMPS.

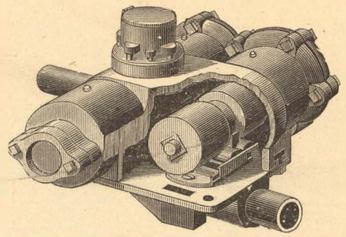
1877, San Antonio, Texas..... 1¼
1878, London, Ont..... 2
1878, Lewiston, Me..... 6
1879, New Brighton, Pa..... ¾
1880, Cooperstown, N. Y..... 1
1881, Somerville, N. J..... ½
1881, Winston, N. C..... ½
1882, New Brunswick, N. J..... 2½

To July 1st, 1883, total contract pumping capacity, 750,000,000 gallons in 24 hours.
A pamphlet fully descriptive of this department of the business furnished on application.

THE WORTHINGTON WATER METER.



THE WORTHINGTON WATER METER.



INTERIOR VIEW.

This machine measures with great accuracy the quantity of water or other fluid passing through it. It is used by water-works corporations to determine the amount of water used by different consumers; and by manufacturers, for measuring oil or other liquids into barrels or tanks. In answer to questions generally asked, the following remarks are submitted:

HEAD OF WATER REQUIRED TO RUN THE METER.—The plungers of this meter are fitted so exactly that they can be propelled by the breath, or by water poured into the meter from an open vessel. Three inches head is, therefore, a full allowance. But it must be understood that excessive speed produces increased and improper resistances, so that to have a meter work without perceptibly reducing the head of water, it should be of ample size to perform the duty when running slowly. When this rule is observed, it is impossible to detect by the flow of water whether the meter is on or off.

SIZE OF METER TO BE SELECTED.—As shown above, it is important to select a meter of a size adapted to the work. In fact, the only difficulties yet developed in practice, can, with scarcely an exception, be traced to the application of meters of too small a size. The mistake is generally made in this way: A consumer uses six thousand gallons in twenty-four hours, for example; this is two hundred and fifty gallons per hour, or about four gallons per minute. A five-eighth inch meter would seem amply large for this case, whereas the consumer may draw this amount into a tank which he wants to fill in six hours. This gives a rate of sixteen gallons per minute, instead of four, and the effect is to overrun the meter and injure the supply. The greatest quantity drawn per minute should, therefore, govern the selection of the proper size.

It was necessary to adopt some classification, and that designating the size of openings into the meter was considered convenient; but it is by no means to be implicitly relied on in determining the size of meter required. A five-eighth inch pipe in one city may deliver four times as much as the same pipe would in another city. All depends upon the head, the plan of distribution, and the number of water takers. Thus a five-eighth inch meter does well on an inch pipe in one place, while an inch meter would scarcely do on a five-eighth inch pipe in another. As a meter never fails from being too large, it is always best to take the safe side.

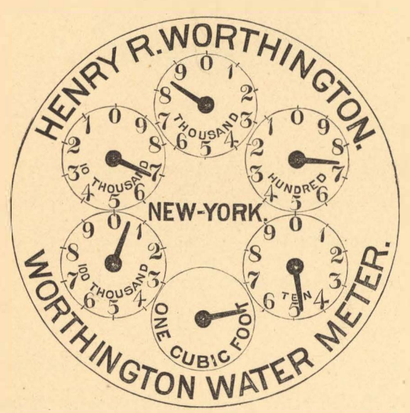
CONSTRUCTION OF THE METER.—A moment's thought will convince anyone that a good and reliable meter is a machine requiring a combination of peculiarities not easy to be obtained. Most important of all is, that of a perfectly positive motion, with nothing like a dead center, a weak place, or a disposition to stop and refuse to start. Every gallon of water drawn in a house must produce a corresponding and registered motion in the meter. If on this point it be not well-nigh infallible, it is useless to talk of other advantages. The expedients for giving this certain motion are very numerous. They include everything from a quarter crank, or even a three-throw crank, to a tumbling block, or weight falling from side to side at each stroke of the machine. That they cannot all answer the purpose is abundantly proved in practice. Many of these motions would do very well with a little oil, or an occasional adjustment, but a meter never gets either; it must work alone and neglected, or it will soon cease working altogether. Again, a meter must be nearly frictionless, and yet so well fitted as to run and register almost on drops. Many meters have been abandoned because a small stream would pass through without moving them. The consumer soon finds this out, and gets a great deal of water without paying for it, by keeping a small stream constantly running into some large receptacle. A meter must also be very durable, with working parts of metal that will not rust, and with a counting gear of the best character. Every joint must be strictly water-tight, and no large stuffing-boxes can be tolerated. The apparently trivial difficulty of a dripping or leaky meter becomes, in many places, an insufferable nuisance. In practice, it sometimes happens that a meter is not looked at oftener than once in two or three months. Unless during these long intervals everything goes exactly right, the greatest trouble and complaint ensues. Finally, all these important requisites must be combined in a machine that costs very little money, otherwise it is cheaper to waste water than to measure it.

The Worthington Meter has been closely and fully tested for the past twenty-five years by the principal water-works companies in this country and in Canada, there being now over thirty thousand of them in use.

The general principle on which the meter acts is the reciprocation of pistons or plungers, each stroke of which is marked on the counter. It is, therefore, of the positive kind, furnishing no water unless properly at work. In this important respect it

differs from that variety of meter called the "Inferential," through which the flow of water is almost uninterrupted, even if the meter chance to cease working. The water-valves are slide-valves, so located and propelled as to dispense with all levers, rock shafts, or similar contrivances. The best way to understand the machine is to take it apart, marking the pieces as they come out. No one can fail to get it together properly, or to comprehend its construction. There is nothing nice or complicated about it, but it is not easy to illustrate its construction in a drawing.

The engraving shows the machine as it stands when connected. It is generally fastened in a strong box, which protects it partially from frost. To save room, the meters are sometimes taken out, but it is better to keep them in the boxes in all cases where it can conveniently be done. The counter registers cubic feet; one foot being $7\frac{48}{100}$ gallons U. S. standard. It is read in the same way as the registers of Gas Meters. The following example and directions may be of use to those unacquainted with the method.



If a pointer is between two figures, the smaller one must invariably be taken. Suppose the pointers of the dials to stand as in the engraving. The reading is 6,874 cubic feet.

From the dial marked TEN, we get the figure 4; from the next, marked HUNDRED, the figure 7; from the next, marked THOUSAND, the figure 8; from the next, marked 10 THOUSAND, the figure 6. The next pointer being between the 10 and 1, indicates nothing. By subtracting the reading taken at one time from that taken at the next, the consumption of water for the intermediate time is obtained.

The counter is covered with a cast-iron box, the lid of which being raised, the dial can be seen through the glass in the top of the box. This box is screwed to the body of the meter, and by covering the heads of the screws with sealing wax stamped with the seal of the Water-works Corporation, it becomes impossible to tamper with the meter without breaking the seal.

In some cases it has been found expedient, if not necessary, to put on a strainer, to prevent fish, pieces of solder, or other matter from entering and obstructing the meter. These strainers can be furnished at a small cost, varying with the size of the meter to which they are to be attached.

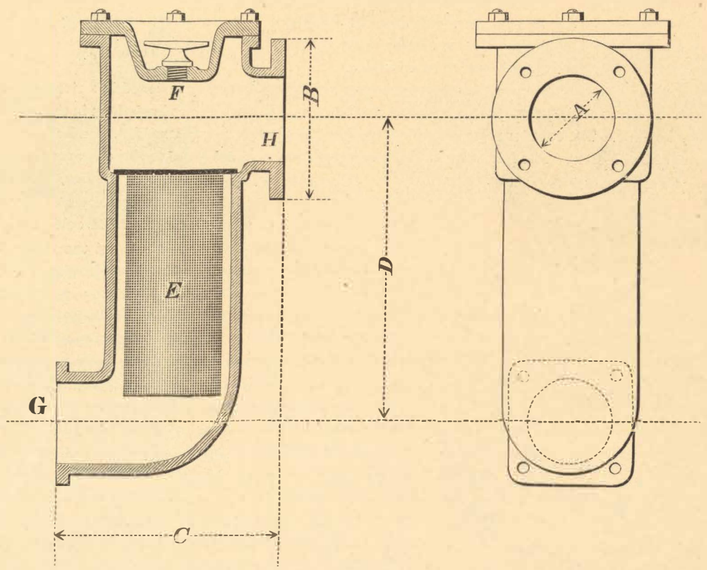
To put up and start the meter, place it with the counter on the upper side; connect the supply pipe with the meter at the hole marked "Inlet." Turn on the water and loosen the four brass screws on top of the meter, and allow the air to blow through. When water appears, tighten them again, and leave the meter to itself, noting the condition of the counter. The motion of the pointers is not continuous, as they move a little and then stop, moving again at the next stroke of the plungers. The flow of water, on the contrary, should be perfectly continuous and unbroken, so long as the water is being drawn through the meter. In spite of every care, it sometimes happens that the pawls which catch into the ratchet wheels in the chamber of the meter will fail to work properly, after standing dry for a considerable time. In such case the machine will run without moving the counter. To correct it, take off the cap or flange which carries the counter, and work the pawls back and forth until they drop freely. Occasionally, also, the india-rubber packing disk around the spindle will become adhesive, and require loosening and readjustment when first started.

SIZES, CAPACITIES AND PRICES OF METERS.

Size of Opening.	Greatest proper Quantity per minute.	Price.	Permanent Box.*
$\frac{5}{8}$ inch pipe.	1 cubic foot, or $7\frac{1}{2}$ gallons.	$17.	$1.00
$\frac{3}{4}$ "	2 " 15 "	27.	1.50
1 "	4 " 30 "	33.	1.75
$1\frac{1}{2}$ "	6 " 45 "	44.	2.00
2 "	8 " 60 "	55.	2.25
3 "	18 " 130 "	109.	3.50
4 "	60 " 450 "	307.	4.50

*This box has a hinged lid, and is made very strong to protect the meter in transportation and while in use. It has suitable openings for the pipe connections.

WORTHINGTON "SIDE-PIPE AND STRAINER."



It is often necessary, and generally desirable, that there should be a strainer attached somewhere to the supply pipe of a pump. The difficulty of reaching it in case it should become obstructed and require cleaning, is the great objection to placing it on the end of the supply pipe furthest from the pump, and has led to the adoption of the arrangement shown in the above cuts.

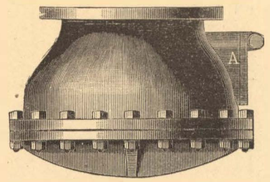
The flange *G* is attached directly to the suction opening of the pump, and the supply pipe to the flange *H*. A basket strainer of ample area is inserted at *E*, down through which the fluid passes, and which can be easily withdrawn for cleaning through the hand hole at the top. In the hand hole plate a thumb-plug *F* is provided, which, if removed when the pump is stopped, admits air into the suction pipe, and prevents the water from syphoning out of the water cylinders. The pump being thus charged with water, is enabled to lift its supply more readily when again started.

The cut on page thirty-three shows the side-pipe and strainer as usually connected, but where more convenient they can be attached horizontally instead of vertically.

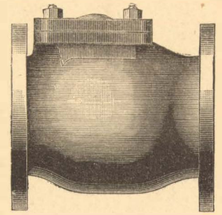
S ide-pipes and strainers will be furnished for most of the regular sizes of Worthington pumps, at the following prices.

Size of Pump water end, for which Side-pipes are furnished.	Diameter of Suction Pipe at *A*.	Distance in inches between faces of Flanges at *C*.	Height in inches to centre of Flanges at *D*.	PRICES.
$4\frac{1}{2} \times 10$	4	13	16	$14.
$5\frac{1}{4} \times 10$	4	14	18	15.
6×10	4	14	18	15.
7×10	5	14	18	17.
$8\frac{1}{2} \times 10$	6	14	20	
$10\frac{1}{4} \times 10$	7	16	25	Prices furnished
12×10	8	19	25	on application.
14×10	10	20	25	

WORTHINGTON CHECK AND FOOT VALVES.



Foot Valve.



Check Valve.

These patterns are constructed with especial care as to proper proportion and strength, combined with good material and workmanship. The areas of their passages are sufficiently large to admit of the fluid passing through them with the minimum amount of frictional resistance.

The interior of the check valves can be reached by means of convenient hand-holes.

For the larger sizes of foot valves is provided an attachment, shown at *A* in the above illustration, designed to relieve the valve and the supply pipe of any undue internal pressure to which they might be subjected. This is in many cases a very necessary safeguard, as with pumping machinery working under severe resistances, the water pressure can be transmitted through leakages, from the force to the supply main while the engine is at rest, and is generally sufficient to burst the foot valve or the suction chamber of the pump, if they are not relieved through a safety device of this character.

The following list comprises the regular patterns of valves. They are usually kept in stock and can always be furnished at short notice.

SIZES, IN INCHES.	3	4	5	6	7	8	10	12	14	16	18	20	24	30	36
PRICES, FOOT VALVES.	$6.	$8.	$12.	$14.	$19.	$23.	$32.	Furnished on application.							
PRICES, CHECK VALVES.	$17.	$23.	$29.	$36.	$38.	$42.	$54.	Furnished on application.							

These prices are for valves having flanges, faced and drilled according to uniform standards. It should be stated in ordering, if they are to be left blank, or are to be drilled to fit any special connection.

They can all be made with bell and spigot ends if desired, at somewhat increased cost.

TO CORRESPONDENTS.

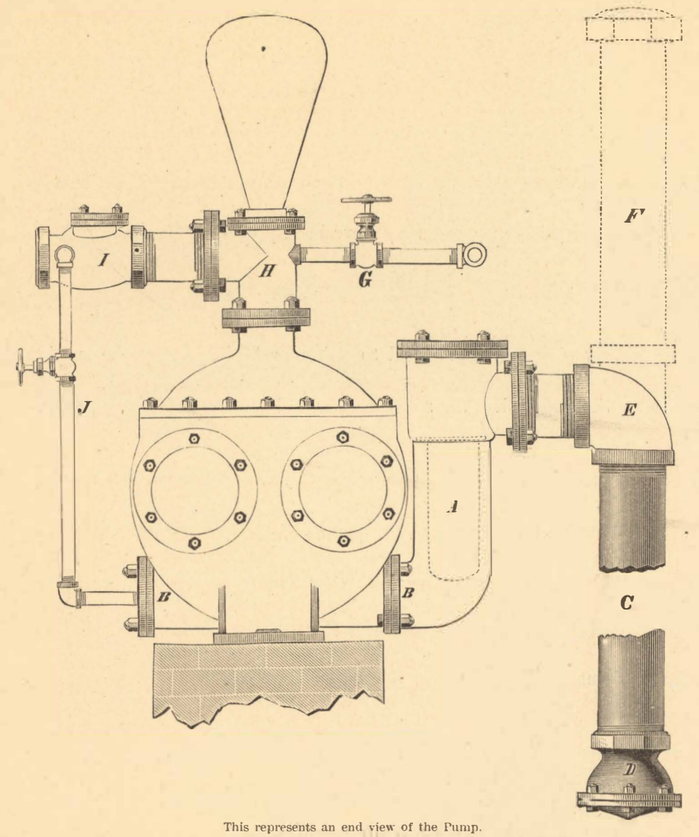
Although it is only in rare cases that they can be recommended in preference to the Duplex, we intend to continue the manufacture of Worthington Steam Pumps of the single cylinder type, of both vertical (as shown on page 19) and horizontal patterns. It is, therefore, especially important that we should be consulted as to the proper type, size, pattern, and proportion of pumps or any peculiar service, as well as to the plan of their connections and the kind of material to be used in their construction.

If any difficulty is experienced in making a pump work properly when first started, it will generally be found to proceed from imperfect connections, or from the temporary stiffness to be expected in a new machine. We should be informed of all the conditions of the service under which the pump is to work, as indicated by the questions on page five.

Unless the suction lift and length of supply pipe are moderate, a foot valve, a charging connection and a vacuum chamber are very desirable, if not absolutely necessary. The supply pipe must of course be entirely free from air leakage.

It often happens that a pump refuses to lift water while the full pressure against which it is expected to work is resting upon the force valves, for the reason that the air within the pump chamber is not dislodged, but only compressed by the motion of the plunger. It is well, therefore, to arrange for running without pressure until the air is expelled, and water follows. This is done by placing a check valve in the delivery pipe, and providing a waste delivery to be closed after the pump has caught water. Such a valve is also required for keeping back the pressure when the pump is opened for examination of the valves.

The following cut is presented for the purpose of showing those not fully acquainted with the subject, a good arrangement of piping, together with the attachments above referred to.



This represents an end view of the Pump.

On the suction pipe *C*, is a foot valve *D*, which keeps the pipe and cylinders charged with water, so that the pump, when being started, does not have to free itself and the suction-pipe of air. This valve is always essential on an unusually long suction-pipe, or where the suction lift is severe. In such cases the vacuum chamber *F*, should also be added. It is readily made by extending the suction-pipe upward, using a tee instead of the elbow *E*, and putting a cap on the top.

The arrangement of side pipe and strainer, shown at *A*, is described on page thirty.

A check-valve *I*, should be placed upon the delivery pipe, to keep back the water when the pump is opened for examination or repairs.

A "waste-delivery" or "starting-pipe," that can be led into any convenient place of overflow, should be provided as shown at *G*, so that the pump at starting can free itself of air, while the pressure is kept from it by the check-valve *I*. When the pump has properly started, the valve in this "waste-delivery" should be closed.

The "charging pipe" *J*, connecting the delivery-pipe *beyond* the check-valve with the suction-chamber of the pump, is for the purpose of charging the cylinders and suction-pipe before starting, with water from the delivery-pipe, in case they have been purposely emptied, or the water has leaked out through the foot-valve.

The suction or supply-pipe can be attached to either or both sides of the suction-chamber at the flange *B*. On some of the larger sizes the suction opening is on the end of the pump.

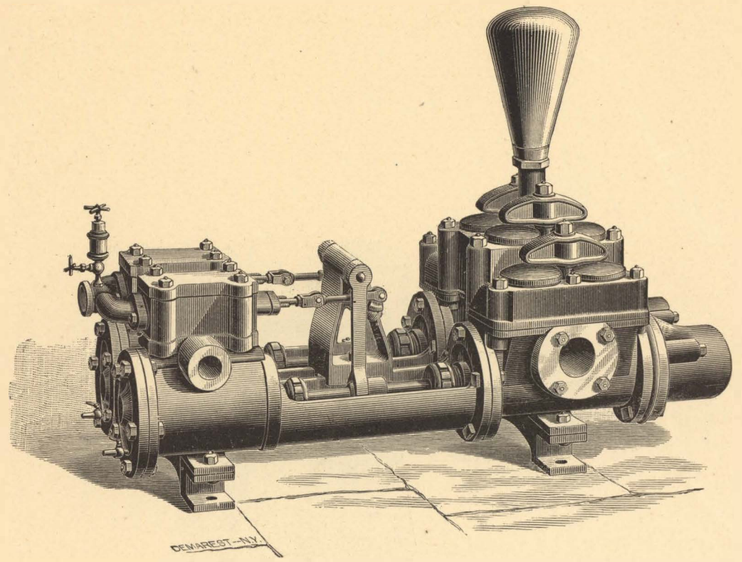
The quality of the material and workmanship of Worthington Steam Pumps is guaranteed to be first-class in every particular. Nothing is omitted in their manufacture that would tend to their improvement in strength or durability. Their exterior finish is ordinarily as plain as is compatible with good taste and design. But where desirable for special cases, they will be finished as ornamentally as may be demanded, at the cost of the extra work.

To designate the sizes of Worthington Pumps, give the diameters of their steam cylinders and water plungers. In referring to one already in use, its shop number should be stated.

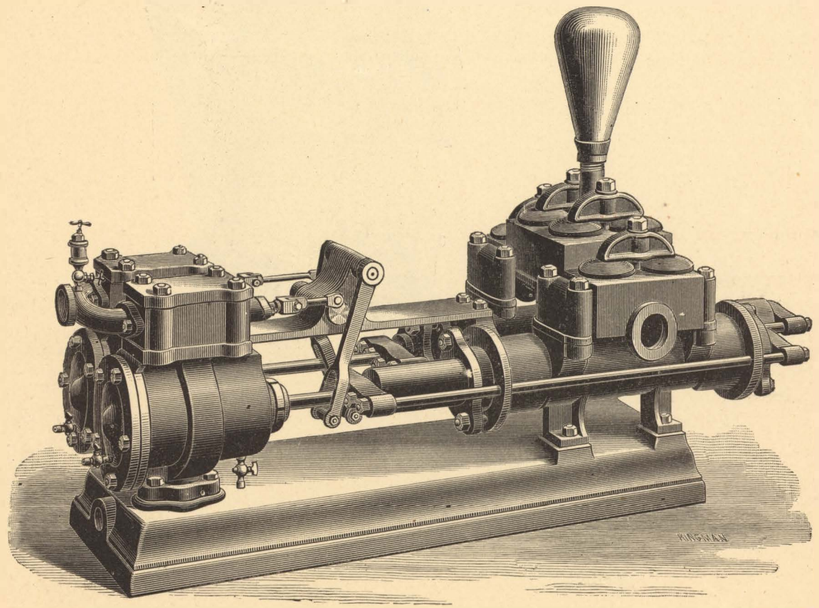
Rubber valves are used in the ordinary pumps for cold water, but brass, rubber composition, or other suitable material is required for hot water or oil. For pumping salt water, or where the pump may lie so long unused as to be liable to rust, the piston rods and plungers should be of brass.

Every machine, whether new or after being repaired, is fully tested under various conditions of speed and pressure before being delivered from the manufactory.

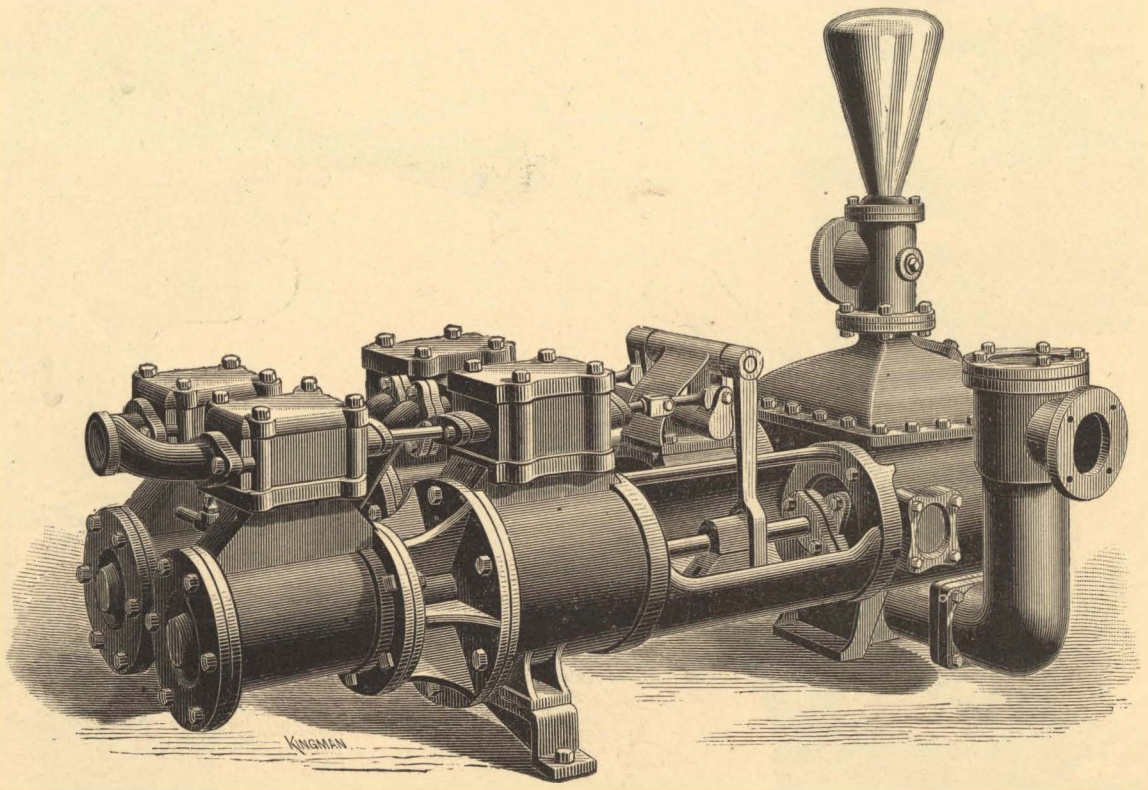
HENRY R. WORTHINGTON.



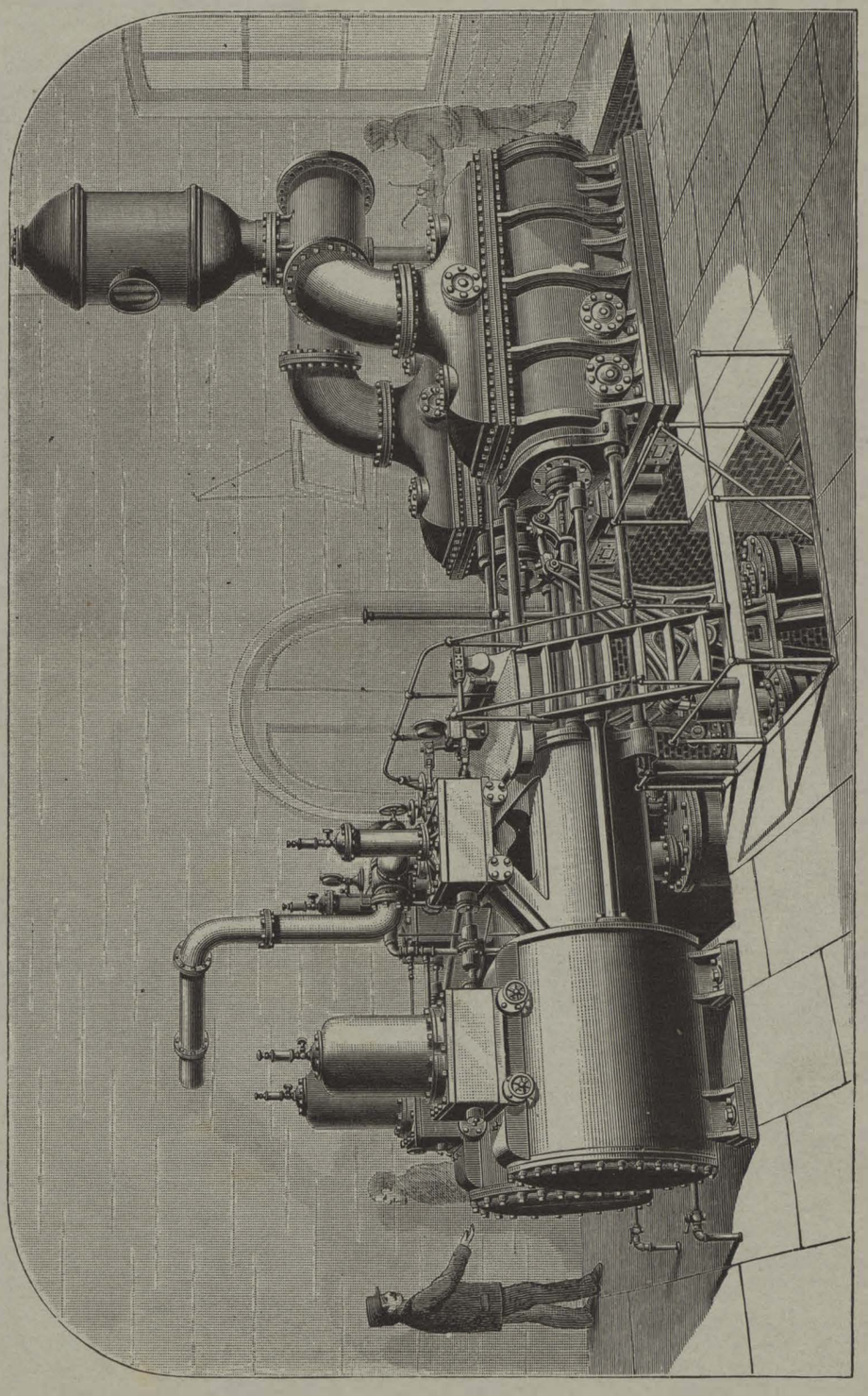
(Worthington Pump. Size, 6 x 4 x 6. Described on page 6.)



(Worthington "Pressure" Pump. Size, 6 x 3½ x 6. Described on page 11.)



(Worthington "Compound" Pump. Size, 8 and 12 x 7 x 10. Described on pages 8 and 9.)



THE WORTHINGTON PUMPING ENGINE.

E. S. DODGE, STEAM PRINTING HOUSE, 95 CHAMBERS ST., N. Y.

TITLE/TITRE : ***Worthington steam pumping engines : compound, condensing or non-condensing, for city water works, boiler feed pumps wrecking pumps, mining pumps, pumps for hydraulic pressure ... and brass casting, water meters, oil meters / Henry R. Worthington***
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