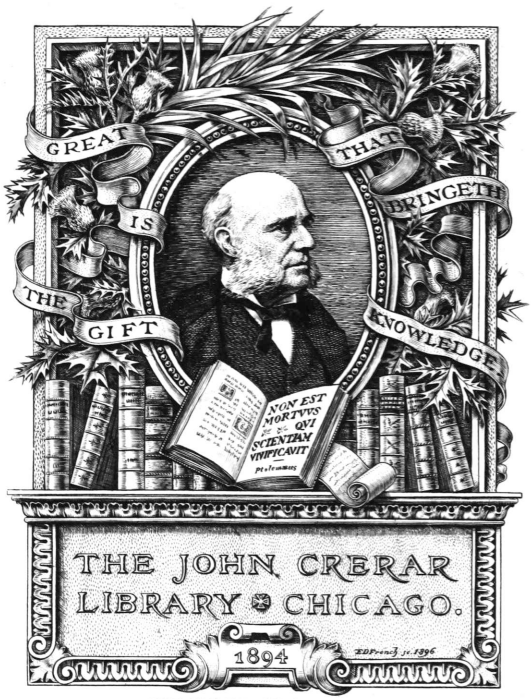


PRESENTED BY

Worthington Pumping Engine Co.

GENERAL CATALOGUE

No. 29

WORTHINGTON

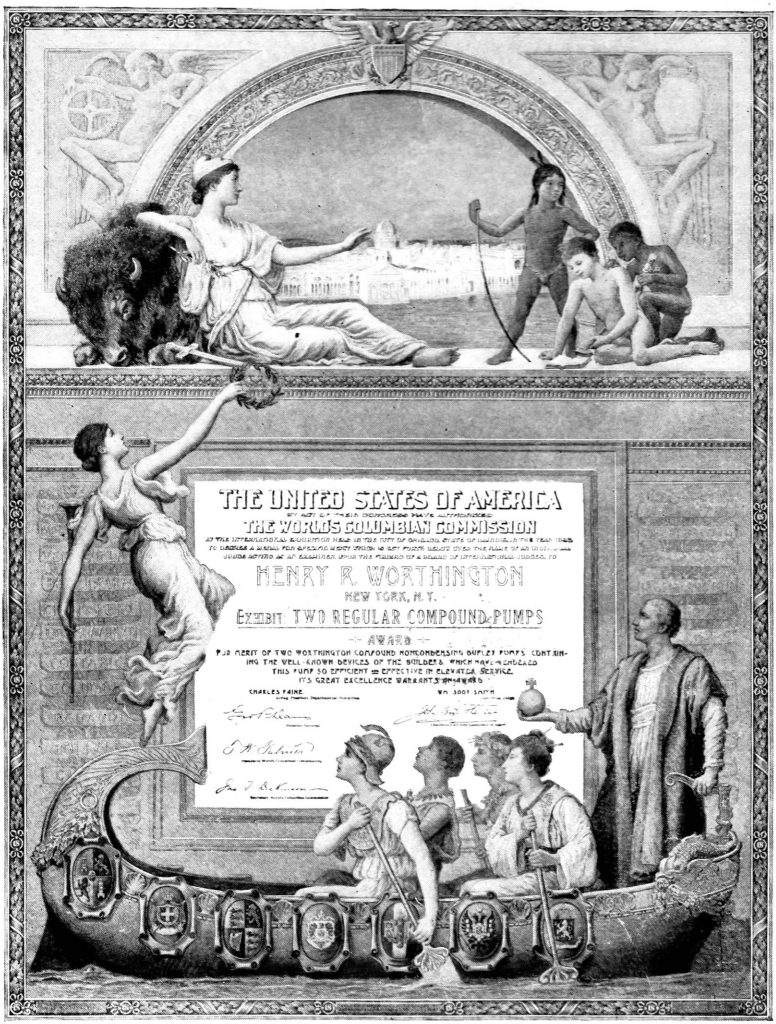
PUMPING ENGINES

STEAM PUMPS

AND

HYDRAULIC MACHINERY

JANUARY 1, 1900

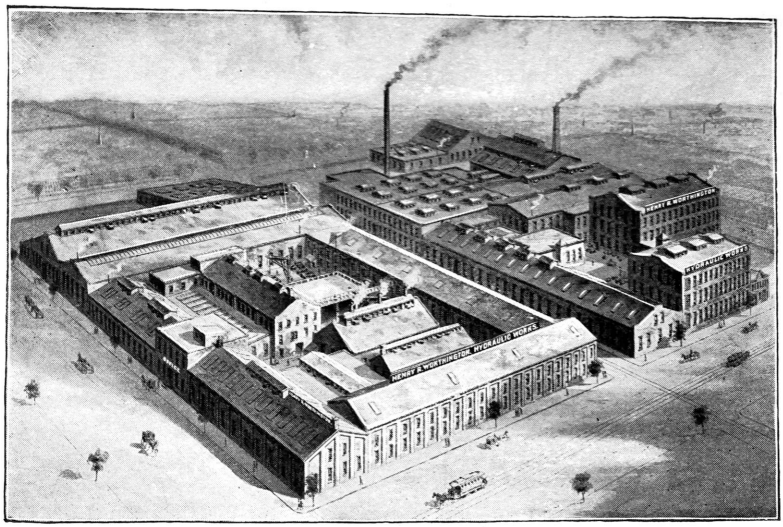


FACSIMILE OF ONE OF TWELVE DIPLOMAS AWARDED TO

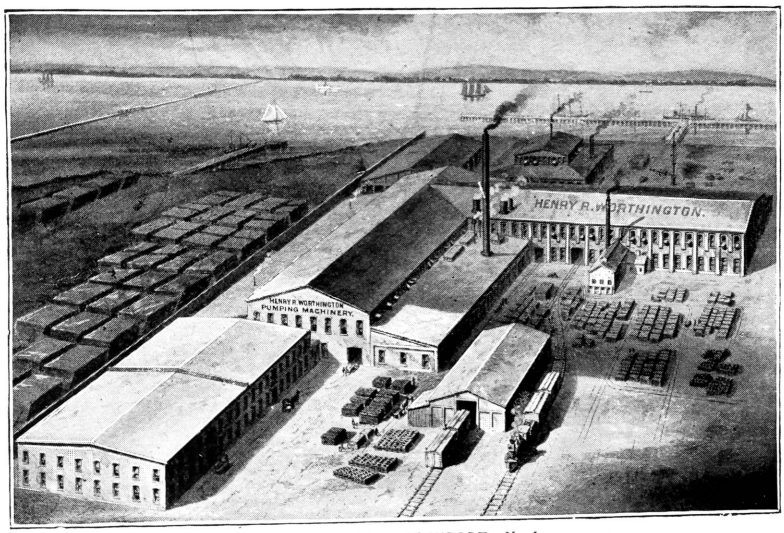
HENRY R. WORTHINGTON

PUMPING MACHINERY EXHIBITED AT THE WORLD'S COLUMBIAN EXPO

1893



HYDRAULIC WORKS, BROOKLYN, N. Y.



FOUNDRIES, ELIZABETHPORT, N. J.

WORTHINGTON STEAM PUMPS

ELECTRIC PUMPS

CONDENSERS AND WATER METERS

HENRY R. WORTHINGTON

HYDRAULIC WORKS

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NOTE

ALL CORRESPONDENCE SHOULD BE ADDRESSED TO HENRY R. WORTHINGTON.

QUOTATIONS, DRAWINGS AND FULL SPECIFICATIONS WILL BE SENT ON APPLICATION.

TERMS—NET CASH IN NEW YORK EXCHANGE. ALL ACCOUNTS NOT SETTLED WITHIN 30 DAYS FROM DATE OF INVOICE ARE SUBJECT TO SIGHT DRAFT WITH EXCHANGE ON NEW YORK.

ALL SHIPMENTS F. O. B. NEW YORK, UNLESS OTHERWISE AGREED UPON. AN EXTRA CHARGE WILL BE MADE FOR ALL DELIVERIES IN GREATER NEW YORK, EXCEPT IN THE BOROUGH OF MANHATTAN, BELOW SIXTIETH STREET, AND IN THE BOROUGH OF BROOKLYN, WITHIN FOUR MILES FROM THE CITY HALL.

AN EXTRA CHARGE IS MADE FOR BOXING REPAIR PARTS OR REPAIRED MACHINES, BOXING OVER ALL, OR ANY OTHER UNUSUAL SHIPPING EXPENSE.

SIZES OF PIPE CONNECTIONS GIVEN IN THIS CATALOGUE ARE SUBJECT TO CHANGE, AND WE CANNOT BE BOUND BY THEM. A CORRECT DRAWING WILL BE SENT IF ASKED FOR AT THE TIME OF ORDERING.

THERE SHOULD BE NO DIFFICULTY IN SELECTING FROM THE LISTS IN THE CATALOGUE PUMPS TO MEET ANY ORDINARY REQUIREMENT; YET IN ALL CASES WHERE TIME WILL PERMIT, IT IS WELL TO COMMUNICATE WITH THE MAIN OFFICE OR THE NEAREST BRANCH OFFICE, STATING FULLY THE CONDITIONS OF SERVICE FOR WHICH A PUMP IS INTENDED, AND ANSWERING SPECIFICALLY THE QUESTIONS ON PAGE 4.

AN INDEX TO THE TELEGRAPHIC CODE WORDS USED IN THE LISTS WILL BE FOUND ON PAGE 96.

PRESS OF ANDREW H. KELLOGG, 409-415 PEARL ST., NEW YORK

INDEX

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 48) and horizontal patterns.

It is, therefore, especially important that we should be consulted as to the proper type, size, pattern, and proportion of pumps for any peculiar service, as well as to the plan of their connections and the kind of material to be used in their construction.

We should be informed of all the conditions of the service under which the pump is to work, as indicated by the following questions:

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 are 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. Will supply be taken from a driven well? If not, from what source?

6th. To what height, or against what pressure, is the water to be pumped?

7th. What is the greatest quantity of water needed per hour?

8th. What pressure of steam is used?

9th. Will pump exhaust into atmosphere, into condenser, or against a back pressure? If so, how much?

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.

Unless the section 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.

* 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.

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.

A general arrangement of pipe connections and attachments is illustrated and described on pages 90 and 91 of this Catalogue. The information will be found useful to those persons not fully acquainted with the subject.

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, and length of stroke. In referring to one already in use, its shop number should be stated.

In ordering repair parts particular attention is directed to pages 92 to 95, where full lists and descriptions are given. It will be noticed that the Worthington pump as now manufactured differs in some details from the earlier patterns. On this account it is very important that the size and *shop number* of the pump be clearly stated in all orders for repair parts.

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.

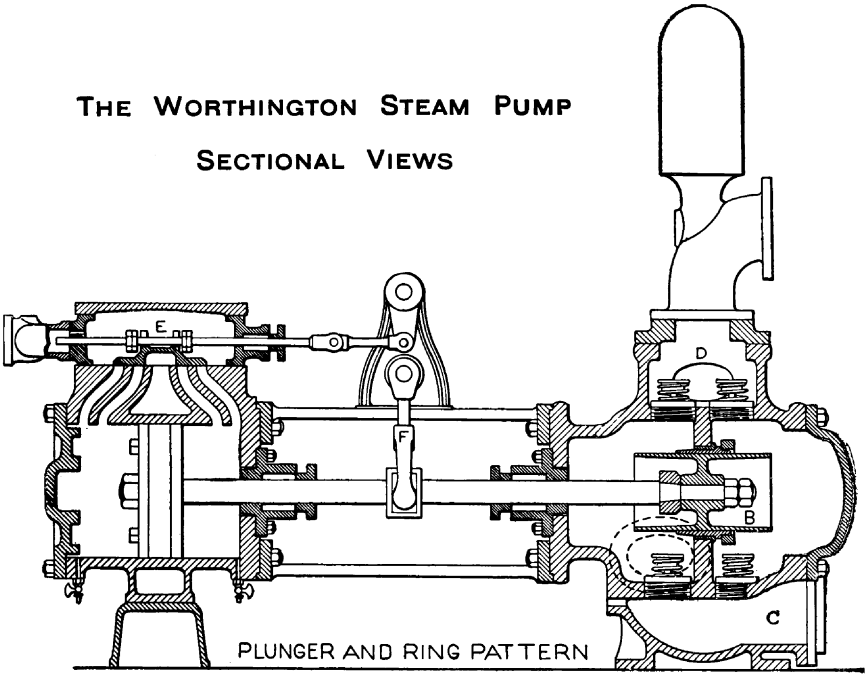
HENRY R. WORTHINGTON.

JANUARY 1, 1900.

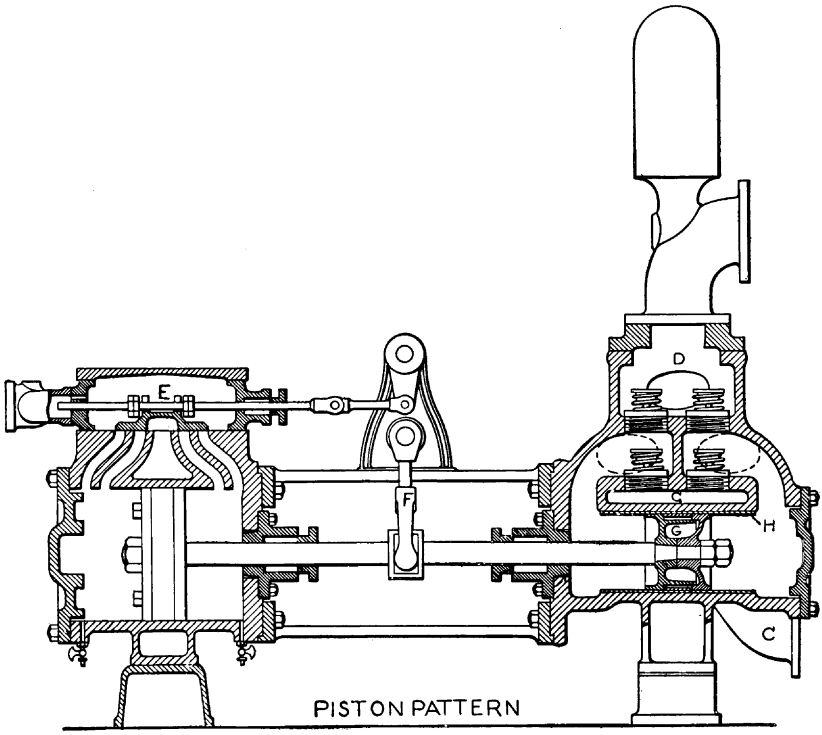
SPECIAL ATTENTION IS CALLED TO THE FACT THAT ROLLED STEEL AND DROP FORGINGS ARE USED EXCLUSIVELY IN THE VALVE MOTION OF WORTHINGTON PUMPS. THIS INSURES GREAT STRENGTH AND DURABILITY.

THE WORTHINGTON STEAM PUMP

SECTIONAL VIEWS



PLUNGER AND RING PATTERN



PISTON PATTERN

THE WORTHINGTON STEAM PUMP

The illustrations on the opposite page are sectional views of one side, or half of the Worthington Steam Pump, showing two different designs. They exhibit generally the great simplicity of the interior arrangement of the pump, and especially the steam valve.

This valve, as may be seen at "E," is an ordinary slide valve, which may be called the simplest and most reliable valve known to engineers.

In the Worthington engine, the motion of this valve is produced by a vibrating arm, seen at "F," 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.

This valve motion is the prominent and distinguishing peculiarity of the Worthington pump. Two steam pumps are placed side by side and so combined that 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 by the other pump before it can renew its motion. This pause allows the water valves to seat quietly, and removes everything like harshness of motion. As one or the other of the steam valves is always open, there is no dead point, and therefore the pump is always ready to start when the steam is admitted.

The same type of steam cylinder and valve motion is furnished with pumps of either the plunger and ring pattern or piston pattern, as shown on the opposite page.

In the Plunger and Ring Pattern there is a double-acting plunger, "B," working through a deep metallic ring bored to accurately fit the plunger. The plunger is located some inches above the suction valves, forming a subsiding chamber, into which any foreign substance may fall below the wearing surfaces. Both the plunger and ring can be quickly taken out and either refitted or, when necessary, renewed at small cost.

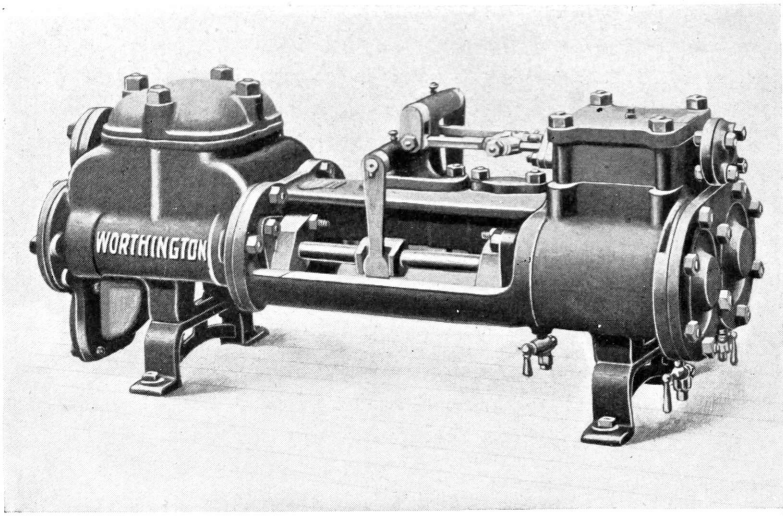
The suction valves being below and the force valves directly above the plungers, the water passes in nearly a straight course from the suction chamber to the delivery chamber.

The valves consist of small discs of rubber or other suitable material, and are readily accessible through convenient handholes.

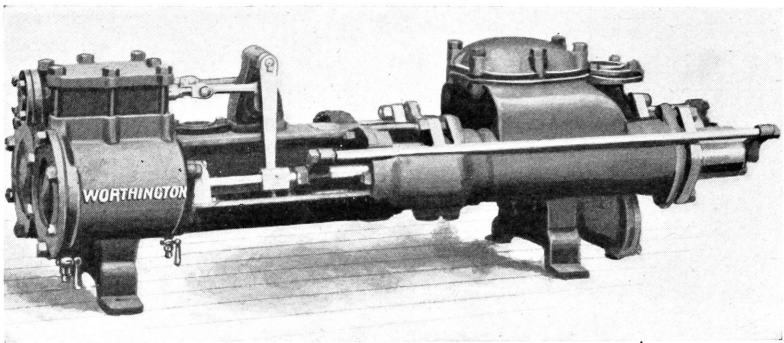
In the Piston Pattern Pump there is a packed water piston, "G," working in a brass lined cylinder, "H." Both the suction and discharge valves are located above the water pistons, so that the pistons may be at all times submerged. The valve areas and water passages are large, and special care is taken to have all the internal parts easily accessible for inspection and repairs.

This pattern is recommended where the liquid to be pumped contains small quantities of grit or foreign material, or where there is an unusually long or high suction lift. In both arrangements all the moving parts are made to gauge, and can be readily renewed.

THE WORTHINGTON BOILER FEED PUMP



PISTON PATTERN, SIZE 6 x 4 x 6



RAM PATTERN, SIZE 7½ x 5 x 6

THE WORTHINGTON BOILER FEED PUMP

PISTON PATTERN, GOOD FOR 150 LBS. PRESSURE

These pumps are fitted with packed water pistons of iron or brass, as may be required, operating in brass-lined cylinders. The water valves are of brass or hard composition, and are controlled by brass cylindrical springs, held in place by guards of the same material.

While nearly all of the Plunger and Ring pumps for general service, given in the list on page 13, and the Piston pumps on page 19, may be used for boiler feeding, yet the following sizes are selected as being those best proportioned for that particular service:

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Horse Power of Boiler, based on 30 pounds of water per hour, which the pump will supply with ease.	Diameter of Pistons 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.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
2	1⅛	2¾	35	1⅝	⅜	½	1	¾	Fabagella
3	2	3	100	3	⅜	½	1¼	1	Fabaginis
4½	2¾	4	200	4	½	¾	2	1½	Fabalibus
5¼	3½	5	400	5	¾	1¼	2½	1½	Fabatarium
6	4	6	550	5⅝	1	1¼	3	2	Fabatorum
7½	5	6	800	7¼	1½	2	4	3	Fabbrico
7½	4½	10	950	6⅜	1½	2	4	3	Fabbro
9	5¼	10	1300	7½	1½	2	4	3	Fabella
10	6	10	1700	8½	2	2½	5	4	Fabelland

RAM PATTERN, GOOD FOR 175 LBS. PRESSURE

These pumps are offered to supply the demand for an outside packed Plunger pump of lighter construction than the pressure pattern on page 11. The water end is a combination of the regular piston pattern and the pressure pattern, having valve chamber like the former and plungers like the latter.

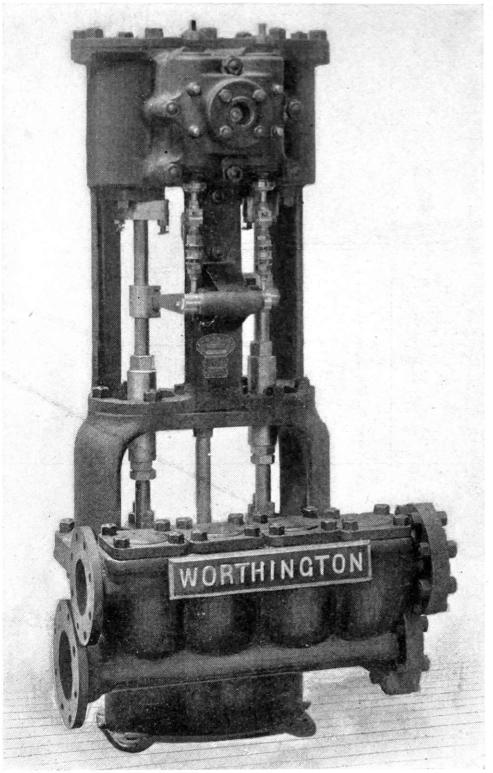
The water cylinders are so designed that all air pockets are avoided when the pump is working in a vertical position, and it will do as satisfactory work in that position as when working horizontally.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Horse Power of Boiler, based on 30 pounds of water per hour, which the pump will supply with ease.	Diameter of Plungers 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.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
4½	2¾	4	200	4	½	¾	2	1½	Fabelreich
5¼	3½	5	400	5	¾	1¼	2½	1½	Fabelsage
6	4	6	550	5⅝	1	1¼	3	2	Fabelwelt
7½	5	6	750	7¼	1½	2	4	3	Fable

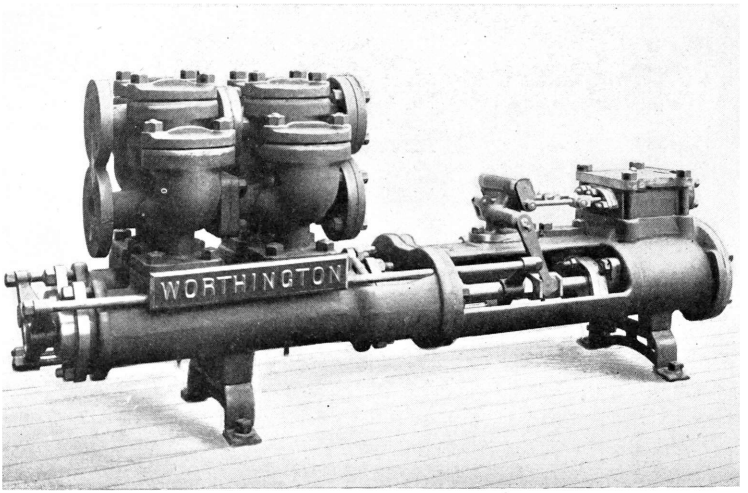
A slight additional charge is made when Pumps are fitted with Brass Plungers or Water Pistons and Piston Rods.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, or Pistons and length of stroke.

THE WORTHINGTON BOILER FEED PUMP



ADMIRALTY PATTERN, SIZE 7½ x 5 x 6



PRESSURE PATTERN, SIZE 6 x 3½ x 6

THE WORTHINGTON BOILER FEED PUMP

ADMIRALTY PATTERN, FOR 250 LBS. PRESSURE

This form of pump was designed to meet the requirements of the British Admiralty, and has since been modified to conform, at the same time, to the views of the United States Bureau of Steam Engineering.

The steam end is of the well-known Worthington type, but embodies some of the latest patented features. The ordinary slide valves have in the case of this design been substituted by improved piston valves with outside adjustable lost motion links, making it possible to readily adjust the stroke. The water end is made of composition, gun metal, or cast iron sufficiently strong to work against a pressure of 250 pounds. When made of cast iron the water end is thoroughly brass fitted.

In accordance with the latest practice, these pumps are intended to run without cylinder lubrication.

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Horse Power of Boiler, based on 30 pounds of water per hour, which the pump will supply with ease.	Diameter of Pistons 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.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
4½	3	4	400	4¼	½	¾	2	2	Fablier
5¼	3½	5	550	5	¾	1¼	2½	2½	Fabordones
6	4	6	750	5⅝	1	1¼	4	3	Fabrefacto
6	4½	6	1000	6⅜	1	1¼	4	3	Fabricaba
7½	5	6	1200	7⅛	1½	2	5	4	Fabricamos
9	6	6	1700	8½	1½	2	5	4	Fabrikland
7½	4½	10	1400	6⅜	1½	2	4	3	Fabrilibus
9	6	10	2100	8½	2	2½	5	4	Fabrique
10	7	10	2900	9⅞	2	2½	6	5	Fabriremus
12	8½	10	4200	12	2½	3	6	5	Fabrizio
12	9¼	10	5000	13	2½	3	6	5	Fabulabunt
14	10	15	7000	14	2½	3	8	6	Fabulas

PRESSURE PATTERN, GOOD FOR 300 LBS. PRESSURE

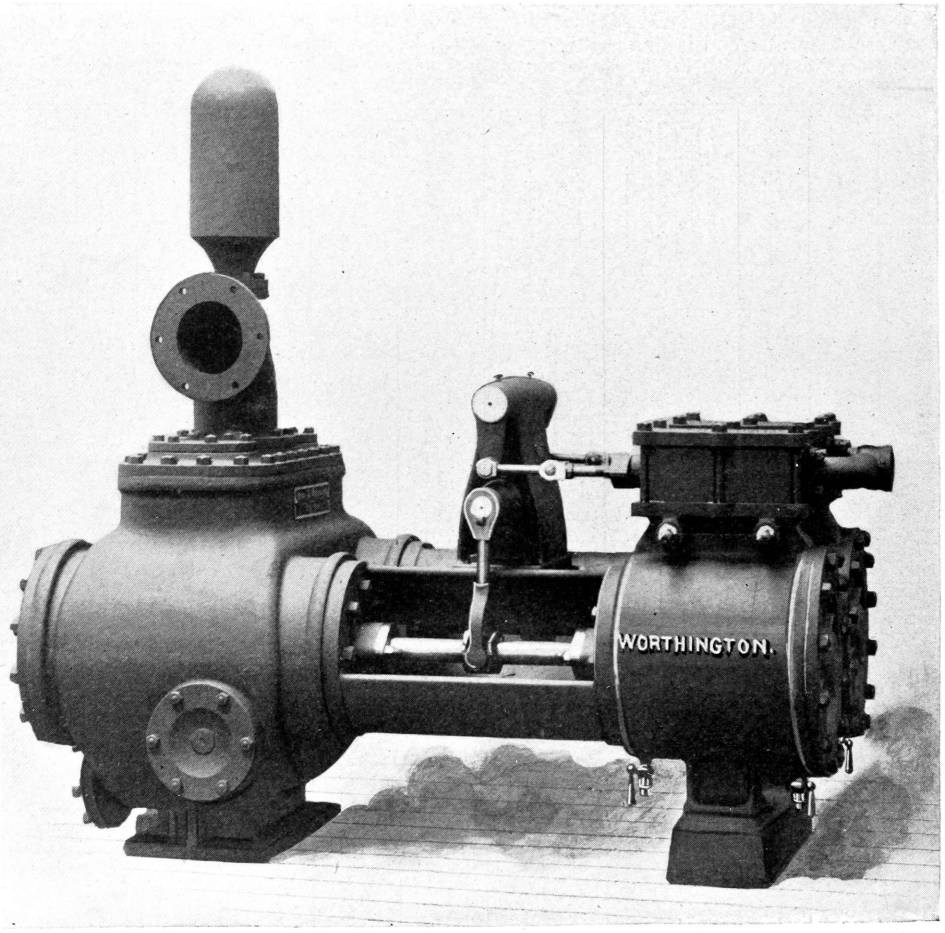
These pumps have four single acting outside packed water plungers, working through adjustable stuffing boxes into the ends of the water cylinders. The valves are of brass, guided from below by wings and controlled by composition springs, and are located in separate valve chambers or pots designed to withstand the heavy pressures to which this pump may be subjected.

4½	2	4	125	3¼	½	¾	1½	1¼	Fabuleggia
5¼	3	5	300	4¼	¾	1¼	2½	2	Fabulisant
6	3½	6	400	5	1	1¼	2½	2	Facessunt
7½	4½	6	550	5⅝	1½	2	4	3	Fabulonis
7½	4¼	10	850	6	1½	2	4	3	Fabulum
9	5	10	1150	7¼	2	2½	4	3	Faccenda
10	6	10	1700	8½	2	2½	6	5	Faccettina
12	7½	10	2500	10½	2½	3	6	5	Faccia
12	7½	15	3000	10½	2½	3	6	5	Faccioso
14	8½	15	4500	12	2½	3	8	7	Facemmo
17	10	15	6000	14	2½	3½	8	7	Facesse

A slight additional charge is made when Pumps are fitted with Brass Plungers.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers or Pistons and length of stroke.

THE WORTHINGTON PLUNGER AND RING PATTERN PUMP
FOR GENERAL SERVICE



SIZE, 16 x 10¼ x 10

THE WORTHINGTON PLUNGER AND RING PATTERN PUMP FOR GENERAL SERVICE

The cut on the opposite page illustrates the Worthington Pump of the Plunger and Ring Pattern, as described on page 7. These pumps are designed for boiler feeding, fire, hydraulic elevator, and general service, where the water pressure does not exceed 150 lbs.

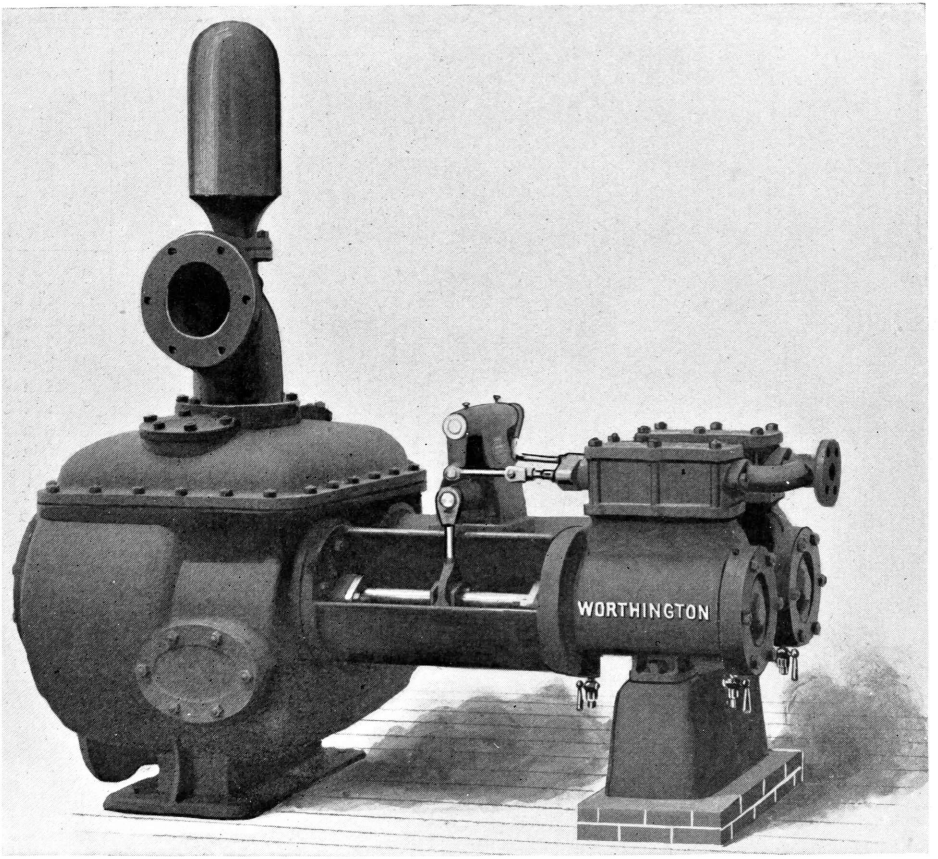
The stated capacities of the pumps given below are based upon a piston travel of about 50 to 125 feet per minute. In case of fire or other emergency this speed can be considerably increased.

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, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
7½	4½	10	.69	75 to 125	100 to 170	6⅜	1½	2	4	3	Gabado
9	5¼	10	.93	75 " 125	135 " 230	7½	1½	2	4	3	Gabalos
10	6	10	1.22	75 " 125	180 " 300	8½	2	2½	5	4	Gabate
10	7	10	1.66	75 " 125	245 " 410	9⅞	2	2½	6	5	Gabbammo
12	7	10	1.66	75 " 125	245 " 410	9⅞	2½	3	6	5	Gabbavate
14	7	10	1.66	75 " 125	245 " 410	9⅞	2½	3	6	5	Gabbia
12	8½	10	2.45	75 " 125	365 " 610	12	2½	3	6	5	Gabbolla
14	8½	10	2.45	75 " 125	365 " 610	12	2½	3	6	5	Gabeln
16	8½	10	2.45	75 " 125	365 " 610	12	2½	3	6	5	Gabilla
18½	8½	10	2.45	75 " 125	365 " 610	12	3	3½	6	5	Gabinho
20	8½	10	2.45	75 " 125	365 " 610	12	4	5	6	5	Gabkar
12	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	3	8	7	Gabrito
14	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	3	8	7	Gaddi
16	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	3	8	7	Gaden
18½	10¼	10	3.57	75 " 125	530 " 890	14¼	3	3½	8	7	Gadfly
20	10¼	10	3.57	75 " 125	530 " 890	14¼	4	5	8	7	Gaffern
14	12	10	4.89	75 " 125	730 " 1220	17	2½	3	10	8	Gagner
16	12	10	4.89	75 " 125	730 " 1220	17	2½	3	10	8	Gagosa
18½	12	10	4.89	75 " 125	730 " 1220	17	3	3½	10	8	Gaillard
20	12	10	4.89	75 " 125	730 " 1220	17	4	5	10	8	Gainsaid
18½	14	10	6.66	75 " 125	990 " 1660	19¾	3	3½	12	10	Galago
20	14	10	6.66	75 " 125	990 " 1660	19¾	4	5	12	10	Galasia
14	10	15	5.10	75 " 125	510 " 1020	14	2½	3	8	7	Galaxy
17	10	15	5.10	50 " 100	510 " 1020	14	2½	3½	8	7	Galifet
20	10	15	5.10	75 " 125	510 " 1020	14	4	5	8	7	Galimo
17	11	15	6.20	50 " 100	620 " 1240	15½	2½	3½	10	8	Garnish
20	11	15	6.20	50 " 100	620 " 1240	15½	4	5	10	8	Garter
20	12	15	7.34	50 " 100	730 " 1460	17	4	5	12	10	Gastric
20	15	15	11.47	50 " 100	1145 " 2290	21					Gavel
25	15	15	11.47	50 " 100	1145 " 2290	21					Gender

A slight additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods. An extra charge is also made for Bed-plates.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON PLUNGER AND RING PATTERN PUMP
FOR TANK OR LIGHT SERVICE



SIZE, 7½ x 10¼ x 10

THE WORTHINGTON PLUNGER AND RING PATTERN PUMP

FOR TANK OR LIGHT SERVICE

These machines are designed for use in connection with Railroad Water Stations, Oil Tanks, Oil Refineries, and other places where fluid is to be raised to a moderate height with ordinary steam pressure. See page 73 for pumps and boilers combined, suitable for this service.

These patterns are of the same general form and interior construction as those shown on pages 6 and 94, but have plungers 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 an "end feed" attached to the end of one of the water cylinders. See illustration on page 72.

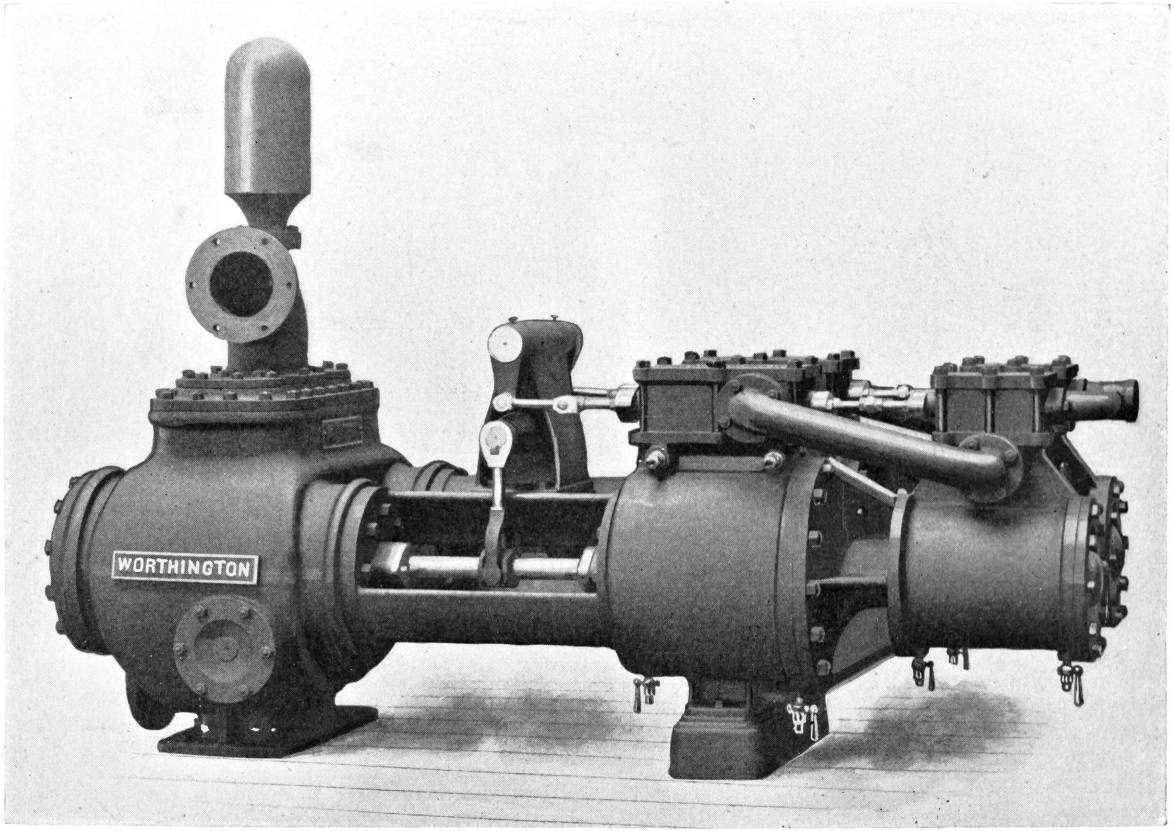
In any emergency the speed of the pumps may be considerably increased beyond the figures stated in the list.

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, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
7 ½	6	10	1.22	75 to 125	180 to 300	8 ½	1 ½	2	5	4	Genius
7 ½	7	10	1.66	75 " 125	245 " 410	9 ⅞	1 ½	2	6	5	Gentry
7 ½	8 ½	10	2.45	75 " 125	365 " 610	12	1 ½	2	6	5	Geology
9	8 ½	10	2.45	75 " 125	365 " 610	12	2	2 ½	6	5	Geometry
7 ½	10 ¼	10	3.57	75 " 125	530 " 890	14 ¼	1 ½	2	8	7	Gestation
10	10 ¼	10	3.57	75 " 125	530 " 890	14 ¼	2	2 ½	8	7	Ghastly
9	12	10	4.89	75 " 125	730 " 1220	17	2	2 ½	10	8	Giant
12	12	10	4.89	75 " 125	730 " 1220	17	2 ½	3	10	8	Giblet
7 ½	14	10	6.66	75 " 125	990 " 1660	19 ¾	1 ½	2	12	10	Giddy
10	14	10	6.66	75 " 125	990 " 1660	19 ¾	2	2 ½	12	10	Gigantic
12	14	10	6.66	75 " 125	990 " 1660	19 ¾	2 ½	3	12	10	Ginger
14	14	10	6.66	75 " 125	990 " 1660	19 ¾	2 ½	3	12	10	Gingerly
16	14	10	6.66	75 " 125	990 " 1660	19 ¾	2 ½	3	12	10	Glacial
10	15	15	11.47	50 " 100	1145 " 2290	21	2	2 ½	14	12	Glacier
12	15	15	11.47	50 " 100	1145 " 2290	21	2 ½	3	14	12	Glamour
14	15	15	11.47	50 " 100	1145 " 2290	21	2 ½	3	14	12	Glassing
17	15	15	11.47	50 " 100	1145 " 2290	21	2 ½	3 ½	14	12	Glisten
17	17	15	14.74	50 " 100	1470 " 2940	24	2 ½	3 ½	14	12	Globe
20	17	15	14.74	50 " 100	1470 " 2940	24	4	5	14	12	Gloomy

A slight additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods. An extra charge is also made for Bed-plates.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON COMPOUND STEAM PUMP
PLUNGER AND RING PATTERN



SIZE, 10 & 16 x 8½ x 10

THE WORTHINGTON COMPOUND STEAM PUMP

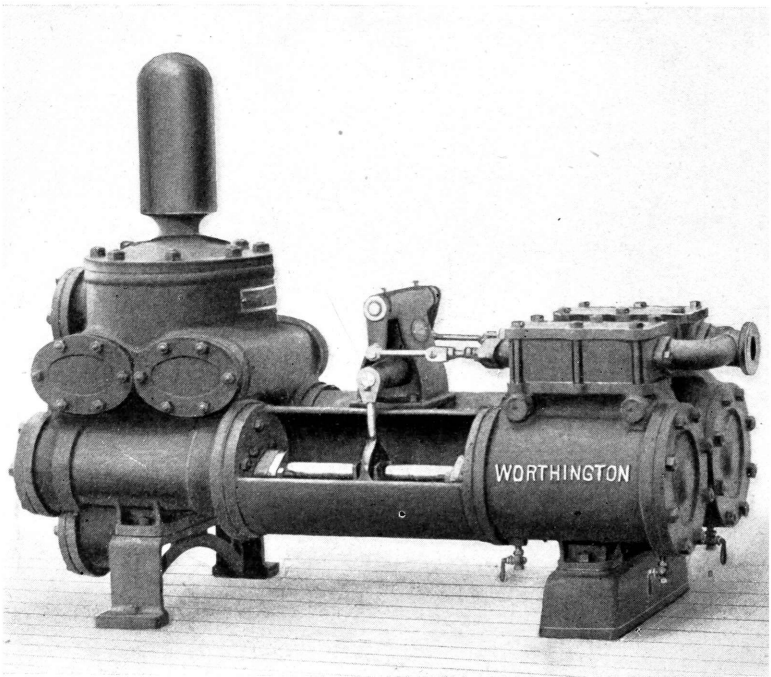
PLUNGER AND RING PATTERN

In the arrangement of steam cylinders here employed the steam is used expansively, which cannot be done in the ordinary form. Having exerted its force through one stroke, upon the smaller steam piston, it 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. Compound cylinders are recommended in any service where the saving of fuel is an important consideration. In such cases their greater first cost is fully justified, as they require 30 to 33 per cent. less coal than any high-pressure form, on the same work. On the larger sizes a condensing apparatus is often added, thus securing the highest economical results. Compound cylinders are 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. When required, the speed of the pumps may be considerably increased beyond the figures stated in the list.

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, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
5¼ to 7½	4½	10	.69	75 to 125	100 to 170	6⅜	1¼	2	4	3	Glorify
6 " 9	5¼	10	.93	75 " 125	135 " 230	7½	1¼	2½	4	3	Glory
6 " 9	6	10	1.22	75 " 125	180 " 300	8½	1¼	2½	5	4	Glossary
6 " 9	7	10	1.66	75 " 125	245 " 410	9⅞	1¼	2½	6	5	Glossoma
8 " 12	7	10	1.66	75 " 125	245 " 410	9⅞	2	3	6	5	Glotora
9 " 14	7	10	1.66	75 " 125	245 " 410	9⅞	2	3	6	5	Glotta
6 " 9	8½	10	2.45	75 " 125	365 " 610	12	1¼	2½	6	5	Glowworm
8 " 12	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	5	Glucose
9 " 14	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	5	Gluer
10 " 16	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	5	Gluptos
12 " 18½	8½	10	2.45	75 " 125	365 " 610	12	2½	3½	6	5	Glutino
14 " 20	8½	10	2.45	75 " 125	365 " 610	12	2½	5	6	5	Glutron
8 " 12	10¼	10	3.57	75 " 125	530 " 890	14¼	2	3	8	7	Gluttony
9 " 14	10¼	10	3.57	75 " 125	530 " 890	14¼	2	3	8	7	Gobelet
10 " 16	10¼	10	3.57	75 " 125	530 " 890	14¼	2	3	8	7	Gobons
12 " 18½	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	3½	8	7	Godelon
14 " 20	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	5	8	7	Godown
8 " 12	12	10	4.89	75 " 125	730 " 1220	17	2	3	10	8	Godsend
9 " 14	12	10	4.89	75 " 125	730 " 1220	17	2	3	10	8	Godson
10 " 16	12	10	4.89	75 " 125	730 " 1220	17	2	3	10	8	Goffo
12 " 18½	12	10	4.89	75 " 125	730 " 1220	17	2½	3½	10	8	Golbery
14 " 20	12	10	4.89	75 " 125	730 " 1220	17	2½	5	10	8	Golden
10 " 16	14	10	6.66	75 " 125	990 " 1660	19¾	2	3	12	10	Goldenly
12 " 18½	14	10	6.66	75 " 125	990 " 1960	19¾	2½	3½	12	10	Goldfish
14 " 20	14	10	6.66	75 " 125	990 " 1660	19¾	2½	5	12	10	Goldney
9 " 14	10	15	5.10	50 " 150	510 " 1020	14	2	3	8	7	Goldrand
12 " 17	10	15	5.10	50 " 150	510 " 1020	14	2½	3½	8	7	Goldstein
14 " 20	10	15	5.10	50 " 150	510 " 1020	14	2½	5	8	7	Golfos
9 " 14	11	15	6.20	50 " 150	620 " 1240	15½	2	3	10	8	Golosas
12 " 17	11	15	6.20	50 " 150	620 " 1240	15½	2½	3½	10	8	Goloso
14 " 20	11	15	6.20	50 " 150	620 " 1240	15½	2½	5	10	8	Gomare
14 " 20	12	15	7.34	50 " 150	730 " 1460	17	2½	5	12	10	Gomelin
12 " 17	15	15	11.47	50 " 150	1145 " 2290	21	..	..	..	..	Gomosia
14 " 20	15	15	11.47	50 " 150	1145 " 2290	21	..	..	..	..	Goodman
16 " 25	15	15	11.47	50 " 150	1145 " 2290	21	..	..	..	..	Goodness
14 " 20	17	15	14.74	50 " 150	1470 " 2940	24	..	..	..	..	Gordos

A slight additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods. An extra charge is also made for Bed-plates.

THE WORTHINGTON PISTON PUMP
FOR GENERAL SERVICE



SIZE, 10 x 6 x 10

THE WORTHINGTON PISTON PUMP

FOR GENERAL SERVICE

The cut on the opposite page illustrates the Worthington Pump of the Piston Pattern, designed for boiler feeding, fire, hydraulic elevator, and general service where the water pressure does not exceed 150 pounds. This pattern should be used where the liquid to be pumped contains small quantities of grit or foreign material, or where there is an unusually long or high suction lift, and a foot valve cannot be used.

The water cylinders are composition lined, and have adjustable packed pistons. The water valves are so arranged that the water pistons are at all times submerged. The valve areas and water passages are large, and special care has been taken to have all the parts easily accessible for inspection or repairs. See description, page 7.

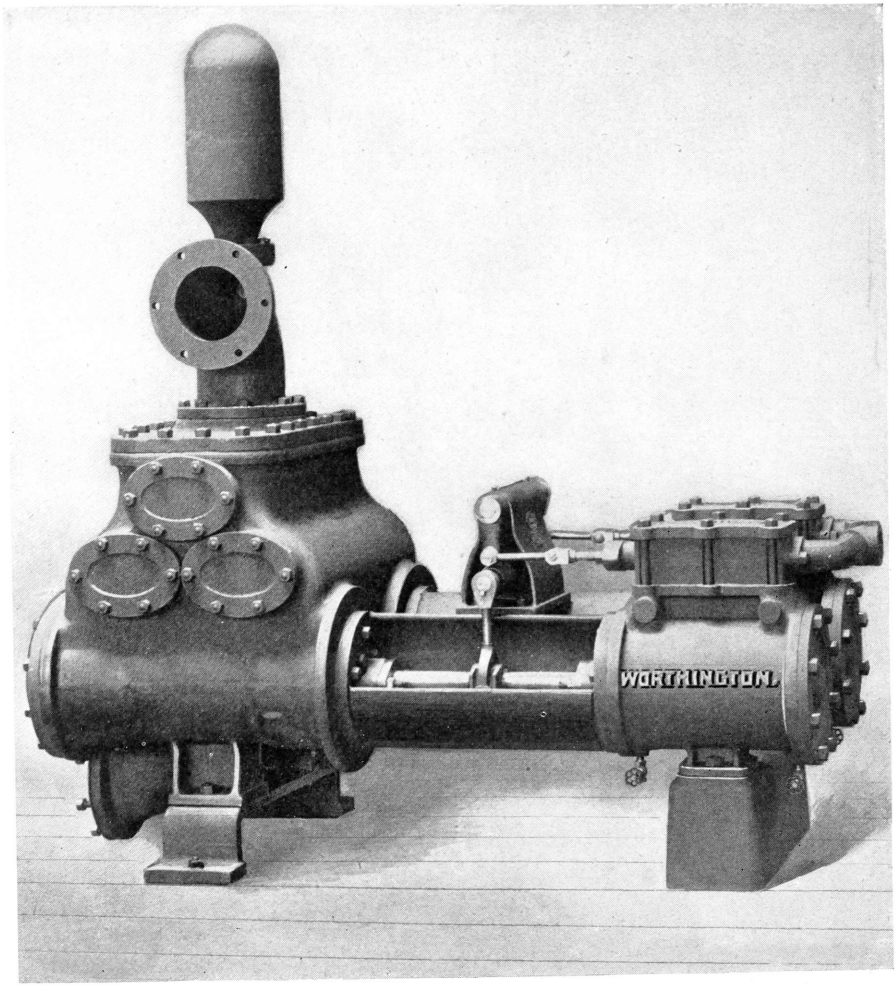
Diameter of Steam Cylinders.	Diameter of Water Piston.	Length of Stroke.	Displacement in Gallons per stroke of ONE Piston.	Proper strokes per minute of ONE Piston, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Pistons at stated number of strokes.	Diameter of Piston required 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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
2	1 1/8	2 3/4	.013	100 to 300	2 to 7	1 3/8	3/8	1/2	1	3/4	Habgier
3	2	3	.04	100 " 250	8 " 20	2 7/8	3/8	1/2	1 1/4	1	Habitile
4 1/2	2 3/4	4	.10	100 " 200	20 " 40	4	1/2	3/4	2	1 1/2	Habiz
5 1/4	3 1/2	5	.20	100 " 200	40 " 80	5	3/4	1 1/4	2 1/2	1 1/2	Hablilla
6	4	6	.33	100 " 150	70 " 100	5 5/8	1	1 1/2	3	2	Hachage
7 1/2	5	6	.51	100 " 150	100 " 150	7	1 1/2	2	4	3	Hacke
9	5	6	.51	100 " 150	100 " 150	7	1 1/2	2	4	3	Hackster
7 1/2	4 1/2	10	.69	75 " 125	100 " 170	6 3/8	1 1/2	2	4	3	Hadbote
9	5 1/4	10	.93	75 " 125	135 " 230	7 1/2	1 1/2	2	4	3	Haften
10	5 1/4	10	.93	75 " 125	135 " 230	7 1/2	2	2 1/2	5	4	Hagedis
10	6	10	1.22	75 " 125	180 " 300	8 1/2	2	2 1/2	5	4	Hagelwit
12	6	10	1.22	75 " 125	180 " 300	8 1/2	2 1/2	3	6	5	Haggle
14	6	10	1.22	75 " 125	180 " 300	8 1/2	2 1/2	3	6	5	Hagnon
10	7	10	1.66	75 " 125	245 " 410	9 7/8	2	2 1/2	6	6	Hailstone
12	7	10	1.66	75 " 125	245 " 410	9 7/8	2 1/2	3	6	6	Hairoche
14	7	10	1.66	75 " 125	245 " 410	9 7/8	2 1/2	3	6	6	Halbnarr
12	7 1/2	10	1.91	75 " 125	285 " 480	10 1/4	2 1/2	3	6	6	Halbthor
14	7 1/2	10	1.91	75 " 125	285 " 480	10 1/4	2 1/2	3	6	6	Halener
16	7 1/2	10	1.91	75 " 125	285 " 480	10 1/4	2 1/2	3	6	6	Halfhout
16	8	10	2.17	75 " 125	300 " 540	11 1/4	2 1/2	3	6	6	Hallmotes
12	8 1/2	10	2.45	75 " 125	365 " 610	12	2 1/2	3	6	6	Halogene
14	8 1/2	10	2.45	75 " 125	365 " 610	12	2 1/2	3	6	6	Haloque
16	8 1/2	10	2.45	75 " 125	365 " 610	12	2 1/2	3	6	6	Halsbein
18 1/2	8 1/2	10	2.45	75 " 125	365 " 610	12	3	3 1/2	6	6	Halsed
20	8 1/2	10	2.45	75 " 125	365 " 610	12	4	5	6	6	Haltbar
14	9 1/4	10	2.90	75 " 125	400 " 700	13	2 1/2	3	8	7	Haltort
16	9 1/4	10	2.90	75 " 125	400 " 700	13	2 1/2	3	8	7	Halyde
18 1/2	9 1/4	10	2.90	75 " 125	400 " 700	13	3	3 1/2	8	7	Hamac
20	9 1/4	10	2.90	75 " 125	400 " 700	13	4	5	8	7	Hamaxa

A slight additional charge is made when Pumps are fitted with Brass Pistons and Piston Rods. An extra charge is also made for Bed-plates.

To designate the sizes, give the diameters of Steam Cylinders and Water Pistons and length of stroke.

THE WORTHINGTON PISTON PUMP

FOR TANK OR LIGHT SERVICE



SIZE, 9 x 8½ x 10

THE WORTHINGTON PISTON PUMP
FOR TANK OR LIGHT SERVICE

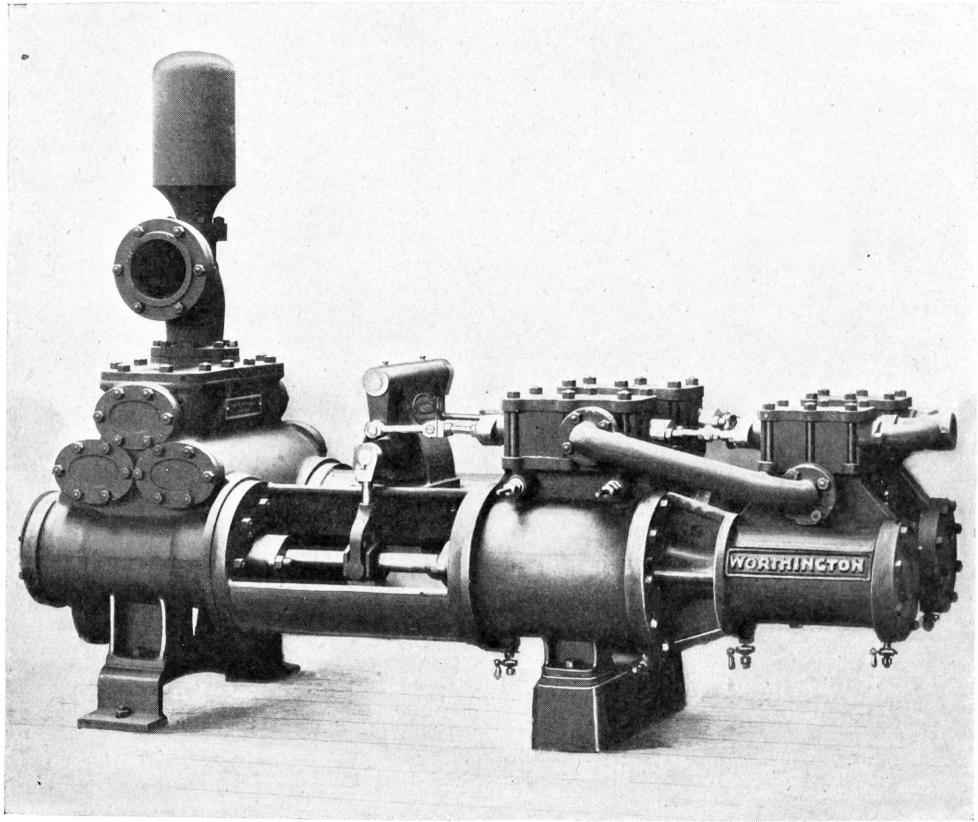
This pattern of pump is precisely like that shown on page 18, except that the steam cylinders are made smaller in diameter in proportion to the water pistons, being designed for raising liquids to moderate heights with ordinary steam pressure. This design is intended for use at railway water stations, breweries, distilleries, gas and oil works, tanneries, bleacheries, refineries, etc. The valves are made of material suitable to the liquid to be pumped.

Diameter of Steam Cylinders.	Diameter of Water Piston.	Length of Stroke.	Displacement in Gallons per stroke of ONE Piston.	Proper strokes per minute of ONE Piston, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Pistons at stated number of strokes.	Diameter of Piston 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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
3	2 ¾	3	.07	100 to 250	15 to 37	4	⅜	½	1¼	1	Hambrear
4½	3¾	4	.20	100 " 200	40 " 80	5¼	½	¾	2½	1½	Hamiform
5¼	4¾	5	.38	100 " 150	75 " 110	6¾	¾	1¼	3	2	Hamster
6	5¾	6	.67	100 " 150	130 " 195	8⅛	1	1¼	4	3	Hanche
7½	5¾	6	.67	100 " 150	130 " 195	8⅛	1½	2	4	3	Handicap
6	7½	6	1.14	100 " 150	225 " 340	10¼	1	1¼	6	5	Handiness
7½	7½	6	1.14	100 " 150	225 " 340	10¼	1½	2	6	5	Handjar
6	8½	6	1.47	100 " 150	295 " 440	12	1	1¼	6	5	Harangue
7½	8½	6	1.47	100 " 150	295 " 440	12	1½	2	6	5	Harbor
7½	6	10	1.22	75 " 125	180 " 300	8½	1½	2	5	4	Harden
10	6	10	1.22	75 " 125	180 " 300	8½	2	2½	5	4	Harmala
7½	7	10	1.66	75 " 125	245 " 410	9⅞	1½	2	6	5	Harping
10	7	10	1.66	75 " 125	245 " 410	9⅞	2	2½	6	5	Harrow
7½	8½	10	2.45	75 " 125	365 " 610	12	1½	2	6	5	Hartshorn
9	8½	10	2.45	75 " 125	365 " 610	12	2	2½	6	5	Hatter
10	8½	10	2.45	75 " 125	365 " 610	12	2	2½	6	5	Hawker
7½	10¼	10	3.57	75 " 125	530 " 890	14¼	1½	2	8	7	Headland
9	10¼	10	3.57	75 " 125	530 " 890	14½	2	2½	8	7	Headlight
10	10¼	10	3.57	75 " 125	530 " 890	14¼	2	2½	8	7	Heartily
12	10¼	10	3.57	75 " 125	530 " 890	14¼	2½	3	8	7	Hectic
9	12	10	4.89	75 " 125	730 " 1220	17	2	2½	10	8	Heedfully
12	12	10	4.89	75 " 125	730 " 1220	17	2½	3	10	8	Heedily
14	12	10	4.89	75 " 125	730 " 1220	17	2½	3	10	8	Heediness
10	14	10	6.66	75 " 125	990 " 1660	19¾	2	2½	12	10	Heedlessly
12	14	10	6.66	75 " 125	990 " 1660	19¾	2½	3	12	10	Heeling
14	14	10	6.66	75 " 125	990 " 1660	19¾	2½	3	12	10	Heighton
12	15	10	7.60	75 " 125	1140 " 1900	21	2½	3	12	10	Heinous
14	15	10	7.60	75 " 125	1140 " 1900	21	2½	3	12	10	Heinously
16	15	10	7.60	75 " 125	1140 " 1900	21	2½	3	12	10	Heirdom
12	14	15	10.00	50 " 100	1000 " 2000	19¾	2½	3	12	10	Heirloom
14	14	15	10.00	50 " 100	1000 " 2000	19¾	2½	3	12	10	Heirship
12	15	15	11.47	50 " 100	1145 " 2290	21	2½	3	12	10	Helaron
14	15	15	11.47	50 " 100	1145 " 2290	21	2½	3	12	10	Helcose
17	15	15	11.47	50 " 100	1145 " 2290	21	2½	3½	12	10	Hellward
12	17	15	14.74	50 " 100	1470 " 2940	24	2½	3	14	12	Helpers
14	17	15	14.74	50 " 100	1470 " 2940	24	2½	3	14	12	Helpful
17	17	15	14.74	50 " 100	1470 " 2940	24	2½	3½	14	12	Helpless
14	19	15	19.39	50 " 100	1940 " 3880	26⅞	2½	3	14	12	Helplessly
17	19	15	19.39	50 " 100	1940 " 3880	26⅞	2½	3½	14	12	Helpmate
20	19	15	19.39	50 " 100	1940 " 3880	26⅞	4	5	14	12	Helpmeets
14	22	15	24.68	50 " 100	2470 " 4950	31	2½	3	16	14	Hemifacial
17	22	15	24.68	50 " 100	2470 " 4950	31	2½	3½	16	14	Hemlock
20	22	15	24.68	50 " 100	2470 " 4950	31	4	5	16	14	Henceforth

A slight additional charge is made when Pumps are fitted with Brass Pistons and Piston Rods. An extra charge is also made for Bed-plates.

To designate the sizes, give the diameters of Steam Cylinders and Water Pistons, and length of stroke.

THE WORTHINGTON COMPOUND STEAM PUMP, PISTON PATTERN, FOR GENERAL SERVICE



SIZE, 8 & 12 x 7 x 10

THE WORTHINGTON COMPOUND STEAM PUMP

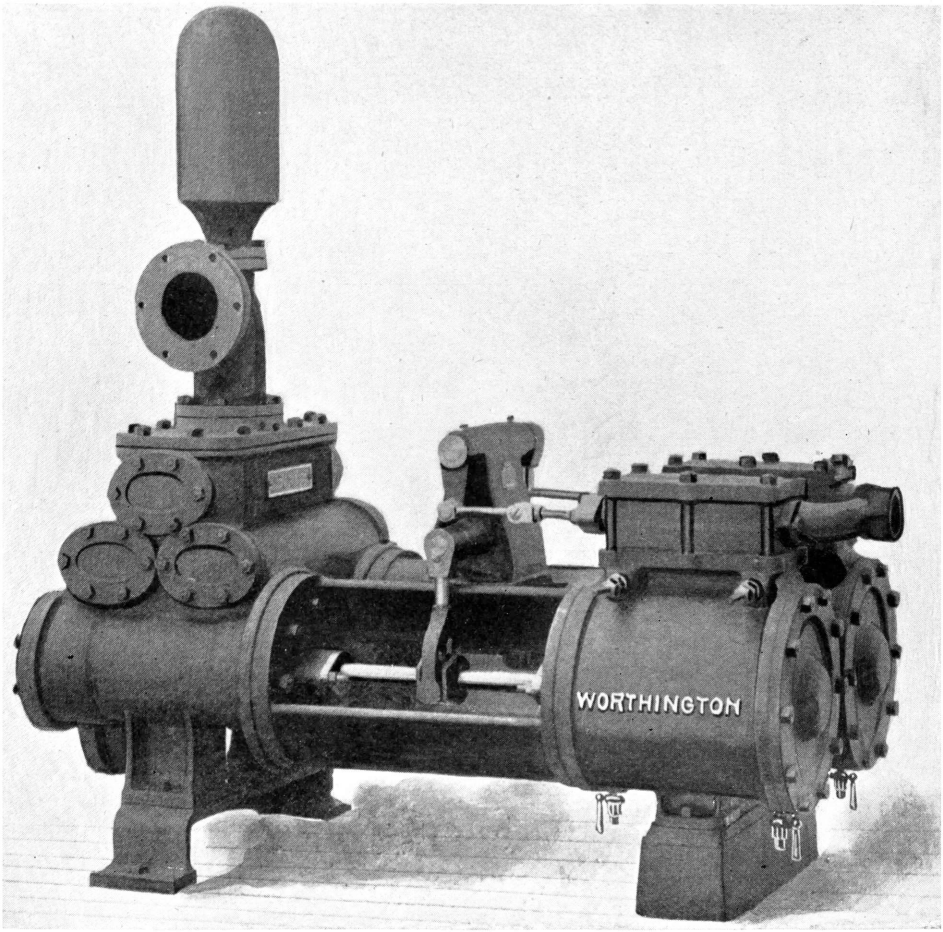
PISTON PATTERN, FOR GENERAL SERVICE

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Displacement in Gallons per stroke of ONE Piston.	Proper strokes per minute of ONE Plunger, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
5¼ & 7½	5	6	.51	100 to 150	100 to 150	7	1	2	4	3	Henchboy
6 " 9	5	6	.51	100 " 150	100 " 150	7	1	2	4	3	Henchman
5¼ " 7½	4½	10	.54	75 " 125	100 " 170	5⅝	1¼	2	5	4	Henkel
6 " 9	4½	10	.54	75 " 125	100 " 170	5⅝	1¼	2½	5	4	Henotic
5¼ " 7½	5¼	10	.93	75 " 125	135 " 230	7½	1¼	2	5	4	Henpeck
6 " 9	5¼	10	.93	75 " 125	135 " 230	7½	1¼	2½	5	4	Henpecked
6 " 9	6	10	1.22	75 " 125	180 " 300	8½	1¼	2½	6	5	Henpecking
8 " 12	6	10	1.22	75 " 125	180 " 300	8½	2	3	6	5	Herbarium
9 " 14	6	10	1.22	75 " 125	180 " 300	8½	2	3	6	5	Herbary
6 " 9	7	10	1.66	75 " 125	245 " 410	9⅞	1¼	2½	6	6	Herbicole
8 " 12	7	10	1.66	75 " 125	245 " 410	9⅞	2	3	6	6	Herbst
9 " 14	7	10	1.66	75 " 125	245 " 410	9⅞	2	3	6	6	Herdgroom
8 " 12	7½	10	1.91	75 " 125	285 " 480	10¼	2	3	6	6	Herdmen
9 " 14	7½	10	1.91	75 " 125	285 " 480	10¼	2	3	6	6	Hermitary
10 " 16	7½	10	1.91	75 " 125	285 " 480	10¼	2	3	6	6	Hermitess
12 " 18½	7½	10	1.91	75 " 125	285 " 480	10¼	2½	3½	6	6	Heroines
8 " 12	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	6	Herrings
9 " 14	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	6	Hessian
10 " 16	8½	10	2.45	75 " 125	365 " 610	12	2	3	6	6	Heterodox
12 " 18½	8½	10	2.45	75 " 125	365 " 610	12	2½	3½	6	6	Heteropod
14 " 20	8½	10	2.45	75 " 125	365 " 610	12	2½	5	6	6	Hibernate
9 " 14	9¼	10	2.90	75 " 125	400 " 700	13	2	3	8	7	Hideous
10 " 16	9¼	10	2.90	75 " 125	400 " 700	13	2	3	8	7	Higgle
12 " 18½	9¼	10	2.90	75 " 125	400 " 700	13	2½	3½	8	7	Hilary
14 " 20	9¼	10	2.90	75 " 125	400 " 700	13	2½	5	8	7	Hentengly

A slight additional charge is made when Pumps are fitted with Brass Pistons and Piston Rods.

To designate the sizes give the diameters of Steam Cylinders and Water Pistons, and length of stroke.

THE WORTHINGTON FIRE PUMP



PISTON PATTERN, SIZE 14 x 7 x 10

THE WORTHINGTON FIRE PUMP

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 page 7.)

The advantages of the Worthington fire pump were from the first recognized by the Underwriters of the country, and for some years it was used on fire service to almost the exclusion of every other form.

When the Associated Factory Mutuals adopted the specifications under which the Underwriter pump described on the following page is built, they insisted that the machines should be of the Duplex type, and a close copy of the Worthington fire pump, modified only in such minor details as their experience proved desirable. As a consequence, all of the fire pumps used to-day are close copies of the original Worthington machine.

☞Worthington Fire Pumps, fitted with water pistons instead of plungers, will be furnished when desired. Such modification of the regular pattern is recommended only in cases where a long suction pipe is used, or a high suction lift is to be overcome. The dimensions given below are for Plunger and Ring Pattern. Piston Pattern dimensions are different.

The pumps will also be fitted with two, four and six-way hose connections, when required, at cost.

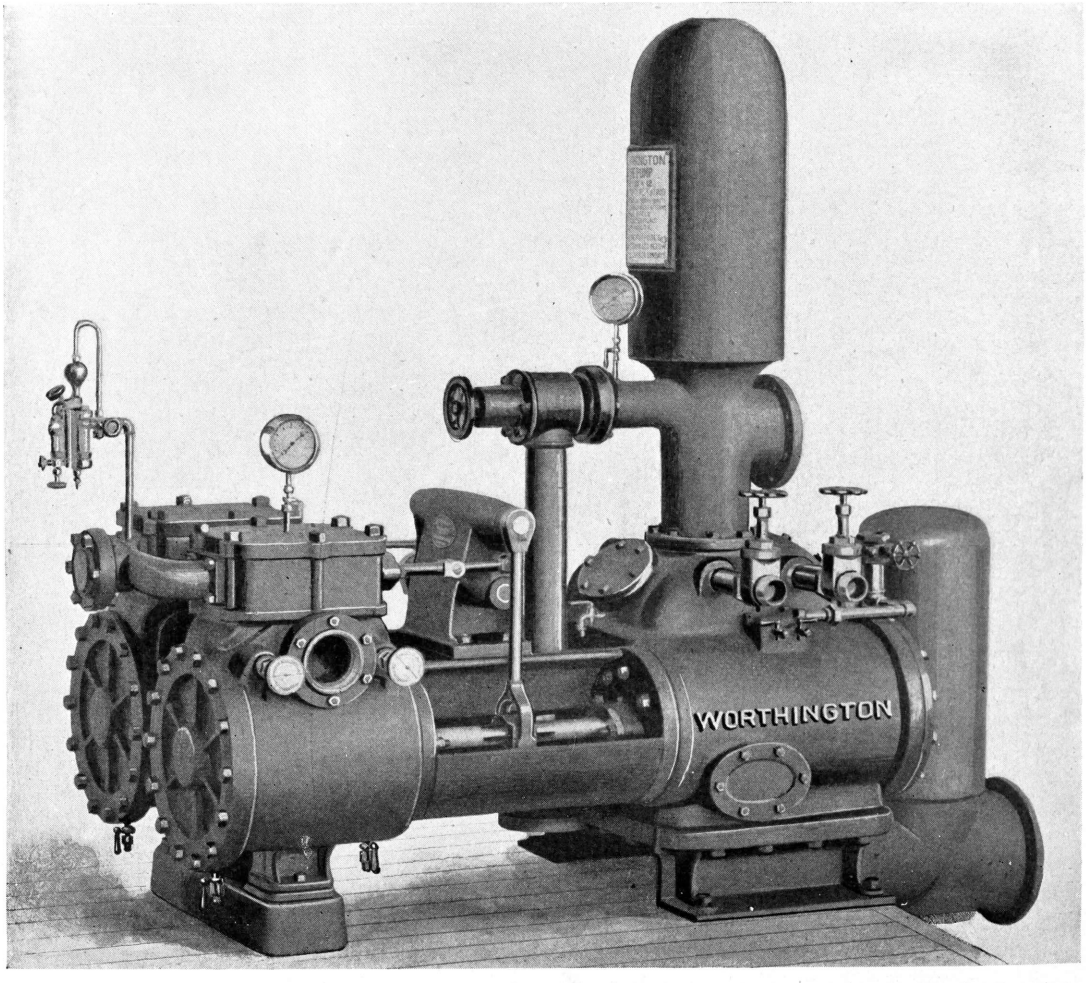
The stated capacities of the pumps of ten-inch stroke given below are based upon a piston travel of about 83 and 125 feet per minute.

LETTER SIZES.	Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Displacement in Gallons per stroke of ONE Plunger.	Strokes per minute of ONE Plunger.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
A	7½	3¾	10	.47	100 to 150	100 to 140	1½	2	4	3	Jabalot
AA	9	4	10	.54	100 " 150	110 " 165	1½	2	4	3	Jabari
B	9	4½	10	.69	100 " 150	140 " 210	1½	2	4	3	Jabler
BB	10	4½	10	.69	100 " 150	140 " 210	2	2½	5	4	Jaboti
C	10	5	10	.85	100 " 150	170 " 250	2	2½	5	5	Jacara
CC	12	5¼	10	.93	100 " 150	190 " 280	2½	3	6	5	Jachtiger
D	12	6	10	1.22	100 " 150	250 " 370	2½	3	6	5	Jachtwet
DD	14	6	10	1.22	100 " 150	250 " 370	2½	3	6	5	Jackal
E	14	7	10	1.66	100 " 150	335 " 500	2½	3	6	6	Jaclard
EE	16	7½	10	1.91	100 " 150	380 " 575	2½	3	6	6	Jacotot
F	16	8	10	2.17	100 " 150	435 " 650	2½	3	6	6	Jadish
FF	18½	8½	10	2.45	100 " 150	490 " 735	3	3½	6	6	Jafetico
G	18½	9¼	10	2.90	100 " 150	560 " 850	3	3½	8	7	Jagden
GG	20	9¼	10	2.90	100 " 150	560 " 850	4	5	8	7	Jagdrift
H	20	10	10	3.4	100 " 150	680 " 1020	4	5	8	7	Jalap
HH	20	11	15	4.1	75 " 125	925 " 1540	4	5	12	10	Jalecos

A slight additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods. An extra charge is also made for Bed-plates.

To designate the sizes, give the letter or the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON UNDERWRITER FIRE PUMP



SIZE, 18 x 10 x 12

THE WORTHINGTON UNDERWRITER FIRE PUMP

The Underwriter Fire Pump is the name adopted by the Associated Factory Mutual Insurance Companies to designate a duplex steam fire pump built in strict accordance with specifications issued by them, and copied in general design after the original Worthington fire pump shown on the preceding page.

These specifications were approved at the Conference of the Associated Companies, and the following resolution was passed:

> "VOTED: To recommend that the so-called 'Underwriter Pattern' of steam fire pump, complete with all attachments, as per specification of June 1st, be recognized as the approved type, and that pumps built and fitted up less perfectly than per this specification be not approved in future installments, except under special circumstances and by special agreement with some executive officer of the insurance companies."

The object in view is to secure to the insurers in these companies a fire pump differing in design and construction from the ordinary trade pumps, and provided with all necessary attachments, so that it can be erected and properly made ready for use without the addition of a number of extra fittings.

By combining with the requirements of these specifications the results of fifty years' experience in the manufacture of this class of machinery, and the intimate knowledge of the duplex valve motion, of which Henry R. Worthington was the inventor and for many years the sole builder, it is confidently claimed that the Worthington Underwriter Pump excels in many particulars all other steam fire pumping apparatus.

This pump, while ordinarily expected to exert a pressure of only one hundred pounds to the square inch, is subjected to a pressure of three hundred pounds, and rigidly tested in other ways. Air and vacuum chambers of large capacity are provided, and, in addition to the necessary number of hose valves, a large delivery opening enables a line of piping to be run to hydrants at a distance, or permits direct connection with the supply pipe of the sprinkler system. These pumps are composition fitted throughout; the piston rods and valve rods, of bronze, are extra heavy, and the stuffing boxes are lined with composition. A large water relief valve, two best quality pressure gauges, a set of brass priming pipes and valves, straightway hose valves, and a sight feed lubricator, as well as all other fittings mentioned in the specifications, are attached to every pump, and are included in the price.

Particular attention is called to the following clause in specifications of Factory Mutual Fire Insurance Companies:

> *"Finally, we remind you that these specifications cover only the outlines of the design, and that all pumps built under them are not of equal merit, for certain of the pump factories possess a broader experience and better shop facilities than others, and that the responsibility for first-class workmanship and strength of materials rests on the pump manufacturers, and not on the Insurance Companies."*

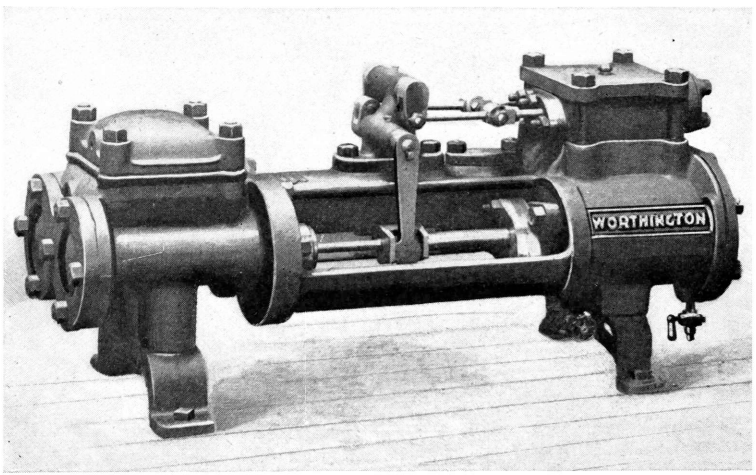
Underwriter's Rating. In gallons, per minute.	No. of 1⅛ inch Smooth Nozzle Fire Streams.	Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
320	1	12	7	10	2½	3	6	5	Jamais
500	2	14	7¼	12	3	4	8	6	Jambon
750	3	16	9	12	3½	4	10	7	Jamlech
1000	4	18	10	12	4	5	12	8	Janella
1500	6	20	12	15	5	6	14	10	Janitrix

The 12 x 7 x 10 pump has the preferred ratio of 3 to 1 between the steam and water cylinders, but it can be furnished with 14 inch steam cylinders, for use in situations where a low steam pressure makes a greater ratio desirable.

A special circular descriptive of this pump will be furnished on application.

HENRY R. WORTHINGTON ALSO MANUFACTURES A FULL LINE OF "CHICAGO UNDERWRITER" AND "INDIANA STANDARD" FIRE PUMPS.

THE WORTHINGTON LOW STEAM-PRESSURE PUMP



SIZE, 6 x 2 x 6

THE WORTHINGTON LOW STEAM-PRESSURE PUMP

In apartment houses, and all public and private buildings, where the "low pressure" system of steam heating is in operation, pumps are required to run with a very moderate pressure of steam. This necessitates different relative proportions of steam cylinders and water plungers from those ordinarily employed. Special patterns are furnished to meet every requirement of such service.

The smooth and noiseless action of the Worthington steam pump renders it particularly preferable for this service, as the shock and jar of any single cylinder pump are, under such circumstances, very objectionable. These pumps are absolutely positive in operation; they require very little attention, and are not liable to get out of order.

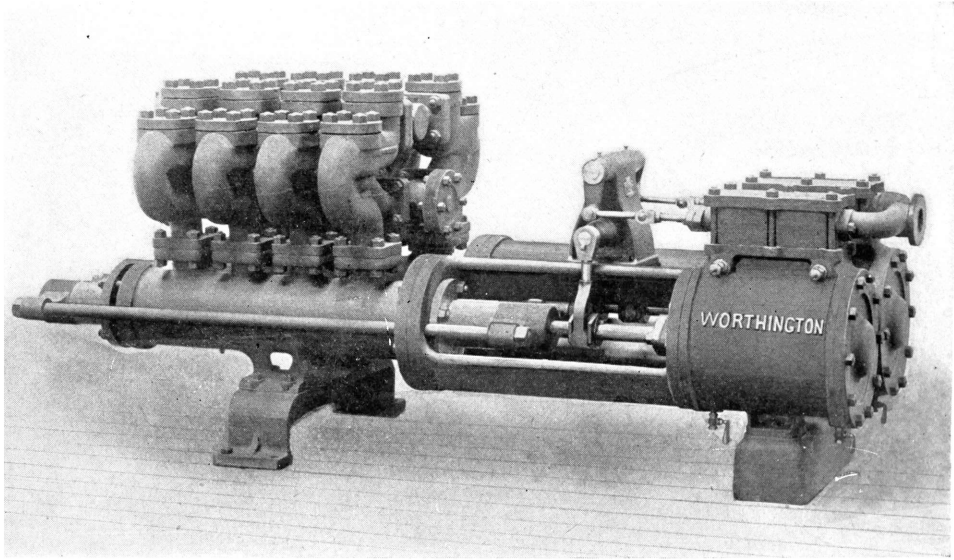
The sizes given in the subjoined list are suitable for pumping against a head of 100 to 125 feet with an effective steam pressure of from five to ten pounds. At a slight additional cost the smaller sizes can be fitted with a hand-power attachment, thereby enabling them to be operated by hand when "steam is down."

The questions on page 4 should be carefully answered when making enquiries about pumps for this service, so that a suitable selection can be made.

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Gallons delivered per hour at moderate speed.	SIZES OF PIPES.				Telegraphic Code Word.
				Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
3	¾	3	50 to 125	⅜	½	1¼	1	Kabelgat
3	1	3	75 " 200	⅜	½	1¼	1	Kabook
4½	1	4	110 " 220	½	¾	2	1½	Kabuff
4½	1¼	4	160 " 320	½	¾	2	1½	Kaffers
5¼	1¼	5	200 " 400	¾	1¼	1½	1	Kahler
5¼	1¾	5	400 " 800	¾	1¼	1½	1	Kaiman
6	1¾	6	500 " 850	1	1¼	1½	1	Kaiser
6	2	6	660 " 1100	1	1¼	1½	1	Kakelen
6	2¼	6	816 " 1410	1	1¼	1½	1	Kalbes
7½	2¼	6	816 " 1410	1½	2	4	3	Kalchas
6	2½	6	1020 " 1740	1	1¼	1½	1	Kalitte
7½	2½	6	1020 " 1740	1½	2	4	3	Kalka
7½	2¾	6	1140 " 1950	1½	2	4	3	Kalkberg
9	2¾	6	1140 " 1950	1½	2	4	3	Kalkerde
9	3¼	6	1710 " 2940	1½	2	4	3	Kalkig

A slight additional charge is made when Pumps are fitted with Brass Water Pistons and Piston Rods.

THE WORTHINGTON PRESSURE PUMP



SIZE, 12 x 5½ x 10

THE WORTHINGTON PRESSURE PUMP

This pattern of pump is especially designed for use in connection with hydraulic lifts and cranes, cotton presses, testing machines, hydraulic riveting and punching machines, and hydraulic presses of all kinds. Also, for oil pipe lines, mining purposes, and such services as require the delivery of liquids under heavy pressures.

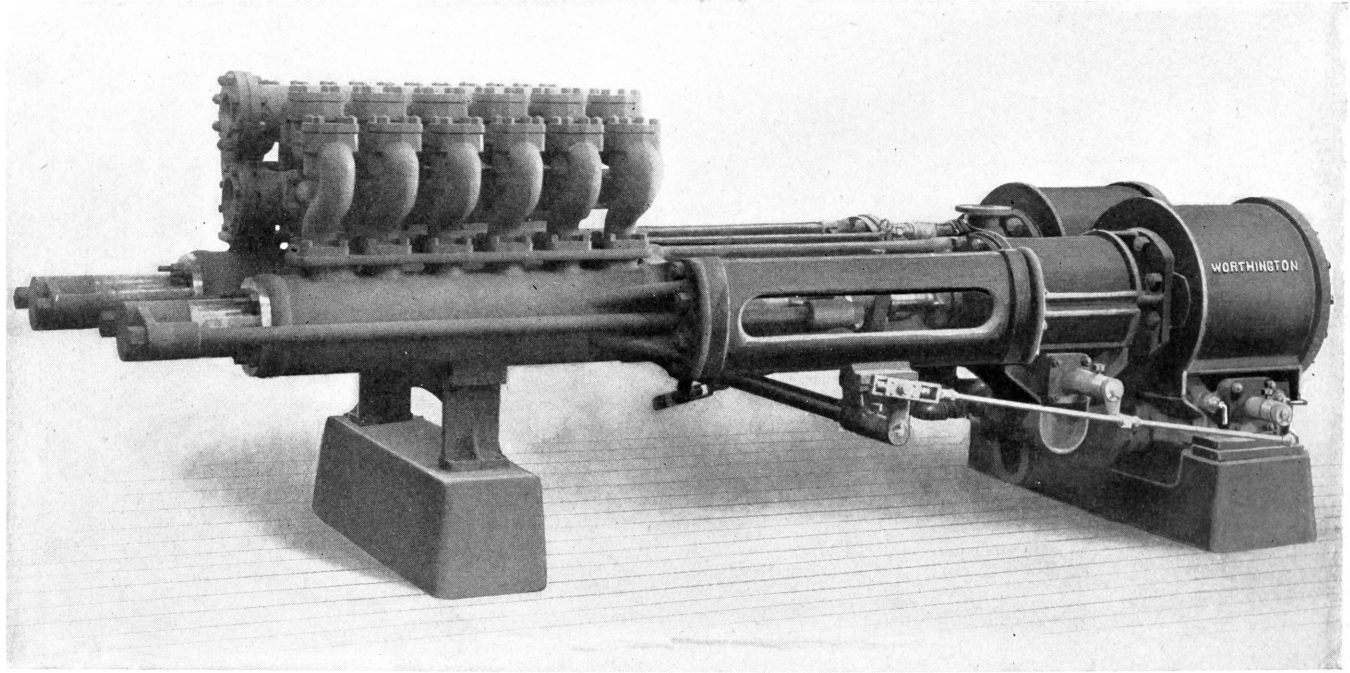
There are four single acting outside packed plungers, which work into the ends of the water cylinders, the latter having central partitions. The arrangement of compound steam cylinders shown on the following page, also the triple expansion arrangement, can be applied to these pumps where a saving of fuel is desired. The water valves are easily accessible, and are contained in small chambers, capable of resisting very heavy pressures. The general arrangement shown in the engraving is subject to numerous alterations, according to various requirements, but the general characteristic of four outside packed plungers is in all cases preserved.

The material used in the construction of these pumps is selected with great care, and every precaution is taken to insure their proper performance on work of the most severe character.

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 set of Plungers, varying with kind of work and pressure.	Gallons delivered per minute by the FOUR Plungers at stated number of strokes.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
						Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Delivery Pipe.	
4½	¾	4	.007	60 to 100	1 to 1½	½	¾	½	½	Labacco
4½	1½	4	.03	60 " 100	3½ " 6	½	¾	1½	1¼	Labdaci
5¼	¾	5	.009	55 " 95	1 " 2	¾	1¼	½	½	Labest
5¼	1¾	5	.05	55 " 95	5½ " 9	¾	1¼	1½	1¼	Labially
6	¾	6	.01	50 " 90	1 " 2	1	1¼	½	½	Labnis
6	1½	6	.048	50 " 90	5 " 9	1	1¼	1½	1¼	Laborio
6	2½	6	.127	50 " 90	12 " 23	1	1¼	2	1½	Labrace
6	3	6	.18	50 " 90	18 " 32	1	1¼	2	1½	Labrelle
7½	¾	6	.01	50 " 90	1 " 2	1½	2	½	½	Labry
7½	1½	6	.048	50 " 90	5 " 9	1½	2	1½	1¼	Labung
7½	2¼	6	.12	50 " 90	12 " 21	1½	2	1½	1¼	Lacaria
7½	3	6	.18	50 " 90	18 " 32	1½	2	2	1½	Laccina
9	¾	6	.01	50 " 90	1 " 2	1½	2	½	½	Lacellie
9	1½	6	.048	50 " 90	5 " 9	1½	2	1½	1¼	Laceratore
9	2¼	6	.12	50 " 90	12 " 21	1½	2	1½	1¼	Lacerna
9	3	6	.18	50 " 90	18 " 32	1½	2	2	1½	Lachbaum
7½	2¼	10	.17	40 " 75	13 " 25	1½	2	2½	2	Lachish
9	2¼	10	.17	40 " 75	13 " 25	2	2½	2½	2	Lackall
10	2¼	10	.17	40 " 75	13 " 25	2	2½	2½	2	Lackey
12	2¼	10	.17	40 " 75	13 " 25	2½	3	2½	2	Lacmus
14	2¼	10	.17	40 " 75	13 " 25	2½	3	2½	2	Laconize
16	2¼	10	.17	40 " 75	13 " 25	2½	3	2½	2	Lacraban
9	3¾	10	.48	40 " 75	38 " 72	2	2½	2½	2	Lactabat
10	3¾	10	.48	40 " 75	38 " 72	2	2½	2½	2	Launder
12	3¾	10	.48	40 " 75	38 " 72	2½	3	2½	2	Lacturni
16	3¾	10	.48	40 " 75	38 " 72	2½	3	2½	2	Lacunars
18½	3¾	10	.48	40 " 75	38 " 72	3	3½	2½	2	Lacydes
20	3¾	10	.48	40 " 75	38 " 72	4	5	2½	2	Laddove
10	4½	10	.69	40 " 75	55 " 104	2	2½	4	3	Ladonis
12	4½	10	.69	40 " 75	55 " 104	2½	3	4	3	Ladrona

(*Continued on page 33.*)

THE WORTHINGTON COMPOUND PRESSURE PUMP



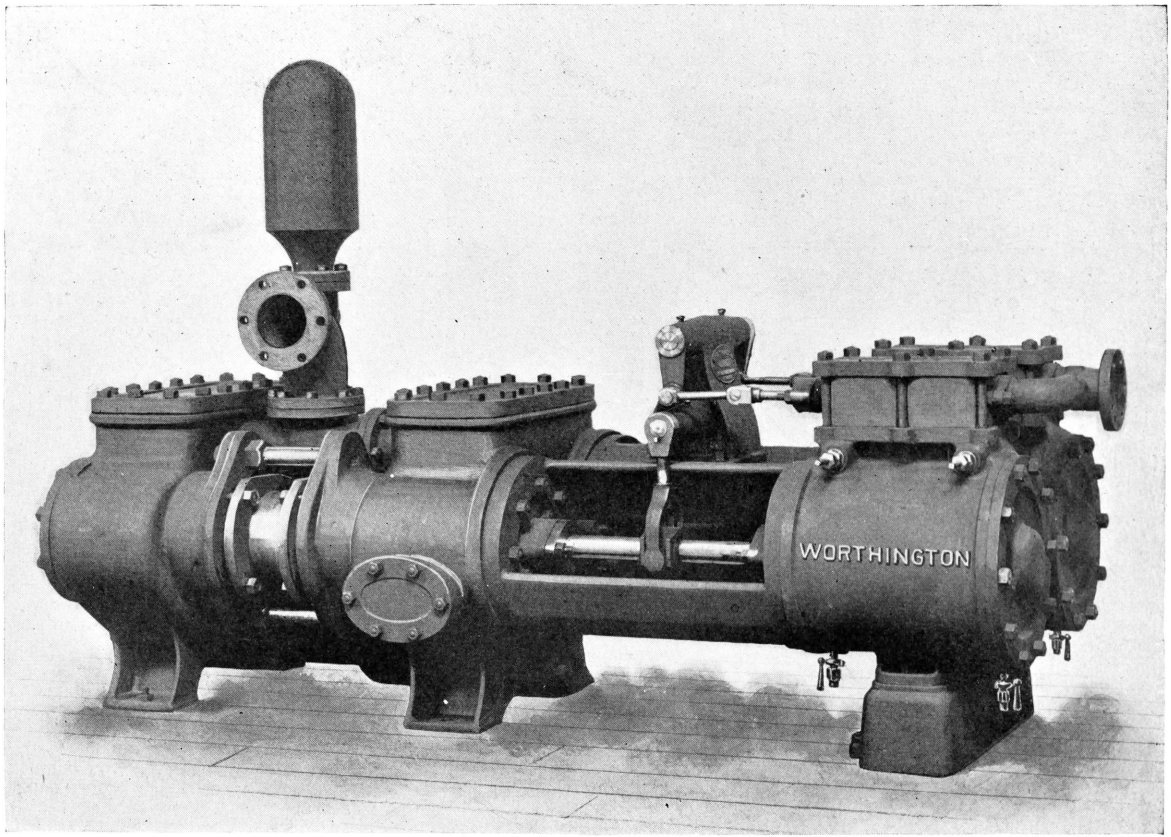
SIZE, 16 & 25 x 7¾ x 15

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 set of Plungers, varying with kind of work and pressure.	Gallons delivered per minute by the FOUR Plungers at stated number of strokes.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
						Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Delivery Pipe.	
14	4½	10	.69	40 to 75	55 to 104	2½	3	4	3	Ladykin
16	4½	10	.69	40 " 75	55 " 104	2½	3	4	3	Lafbek
18½	4½	10	.69	40 " 75	55 " 104	3	3½	4	3	Lagedo
20	4½	10	.69	40 " 75	55 " 104	4	5	4	3	Lagerten
10	5½	10	1.01	40 " 75	80 " 150	2	2½	4	3	Lagerzeit
12	5½	10	1.01	40 " 75	80 " 150	2½	3	4	3	Laggard
14	5½	10	1.01	40 " 75	80 " 150	2½	3	4	3	Lagima
16	5½	10	1.01	40 " 75	80 " 150	2½	3	4	3	Lagniate
18½	5½	10	1.01	40 " 75	80 " 150	3	3½	4	3	Lagomio
20	5½	10	1.01	40 " 75	80 " 150	4	5	4	3	Lagoon
12	6	10	1.20	40 " 75	95 " 180	2½	3	5	4	Lagotero
14	6	10	1.20	40 " 75	95 " 180	2½	3	5	4	Lagrimato
16	6	10	1.20	40 " 75	95 " 180	2½	3	5	4	Lagunes
18½	6	10	1.20	40 " 75	95 " 180	3	3½	5	4	Lagundo
20	6	10	1.20	40 " 75	95 " 180	4	5	5	4	Lamping
12	7	10	1.66	40 " 75	130 " 250	2½	3	6	5	Lancet
14	7	10	1.66	40 " 75	130 " 250	2½	3	6	5	Landed
16	7	10	1.66	40 " 75	130 " 250	2½	3	6	5	Landman
18½	7	10	1.66	40 " 75	130 " 250	3	3½	6	5	Landscape
20	7	10	1.66	40 " 75	130 " 250	4	5	6	5	Language
18½	7¾	10	2.01	40 " 75	160 " 300	3	3½	6	5	Languor
20	7¾	10	2.01	40 " 75	160 " 300	4	5	6	5	Lanterne
10	2¼	15	.25	30 " 65	15 " 32	2	2½	2½	2	Lanzados
12	2¼	15	.25	30 " 65	15 " 32	2½	3	2½	2	Lapdog
14	2¼	15	.25	30 " 65	15 " 32	2½	3	2½	2	Lapedo
12	3¾	15	.70	30 " 65	42 " 90	2½	3	2½	2	Lapelled
14	3¾	15	.70	30 " 65	42 " 90	2½	3	2½	2	Lapful
17	3¾	15	.70	30 " 65	42 " 90	2½	3½	2½	2	Lapgeld
20	3¾	15	.70	30 " 65	42 " 90	4	5	2½	2	Lapidation
17	4½	15	1.00	30 " 65	60 " 130	2½	3½	4	3	Lapidator
20	4½	15	1.00	30 " 65	60 " 130	4	5	4	3	Lapwork
25	4½	15	1.00	30 " 65	60 " 130	5	7	4	3	Larkspur
17	5½	15	1.50	30 " 65	90 " 195	2½	3½	4	3	Lassitude
20	5½	15	1.50	30 " 65	90 " 195	4	5	4	3	Lastbar
25	5½	15	1.50	30 " 65	90 " 195	5	7	4	3	Lastbrief
17	6	15	1.84	30 " 65	110 " 240	2½	3½	5	4	Latining
20	6	15	1.84	30 " 65	110 " 240	4	5	5	4	Latinism
25	6	15	1.84	30 " 65	110 " 240	5	7	4	3	Latinistic
17	7	15	2.50	30 " 65	150 " 325	2½	3½	6	5	Latinists
20	7	15	2.50	30 " 65	150 " 325	4	5	6	5	Lauded
25	7	15	2.50	30 " 65	150 " 325	5	7	6	5	Laughing
17	7¾	15	3.00	30 " 65	180 " 390	2½	3½	6	5	Laughingly
20	7¾	15	3.00	30 " 65	180 " 390	4	5	6	5	Laughsome
25	7¾	15	3.00	30 " 65	180 " 390	5	7	6	5	Laughter

A slight additional charge is made when Pumps are fitted with Brass Plungers. An extra charge is also made for Bed-plates.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON PACKED PLUNGER PUMP



SIZE, 12 x 8½ x 10

THE WORTHINGTON PACKED PLUNGER PUMP

In designing this pattern great care has been taken to reduce as much as practicable the loss by friction inseparable from packed plungers of all forms by adopting such methods of construction as will secure absolute rigidity of alignment under the heavy pressures often encountered by this form of pump.

The pumps are made to withstand 200 pounds per square inch, water pressure. The patterns are so subdivided that the rupture, from any cause, of any one part, only necessitates the renewal of a comparatively small casting. The cost of this pump is of necessity somewhat greater than that of the ordinary pattern, but knowing that wherever the selection of the Packed Plunger form is advisable, the service is of such severe character as to call for the best obtainable workmanship and design, no expense has been spared to add to its efficiency or strength.

The arrangement of Compound Cylinders, shown on page 16, can be applied to these pumps with advantage when a saving of fuel is desired.

The pumps given in the list on page 13, and others of larger capacity, can be fitted with a Packed Plunger water end, at a somewhat increased cost. In any emergency the stated capacity of the pumps can be considerably exceeded.

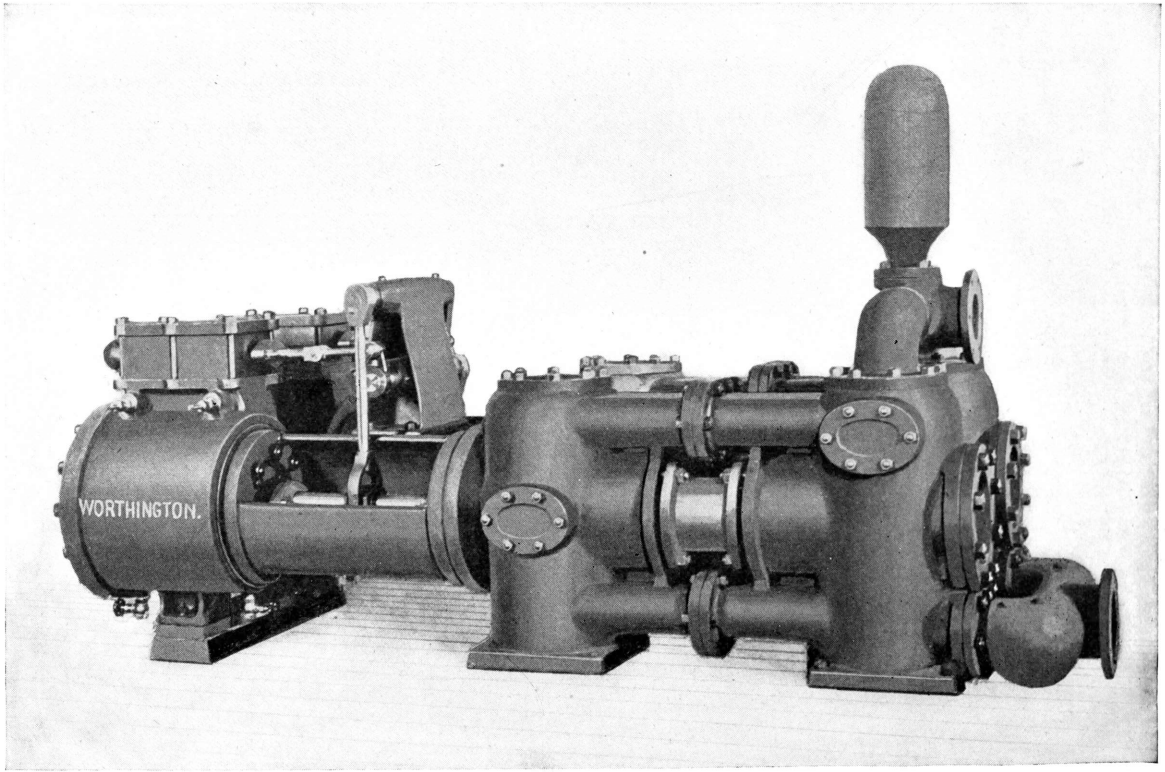
Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
10	6	10	250	8½	2	2½	5	4	Mabuse
12	7	10	335	9⅞	2½	3	6	5	Macalon
14	7	10	335	9⅞	2½	3	6	5	Macareno
16	7	10	335	9⅞	2½	3	6	5	Macarite
18½	7	10	335	9⅞	3	3½	6	5	Macaw
14	8½	10	490	12	2½	3	6	5	Mactildo
16	8½	10	490	12	2½	3	6	5	Maceran
18½	8½	10	490	12	3	3½	6	5	Maceris
20	8½	10	490	12	4	5	6	5	Machary
14	10¼	10	700	14	2½	3	8	7	Machilo
16	10¼	10	700	14	2½	3	8	7	Machonic
18½	10¼	10	700	14	3	3½	8	7	Machucar
20	10¼	10	700	14	4	5	8	7	Macrinic
16	12	10	980	17	2½	3	10	8	Macizar
18½	12	10	980	17	3	3½	10	8	Macline
20	12	10	980	17	4	5	10	8	Macorem
14	8½	15	600	12	2½	3	6	5	Macra
17	8½	15	600	12	2½	3½	6	5	Macrobe
20	8½	15	600	12	4	5	6	5	Macrodite
17	10¼	15	850	14¼	2½	3½	8	7	Macronyx
20	10¼	15	850	17	4	5	8	7	Macrural
17	12	15	1175	17	2½	3½	10	8	Mactant
20	12	15	1175	17	4	5	10	8	Mactet

An additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON PACKED PLUNGER PUMP

SCRANTON PATTERN



SIZE, 18½ x 7 x 10

THE WORTHINGTON PACKED PLUNGER PUMP

SCRANTON PATTERN

It is very difficult to design and construct a steam pump that will satisfactorily meet the 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 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. The valve areas and water ways are unusually large in proportion to the displacements of the plunger, so that the velocity and consequent destructive action of the water currents are decreased. It will be noticed that the supply pipe can be placed either side of the pump, or turned either way. The discharge tee can also be turned in any direction.

The pumps are designed to safely withstand a working pressure of 250 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 they are liable to be subjected.

The cut on the opposite page illustrates a pump of this pattern. The arrangement of compound or triple expansion steam cylinders can also be applied to these pumps where a saving of fuel is desired. In any emergency the capacity of the pumps can be considerably increased beyond the figures stated in the list.

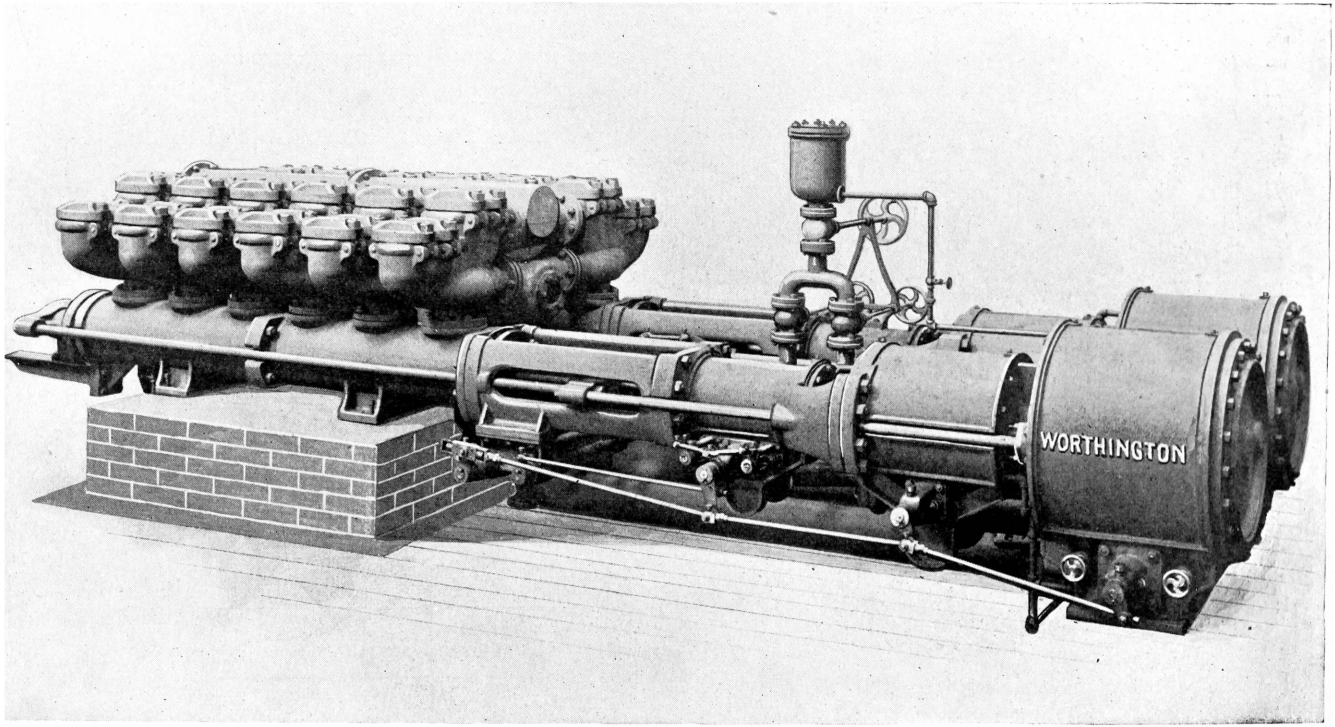
Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at proper speed under ordinary conditions.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
14	8½	10	500	12	2½	3	8	6	Macuba
16	8½	10	500	12	2½	3	8	6	Maculons
18½	8½	10	500	12	3	3½	8	6	Madama
20	8½	10	500	12	4	5	8	6	Madebat
16	10¼	10	750	14¼	2½	3	10	8	Madefy
18½	10¼	10	750	14¼	3	3½	10	8	Maderup
20	10¼	10	750	14¼	4	5	10	8	Madido
18½	12	10	1025	17	3	3½	12	10	Madman
20	12	10	1025	17	4	5	12	10	Madonna
17	8½	15	750	12	2½	3½	8	6	Madrafan
20	8½	15	750	12	4	5	8	6	Madrasta
17	10¼	15	1100	14¼	2½	3½	10	8	Madronal
20	10¼	15	1100	14¼	4	5	10	8	Madroso
25	10¼	15	1100	14¼	5	7	10	8	Madrure
20	12	15	1500	17	4	5	12	10	Magic
25	12	15	1500	17	5	7	12	10	Magnet

An additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON TRIPLE EXPANSION MINE PUMP

LEHIGH PATTERN



SIZE, 12 & 18 & 29 x 11 x 18

THE WORTHINGTON MINE PUMP

LEHIGH PATTERN, FOR 300 LBS.

The pattern of Worthington Mine Pump, illustrated on the opposite page, is especially designed to withstand the heavy pressure encountered in deep workings, and is recommended in all cases where a working pressure greater than 200 pounds to the square inch is to be overcome, or where, on account of bad water, it is not desirable to use valve seats which are screwed into the valve plates.

These pumps are designed with four single-acting outside packed water plungers which work into the ends of the water cylinders, the latter having central partitions. All parts exposed to pressure are subdivided as much as possible, in order to facilitate renewals in case of rupture through accident or negligence. The water valves are arranged in a series of valve boxes or pot chambers, each chamber containing one or more small valves having a low lift, and which are easily accessible by screwing back the nuts on the swing bolts and removing the valve box covers. The valve seats are forced into place on a slight taper. The valves are of brass faced with leather, guided from below by wings, and controlled by composition springs held in place by the valve box covers. This arrangement eliminates all screw threads from that portion of the pump coming in contact with the mine water.

These pumps can be arranged to operate either non-condensing or condensing, and are also made with compound and triple expansion steam cylinders, where a saving of fuel is desirable.

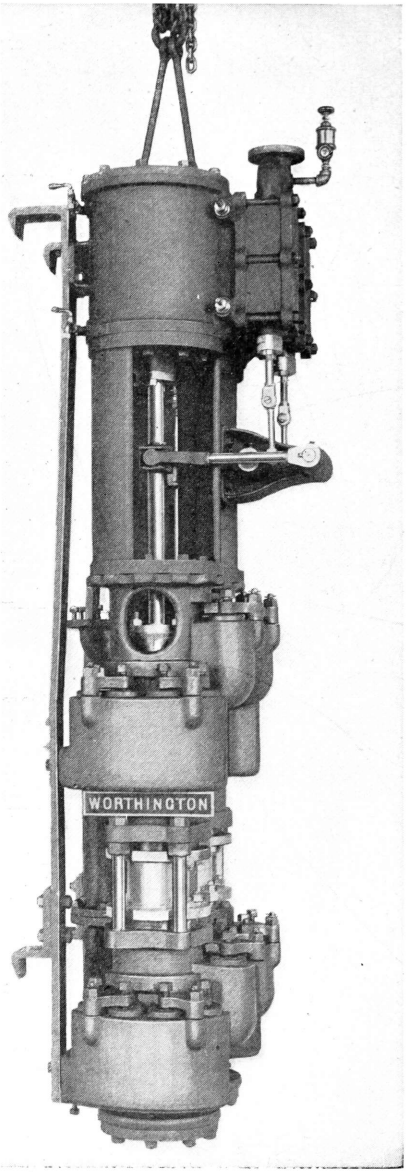
Pumps of this design of larger size or for heavier service can be furnished. In any emergency the capacity of the pumps can be considerably increased beyond the figure stated in the list.

Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at proper speed under ordinary conditions.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
				Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Delivery Pipe.	
16	6	10	200	2½	3	6	5	Magnetic
18½	6	10	200	3	3½	6	5	Magnetism
20	6	10	200	4	5	6	5	Magnitude
16	7½	10	300	2½	3	6	5	Malay
18½	7½	10	300	3	3½	6	5	Mandate
20	7½	10	300	4	5	6	5	Mangrove
17	6	15	220	2½	3½	6	5	Manly
20	6	15	220	4	5	6	5	Mantle
17	7½	15	320	2½	3½	6	5	Manxman
20	7½	15	320	4	5	6	5	Marasmo
18	7	18	350	3	4	6	5	Marasmus
22	7	18	350	4	6	6	5	Marathi
18	8	18	450	3	4	10	8	Marbete
22	8	18	450	4	6	10	8	Marbod

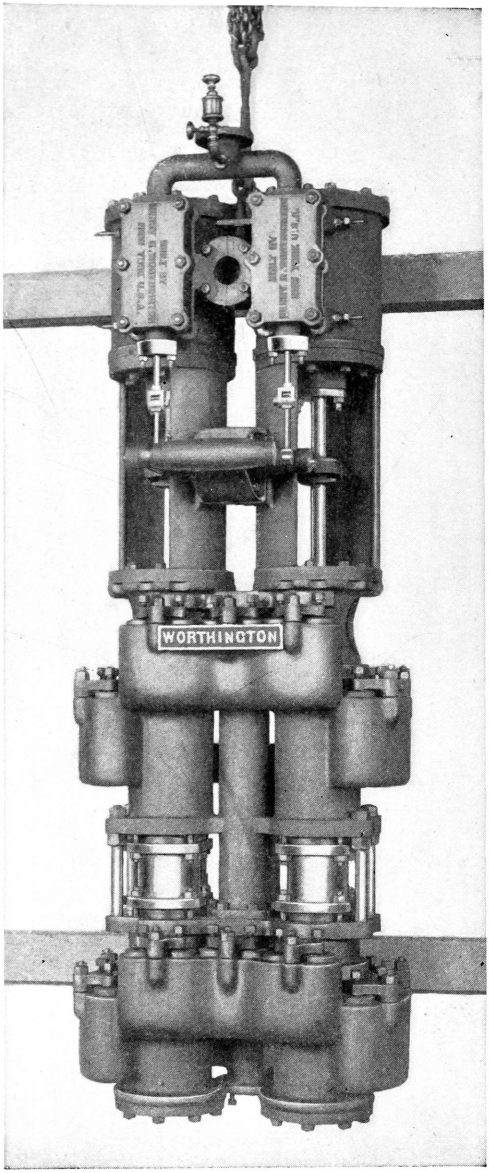
An additional charge is made when Pumps are fitted with Brass Plungers and brass bushed glands.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON SINKING PUMP



SIDE VIEW



FRONT VIEW

SIZE, 14 x 7½ x 10

THE WORTHINGTON SINKING PUMP

The Worthington Sinking Pump, shown on the opposite page, combines all of the advantages of single cylinder sinking pumps, with the additional advantages of being positive in its action and quiet in its operation, while the space occupied in the shaft is practically less than a single cylinder pump of the same capacity.

The design combines great strength with minimum space occupied, and the working parts, especially the water valves, are easily accessible.

The water end is amply strong for a working pressure of two hundred pounds. The valves are the standard winged mine valves, faced with leather, each being located in a separate chamber. The valve caps are held in place by bolts covering the caps, which can be swung out by simply releasing the strain on two set screws, so that all valves may be examined or replaced in the least possible time.

The valve motion is of the Worthington Standard, constructed throughout of forgings. This motion is positive in its action, and will always start from any point of its stroke.

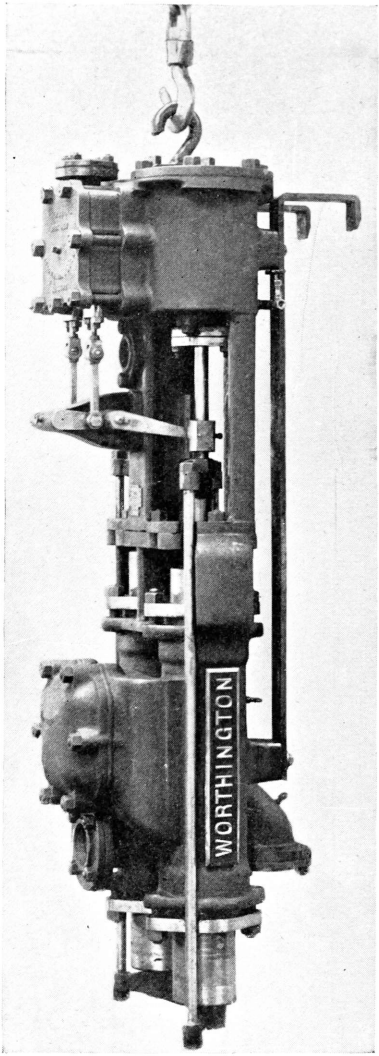
Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	APPROXIMATE SPACE OCCUPIED.			Approximate Shipping Weight.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Breadth.	Width.	Height.		Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
								Lbs.					
6	3½	6	65	5	28″	24″	7′4″	2150	1	1¼	3½	3	Marcentis
7½	3½	6	65	5	28″	26″	7′4½″	2250	1½	2	3½	3	Marchada
6	4	6	85	5½	28″	24″	7′4″	2200	1	1¼	3½	3	Marchander
7½	4	6	85	5½	28″	26″	7′4½″	2300	1½	2	3½	3	Marchito
7½	4½	10	140	6⅜	32″	28″	9′	3000	1½	2	4	3	Marcidity
9	4½	10	140	6⅜	34″	28″	9′	3100	2	2½	4	3	Marcidola
10	4½	10	140	6⅜	34″	28″	9′	3200	2	2½	4	3	Marco
9	6	10	250	8½	42″	31″	9′2″	4460	2	2½	5	4	Marfado
10	6	10	250	8½	42″	31″	9′2″	4560	2	2½	5	4	Marfaga
12	6	10	250	8½	42″	36″	9′6″	5160	2½	3	5	4	Margin
14	6	10	250	8½	42″	36″	9′6″	5560	2½	3	5	4	Marginal
9	7½	10	420	10½	43″	32″	9′6″	5600	2	2½	6	5	Margosa
10	7½	10	420	10½	43″	32″	9′6″	5700	2	2½	6	5	Margotta
12	7½	10	420	10½	43″	36″	9′8″	6300	2½	3	6	5	Marmiton
14	7½	10	420	10½	43″	36″	9′8″	6500	2½	3	6	5	Marmorin
16	9	10	600	12¾	52″	41″	10′5″	8000	2½	3	8	6	Marooned
18½	9	10	600	12¾	52″	41″	10′5″	8500	3	3½	8	6	Marooning
20	11	10	900	15½	56″	46″	10′9″	11000	4	5	10	8	Marquis

An additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON SINKING PUMP

PROSPECTING PATTERN



SIZE, 7½ x 5 x 6

THE WORTHINGTON SINKING PUMP

PROSPECTING PATTERN

To supply the demand for a sinking pump of moderate cost the Worthington "Prospecting Pump," illustrated on the opposite page, was designed. This design combines some of the features of the four plunger outside packed, and the regular pattern pumps, having water cylinders and plungers of the former and the valve chamber of the latter. All of these pumps are provided with eye-bolts and hanging irons so that they may be suspended by cable or fastened to the side timbers of the shaft. They will work equally well in horizontal and vertical positions, and in small mines where the quantity of water to be handled is within their capacity, they make excellent station pumps.

The steam ends are regular standard pattern, ordinarily fitted with slide valves, but they can be fitted with piston valves at a slight advance in cost.

The water ends are amply strong for a water pressure of 175 pounds.

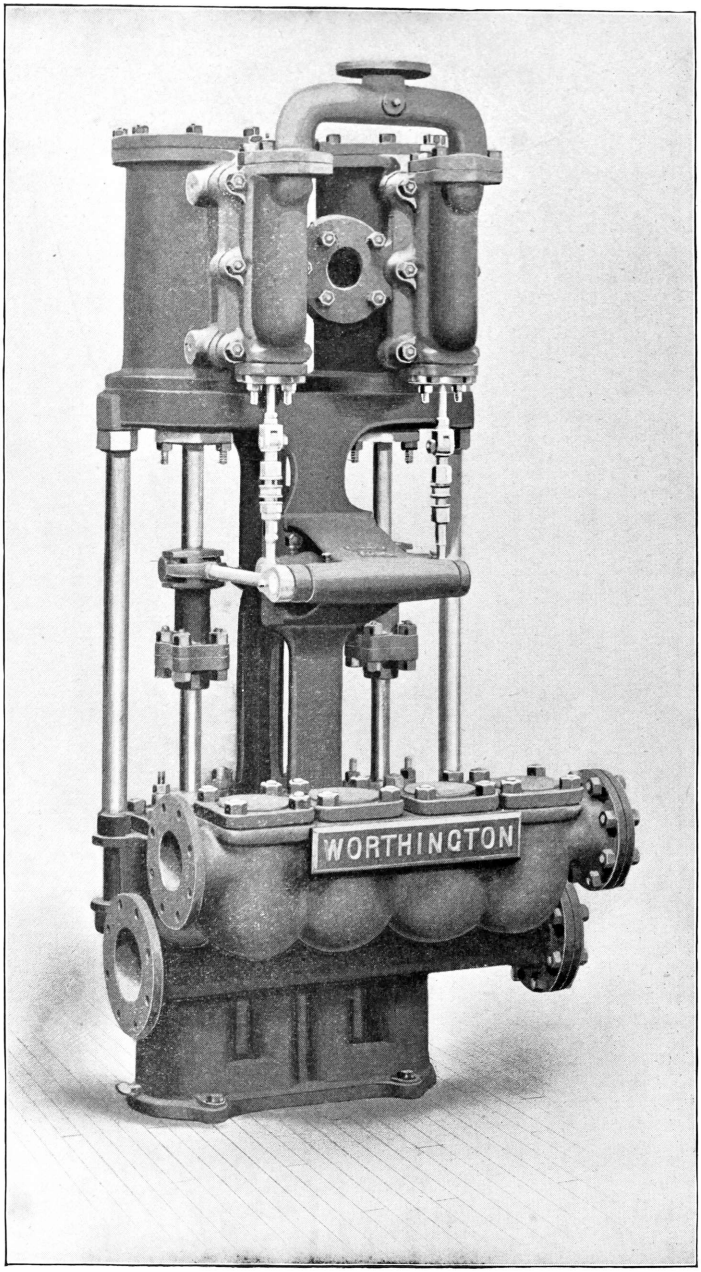
Diameter of Steam Cylinders.	Diameter of Water Plungers.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	Diameter of Plunger required in any single cylinder pump to do the same work at same speed.	APPROXIMATE SPACE OCCUPIED.			Approximate Shipping Weight.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Breadth.	Width.	Height.		Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
4½	2¾	4	30	4	13	22	4′8″	350	½	¾	2	1½	**Marquisat**
5¼	3½	5	50	5	15	24	5′5″	550	¾	1¼	2½	1½	**Marshals**
6	4	6	60	5⅝	16	29	6′1″	750	1	1¼	3	2	**Marshiness**
7½	5	6	100	7	21	29	6′3″	1050	1½	2	4	3	**Martial**

An additional charge is made when Pumps are fitted with Brass Plungers.

To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON MARINE PUMP

ADMIRALTY PATTERN



SIZE, 9 x 6 x 10

THE WORTHINGTON MARINE PUMP

ADMIRALTY PATTERN

This form of pump was designed to meet the requirements of the British Admiralty, and has since been modified to conform, at the same time, to the views of the United States Bureau of Steam Engineering.

The steam end is of the well-known Worthington type, embodying some of the latest patented features. The water end is made of either composition or gun metal, or of cast iron sufficiently strong to work against pressure of from 150 to 250 lbs. When made of cast iron the water end is thoroughly brass fitted.

The object of designing a pump of this description was to meet the demands of marine engineers who require a machine which will occupy the least possible floor space and head room; which will be easy of access to all its internal parts; which will be simple and strong in its construction; and which by reason of its superior workmanship and material shall require the least possible attention and repair.

The water passages are free and direct, and the water valves are easily reached and readily replaced. The water pistons are accessible through the top of the cylinders, without disturbing either the steam pistons or valve motion.

The pumps under test have shown an efficiency of 96 per cent. If necessary, a hand attachment can be supplied at a slight additional cost. The compact form, light weight, quietness of movement, certainty of action, and durability of these pumps have created a large demand for them both at home and abroad.

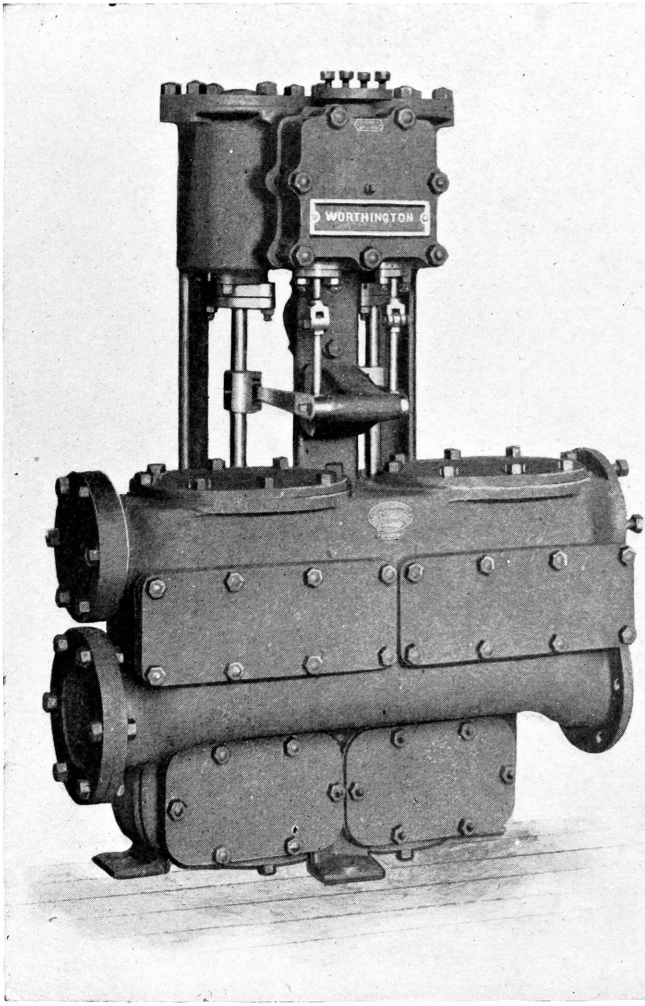
This pattern of Worthington Marine Pump can be used as an independent boiler feeder with special advantage where high steam pressure is carried in connection with triple and quadruple expansion marine engines. It is also well adapted for bilge and fire service where excessive weight is objectionable and where but limited space is available.

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Displacement in Gallons per stroke of ONE Piston.	Proper strokes per minute of ONE Piston, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Pistons at stated number of strokes.	Diameter of Piston 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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
4½	3	4	.12	75 to 150	18 to 36	4¼	½	¾	2	2	Nabica
5¼	3½	5	.20	75 " 150	30 " 60	5	¾	1¼	2½	2½	Nablia
6	4	6	.33	75 " 125	50 " 80	5⅝	1	1¼	4	3	Nabob
6	4½	6	.41	75 " 125	60 " 100	6⅜	1	1¼	4	3	Naboria
7½	5	6	.51	75 " 125	75 " 130	7⅛	1½	2	5	4	Nabosco
9	6	6	.73	75 " 125	110 " 180	8½	1½	2	5	4	Nacelle
7½	4½	10	.69	50 " 90	70 " 125	6⅜	1½	2	4	3	Nachkur
9	6	10	1.22	50 " 90	120 " 215	8½	2	2½	5	4	Nachbar
10	7	10	1.66	50 " 90	170 " 300	9⅞	2	2½	6	5	Nachbild
12	8½	10	2.45	50 " 90	245 " 440	12	2½	3	6	5	Nachalbo
12	9¼	10	2.90	50 " 90	290 " 530	13	2½	3	6	6	Nachhall

To designate the sizes, give the diameters of Steam Cylinders and Water Pistons, and length of stroke.

THE WORTHINGTON BALLAST PUMP

VERTICAL PATTERN



SIZE, 7½ x 9 x 6

THE WORTHINGTON BALLAST PUMP

This machine was constructed to meet the requirements of steamship builders, and is now recognized and adopted by the principal marine engineers of this and of other countries as the standard design for this service and for oil-tank steamer work. It will be observed that its proportions are such as to secure the advantages of large pumping capacity with unusual compactness and moderate weight. This pump is of the packed piston type, and has the valves so arranged that the water pistons are always submerged, thus making it particularly well adapted for long and difficult suction lifts, such as are met with in steamers carrying petroleum in bulk, and in steamers having extensive systems of water ballast tanks. The demands for water ballast service are generally met by the following sizes, but wherever required machines of greater or less capacity can be supplied.

HORIZONTAL PATTERN. (See cut, page 20.)

Diameter of Steam Cylinders.	Diameter of Water Pistons.	Length of Stroke.	Gallons delivered per minute at ordinary speed.	Diameter of Piston required in any single cylinder pump to do the same work at same speed.	SIZES OF PIPE FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
					Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Delivery Pipe.	
3	2¾	3	30	4	⅜	½	1¼	1	Nachlan
4½	3¾	4	60	5¼	½	¾	2½	1½	Nachporto
5¼	4¾	5	110	6¾	¾	1¼	3	2	Nachricht
6	5¾	6	160	8⅛	1	1¼	4	3	Nachspiel
7½	5¾	6	160	8⅛	1½	2	4	3	Nachteule
6	7½	6	285	10¼	1	1¼	6	5	Nachtluft
7½	7½	6	285	10¼	1½	2	6	5	Nachtrag
6	8½	6	375	12	1	1¼	6	5	Nachts
7½	8½	6	375	12	1½	2	6	5	Nachtslot
9	8½	6	375	12	1½	2	6	5	Nacibo
7½	6	10	250	8½	1½	2	5	4	Nacrite
7½	7	10	350	9⅞	1½	2	6	5	Nadel
7½	8½	10	500	12	1½	2	6	5	Nadering
9	8½	10	500	12	2	2½	6	5	Nadivo
7½	10¼	10	730	14¼	1½	2	8	7	Nafego
10	10¼	10	730	14¼	2	2½	8	7	Nafiri
9	12	10	1000	17	2	2½	10	8	Nagelag
12	12	10	1000	17	2½	3	10	8	Nagelfell
10	14	10	1400	19¾	2	2½	12	10	Nageln
12	14	10	1400	19¾	2½	3	12	10	Nageur

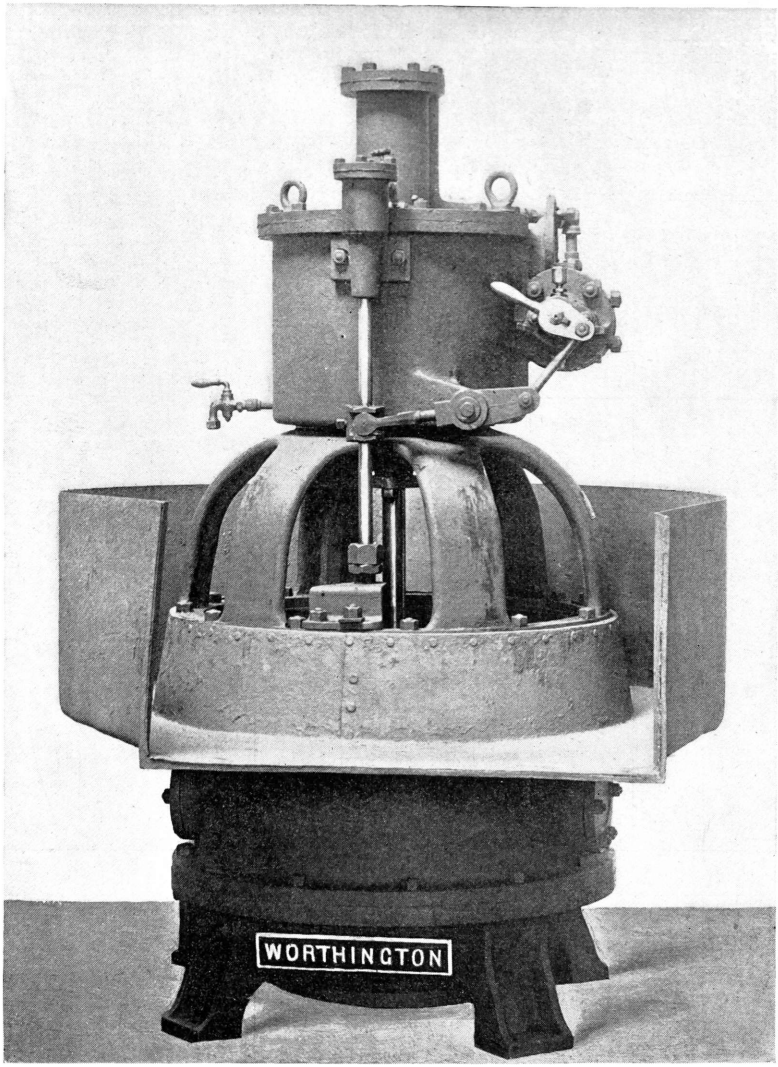
VERTICAL PATTERN. (See cut opposite.)

3	2	3	15	2⅞	⅜	½	1¼	1	Nagewas
5¼	5	5	120	7	¾	1¼	4	3	Naham
6	6	6	180	8½	1	1¼	5	4	Nahrhaft
6	7½	6	285	10¼	1	1¼	5	4	Naipes
7½	7½	6	285	10¼	1½	2	5	4	Naively
6	9	6	375	12	1	1¼	6	5	Nakind
7½	9	6	375	12	1½	2	6	5	Nalime
7½	10¼	10	730	14¼	1½	2	8	7	Namarkt
10	12	10	1000	17	2	2½	10	8	Natal
12	14	10	1400	19¾	2½	3	12	10	Necking
12	15	15			2½	3	14	12	Necrosis

A slight additional charge is made when Pumps are fitted with Brass Pistons and Piston Rods.

To designate the sizes, give the diameters of Steam Cylinders and Water Pistons, and length of stroke.

THE WORTHINGTON WRECKING PUMP



SIZE, 18½ x 30 x 10

THE WORTHINGTON WRECKING PUMP

This form of Worthington pump was constructed many years ago, for wrecking, drainage, or irrigating purposes, and has 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 water valves are of rubber, the lower ones being upon a permanent plate at the bottom of the pump. The water piston also is fitted with valves. These last open for the passage of water when the piston descends.

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

In operation these pumps are more economical than other forms of pumps used for this service.

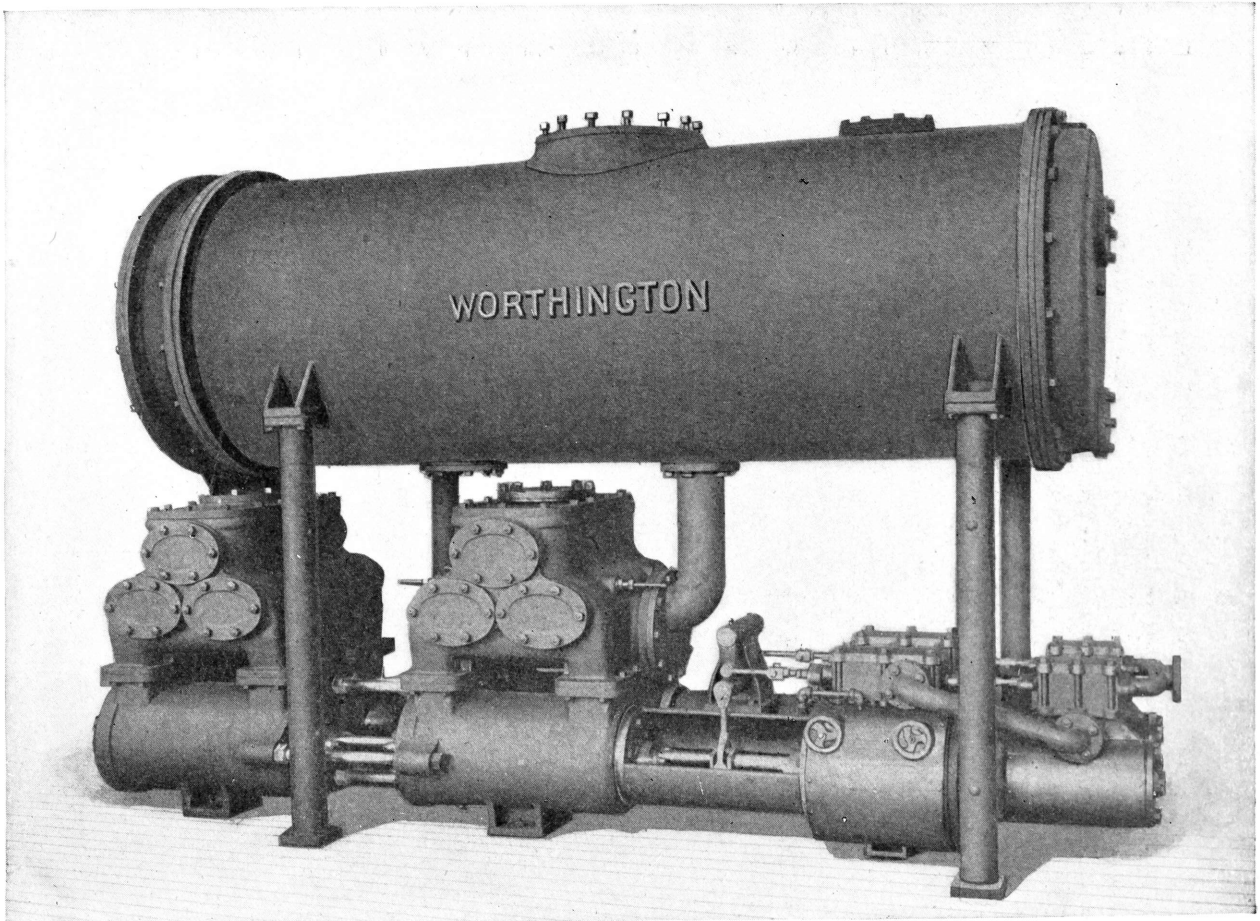
When ordering, specify whether the pump is to be used for pumping fresh or salt water.

The stated capacities of the pumps given in the list can be exceeded in cases of emergency.

Diameter of Steam Cylinder.	Diameter of Water Piston.	Length of Stroke.	Diameter of Suction Pipe.	Gallons. per minute.	Telegraphic Code Word.	
					Fitted for Fresh Water.	Fitted for Salt Water.
6	12	9	6	300 to 400	Neighbor	Nibredo
12	20	9	10	1000 " 1200	Nepotism	Nicusic
16	25	10	12	1400 " 1600	Nervate	Nidrino
18½	30	10	14	2000 " 2300	Nericto	Niguso
19½	33	15	16	3200 " 3600	Netrudo	Nilicto

To designate the sizes, give the diameters of the Steam Cylinder and Water Piston, and length of stroke.

THE WORTHINGTON SURFACE CONDENSER WITH AIR AND CIRCULATING PUMP



Capacity, 750 H. P. Steam Cylinders of Air and Circulating Pump are compounded.

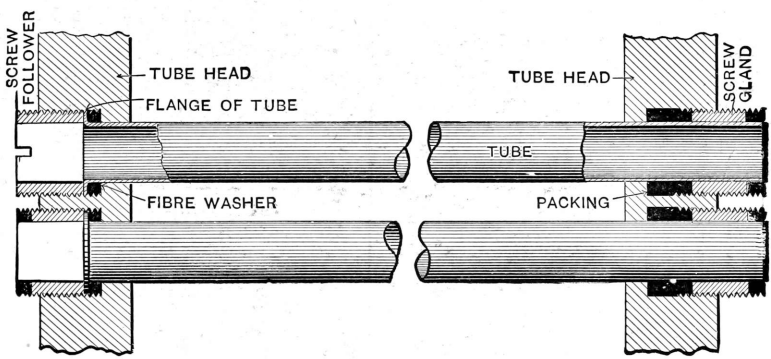
THE WORTHINGTON SURFACE CONDENSER WITH AIR AND CIRCULATING PUMP

This combination forms a complete and very compact apparatus, as will be seen from the cut. The surface condenser is placed directly over the air and circulating pump, is supported by four substantial cast-iron columns, and is connected to the pump by the necessary pipes. All that remains to be done is to make the steam and water connections to the apparatus.

The shells of these condensers are usually cylindrical in form and of close grain cast iron. They are provided with openings for the exhaust steam, and also with properly placed openings for cleaning purposes; suitable feet form a substantial support either upon brick piers or upon girders or columns. The bonnets are provided with hand holes for cleaning or inspection.

The tubes are seamless drawn brass of the very best composition for the purpose. The tube heads are carefully drilled and tapped to receive the followers on one end of the condenser, and the screw glands on the other.

Special attention is called to a feature of great merit in these Condensers which is illustrated by the following cut.



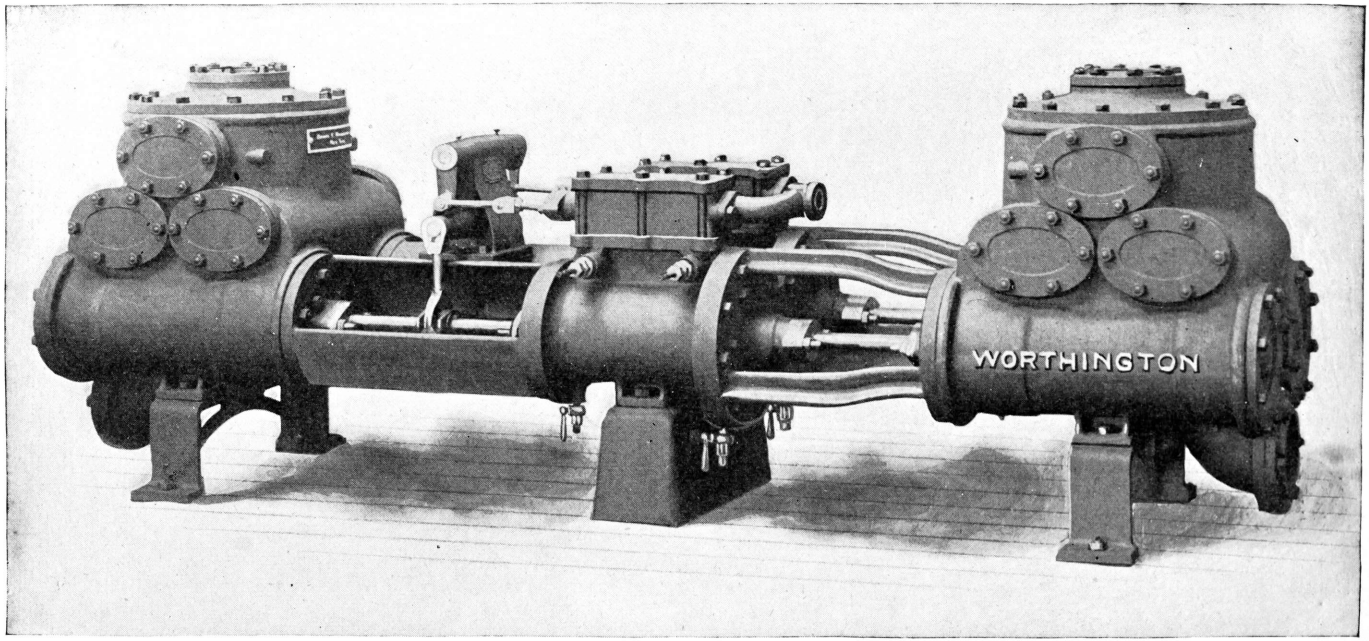
PATENTS APPLIED FOR.

One end of each tube is flanged and rigidly held in the tube head by means of a screw follower; the other end of the tube passes through an adjustable gland, which permits of free movement of the tube during expansion and contraction. This method of securing rigidly one end of the tube reduces the number of glands or stuffing-boxes to just one-half the number found in ordinary condensers. The glands can be readily removed and the packing replaced if it becomes leaky from long use.

Each condenser is provided with a baffle plate to distribute the exhaust steam as it enters, and the larger sizes have supporting plates to bear the weight of the tubes at the centre.

Worthington Surface Condensers are built of any size and for any service.

THE WORTHINGTON AIR AND CIRCULATING PUMP



SIZE, 7½ x 8½ x 8½ x 10

THE WORTHINGTON AIR AND CIRCULATING PUMP

This combination of the air and circulating pumps, in which one steam end drives both pumps, is an especially good form, if care is taken in the selection of the relative proportions of the cylinders. The steam cylinders may be either single, compound, or triple, as the case may warrant. The cylinders for the circulation of the water are of the same construction as those of standard Worthington pumps, their function being to supply the water used for cooling the surface of the condensers. The steam pistons driving them are located in the central cylinders, the piston rods being prolonged through to the air pumps at their other ends, thus making a direct and simple connection.

By an arrangement of the connecting casting between the circulating and steam cylinders, the steam pistons can be overhauled without disturbing the alignment of the pump or breaking any of the steam or water pipe connections.

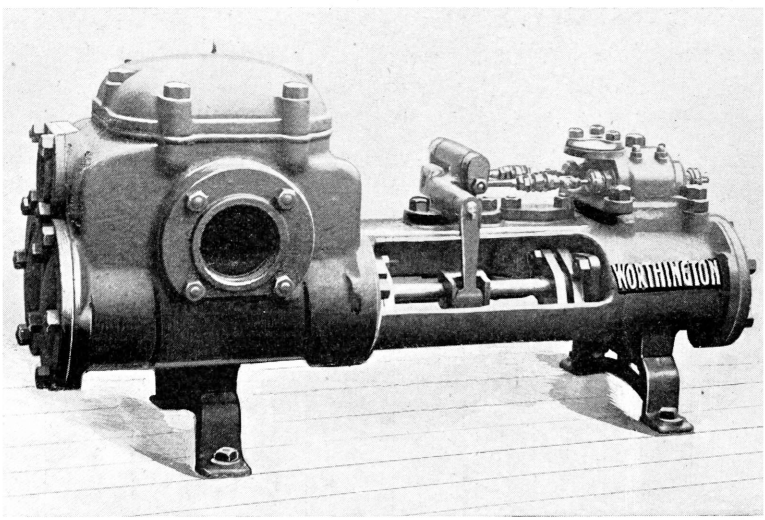
The air pumps are so constructed that their pistons are kept submerged, the vapor being drawn in and expelled through the alternate pulsations of water columns each side of the air pump pistons.

These pumps are built in the following sizes, which cover the range of usual requirements:

Diameter of Steam Cylinders.	Diameter of Air Pump Cylinders.	Diameter of Circulating Cylinders.	Length of Stroke.	Steam Pipe.	Exhaust Pipe.	Circulating Pump Suction Pipe.	Circulating Pump Discharge Pipe.	Air Pump Suction Pipe.	Air Pump Discharge Pipe.	Telegraphic Code Word.
4½	3¾	3¾	4	½	¾	2½	1½	2½	1½	Oakum
5¼	4¾	4¾	5	¾	1¼	3	2	3	2	Oarion
6	5¾	5¾	6	1	1¼	4	3	4	3	Oaxida
6	7½	7½	6	1	1¼	6	5	6	5	Obarni
7½	8½	8½	6	1½	2	6	5	6	5	Obarsit
7½	6	6	10	1½	2	5	4	5	4	Obbam
7½	7	7	10	1½	2	6	5	6	5	Obbis
7½	8½	8½	10	1½	2	6	5	6	5	Obclave
7½	10¼	10¼	10	1½	2	8	7	8	7	Obdach
9	12	12	10	2	2½	10	8	10	8	Obdet
10	14	14	10	2	2½	12	10	12	10	Obditos
12	15	15	10	2½	3	12	10	..	..	Obduce
12	15	15	15	2½	3	12	10	..	..	Obdured
14	17	17	15	2½	3	14	12	..	..	Obedible
14	19	19	15	2½	3	14	12	..	..	Obelias
17	22	22	15	2½	3½	16	14	..	..	Obelize

It must be remembered, in comparing these sizes with single cylinder air and circulating pumps, that the Worthington has *two* circulating pistons, and *two* air pump pistons, all double-acting and working together, and is, therefore, double the capacity of a single air and circulating pump with cylinders of like diameter.

THE WORTHINGTON WET VACUUM PUMP



SIZE, 5¼ x 5¾ x 5

THE WORTHINGTON WET VACUUM PUMP

In the operation of the Wet System of Condensation, there has been for a long time a demand for an apparatus that will produce a steady and high degree of vacuum without complication of machinery.

These pumps are exceedingly simple. The steam valves are of a patented piston form, and as two steam cylinders and two air cylinders are located side by side, and the piston-rod of one pump through the intervening valve motion operates the steam valve of the other pump, the whole power of either steam cylinder is thus available to move the opposite steam valve, whereas in single cylinder pumps, which require steam thrown valves actuated by small supplemental pistons, no such surplus power is available.

The piston steam valves are perfectly balanced, and require little or no oiling. This feature allows long periods of running without attention. This is important in connection with surface condensers and with those systems of building heating that employ a vacuum of greater or less degree on the returns, and where machines that require constant attendance cannot safely be placed.

Special consideration will be given to the selection of this apparatus for use with Surface Condensers, Keel Condensers, Vacuum Pans, Multiple Effect Evaporating Apparatus, Stills and Heating Systems.

It must be remembered, in comparing these sizes with Single Cylinder Pumps, that the Worthington Wet Vacuum Pump has two double acting pistons working together, and is, therefore, double the capacity of a single cylinder pump with a piston of same diameter.

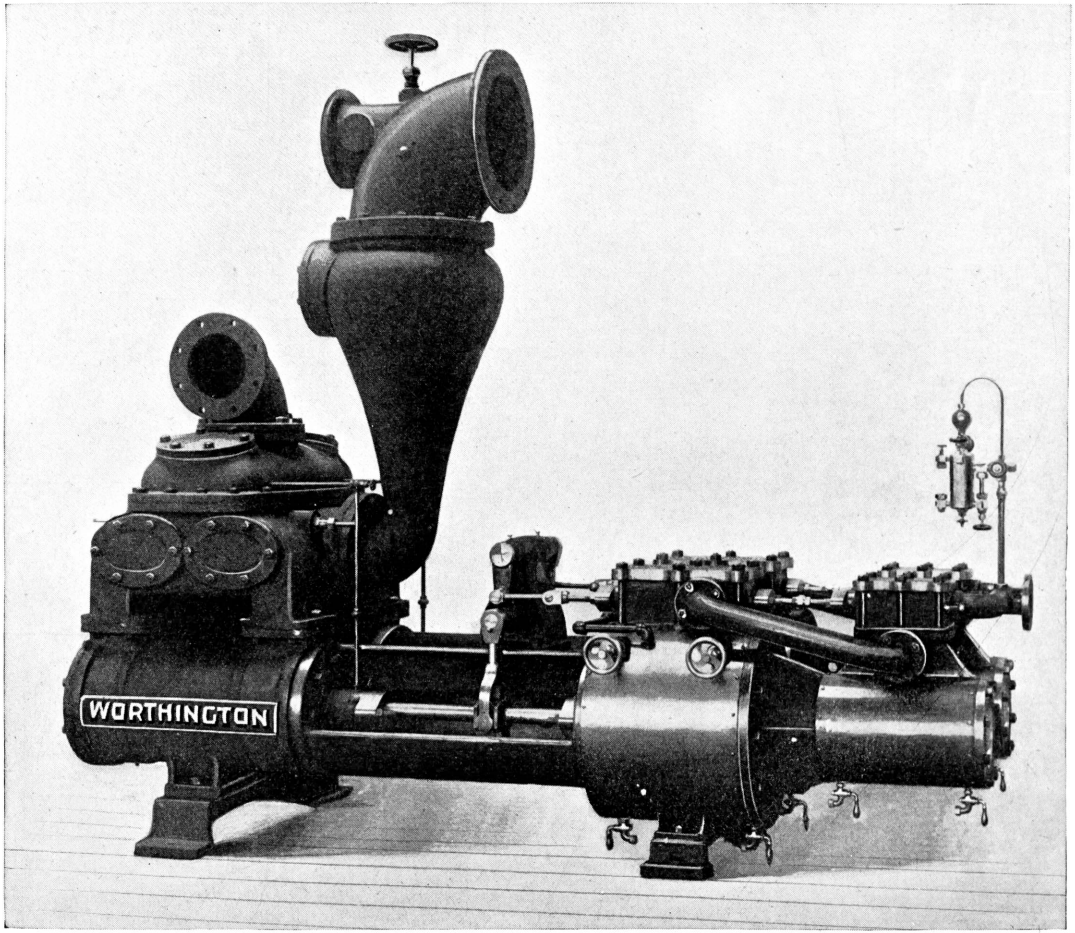
The following list represents the standard sizes of Worthington Wet Vacuum Pumps.

Diameter of Steam Cylinders.	Diameter of Vacuum Cylinders.	Length of Stroke.	Diameter of Piston 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.				Telegraphic Code Word.
				Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
4½	3¾	4	5¼	½	¾	2½	1½	Oberarm
5¼	4¾	5	6¾	¾	1¼	3	2	Oberbett
5¼	5¾	5	8⅛	¾	1¼	4	3	Oberhalb
6	5¾	6	8⅛	1	1¼	4	3	Oberon
6	7½	6	10¼	1	1¼	6	5	Oberro
6	8½	6	12	1	1¼	6	5	Oberst
7½	7	10	9⅞	1½	2	6	5	Oberwelt
7½	8½	10	12	1½	2	6	5	Obeyed
7½	10¼	10	14¼	1½	2	8	7	Obgero
9	12	10	17	2	2½	10	8	Obicio
12	14	10	19¾	2½	3	12	10	Obirati
12	15	10	21	2½	3	12	10	Obivit
12	15	15	21	2½	3	12	10	Oblato

A slight additional charge is made for Brass fitting.

To designate the sizes, give the diameters of Steam and Vacuum Cylinders and length of stroke.

THE WORTHINGTON COMPOUND JET CONDENSER



CAPACITY, 800 H.P.

THE WORTHINGTON JET CONDENSER

This is the standard form of Condenser, and should be used where a natural supply of fresh water can be had for condensing purposes. It is exceedingly substantial and reliable. The valve motion is entirely of steel and drop forgings, and, operating on the duplex principle, never allows the machine to get on centres and stop while steam is turned on.

A most important advantage the Worthington Jet Condenser has over other forms of condensers is, that it is practically impossible for the injection water to be drawn into the steam cylinders of the main engine while it is running. The serious danger of flooding is avoided without the use of floats, check valves, or other automatic contrivances resorted to in the manufacture of other machines, and which are liable to become inoperative from disuse.

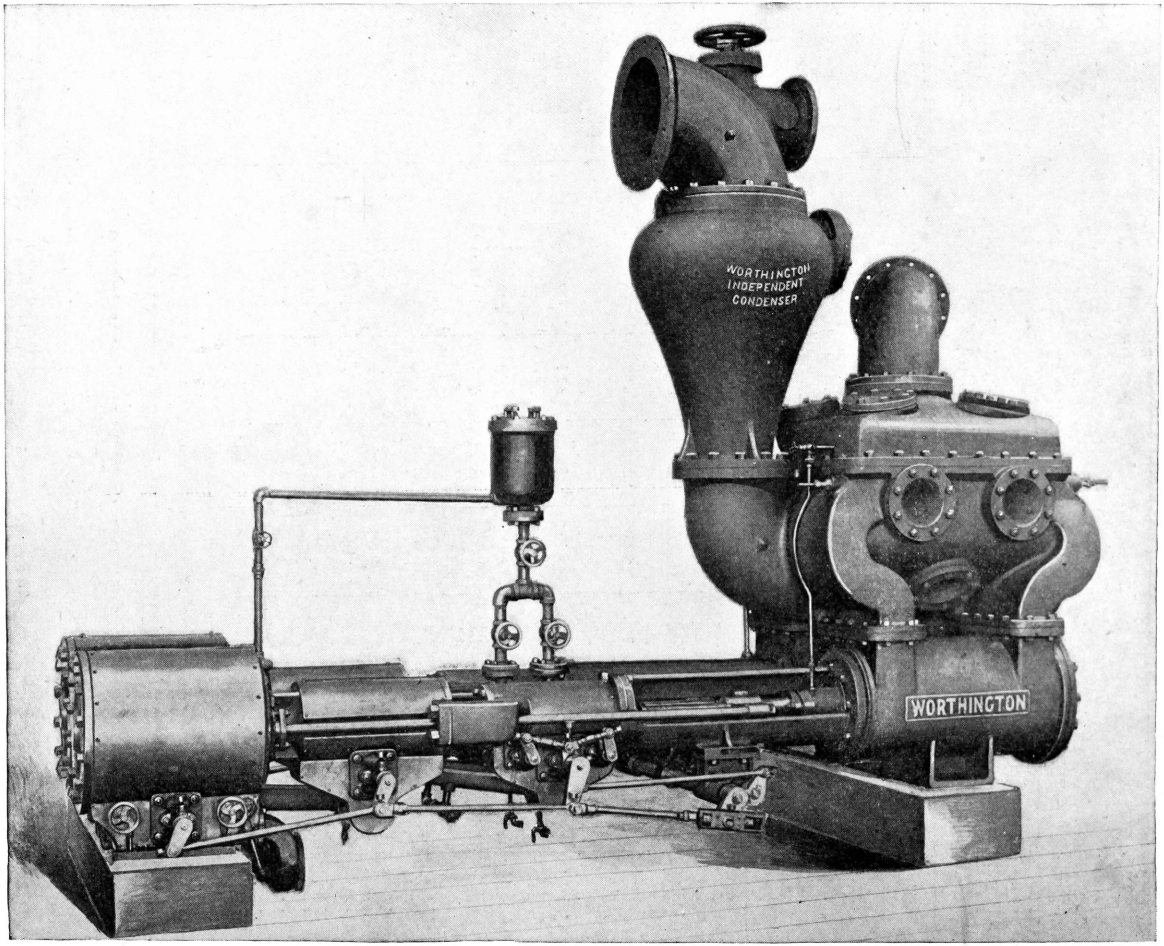
The following list gives the ordinary sizes with single steam cylinders. Estimates for condensers of any desired capacity will be furnished on application. See Special Catalogue.

No. of Condenser.	Diameter of Steam Cylinders.	Diameter of Water Cylinders.	Length of Stroke.	Diameter of Steam Pipe of Pump.	Diameter of Exhaust Pipe of Pump.	Diameter of Engine Exhaust Opening.	Diameter of Injection Pipe.	Diameter of Discharge Pipe.	Telegraphic Code Word.
1	5¼	4¾	5	¾	1¼	4	2½	2	Obliage
2	6	5¾	6	1	1¼	5	3	3	Obligor
2½	7½	7½	6	1½	2	8	4	4	Obliniti
3	7½	7	10	1½	2	8	4	4	Oblito
4	7½	7	10	1½	2	10	4	4	Obluvia
5	7½	8½	10	1½	2	12	5	5	Obmoti
6	7½	8½	10	1½	2	12	5	5	Obmusso
7	7½	10¼	10	1½	2	14	7	6	Obnatis
8	9	12	10	2	2½	14	7	8	Obniti
9	12	14	10	2½	3	16	8	10	Obnoxio
9½	12	15	10	2½	3	16	8	10	Obnubo
10	12	15	15	2½	3	18	10	10	Oboca
..	12	17	15	2½	3	18	10	12	Obollah
..	14	17	15	2½	3	18	10	12	Obscene
..	12	19	15	2½	3	18	10	12	Obscurity
..	14	19	15	2½	3	18	10	12	Observe
..	17	19	15	2½	3½	18	10	12	Obversion
..	14	22	15	2½	3	20	10	14	Occasion
..	17	22	15	2½	3½	20	10	14	Occult
..	18	22	18	3	4	20	10	14	Occulted
..	18	24	18	3	4	20	10	14	Occultly
..	18	26	18	3	4	24	12	16	Oceano
..	18	29	18	3	4	24	14	18	Ochava

THE WORTHINGTON JET CONDENSER WITH COMPOUND STEAM CYLINDERS

When the exhaust steam from the condenser pump can be used to heat the boiler feed-water, the ordinary form of steam cylinders is recommended, both on account of economy and simplicity. There are, however, many cases where this cannot be done, and it becomes advisable to compound the steam cylinders, so that the steam may be used expansively and with high economy. The condenser pump itself may be run condensing by exhausting into the main exhaust pipe, and the benefit of the vacuum obtained upon it.

THE WORTHINGTON TRIPLE JET CONDENSER



CAPACITY, 1200 H.P.

THE WORTHINGTON JET CONDENSER WITH TRIPLE EXPANSION STEAM CYLINDERS

In large plants where the feed water is heated by economizers or by exhaust steam from sources other than the auxiliaries, the refinement of the condensing apparatus by compounding the steam cylinders may be carried a step farther with excellent results.

The cost of producing the vacuum is reduced to a minimum, the operation often being with greater economy than obtained by the main engine itself.

The cut on the opposite page is from a photograph of a condenser with triple expansion steam cylinders, and shows the simplicity and convenience of the design. The steam cylinders are so arranged that any piston may be examined by simply removing a cylinder head, without disturbing the other cylinders in any way whatever. The valves are of the Corliss or semi-rotative type, and the high pressure cylinders are provided with cut-off valves to assure the desired rate of expansion. The steam cylinders are steam jacketed, covered with non-conducting material and lagged with Russia iron. The valve motion is of rolled steel and forgings, and the machine is in every way of superior quality and construction.

These machines are built in sizes varying from 1,000 horse-power to 10,000 horse-power in capacity. As every machine should be selected, both as to size and proportion of cylinders, to meet given requirements, it is not practicable to insert here a list of sizes.

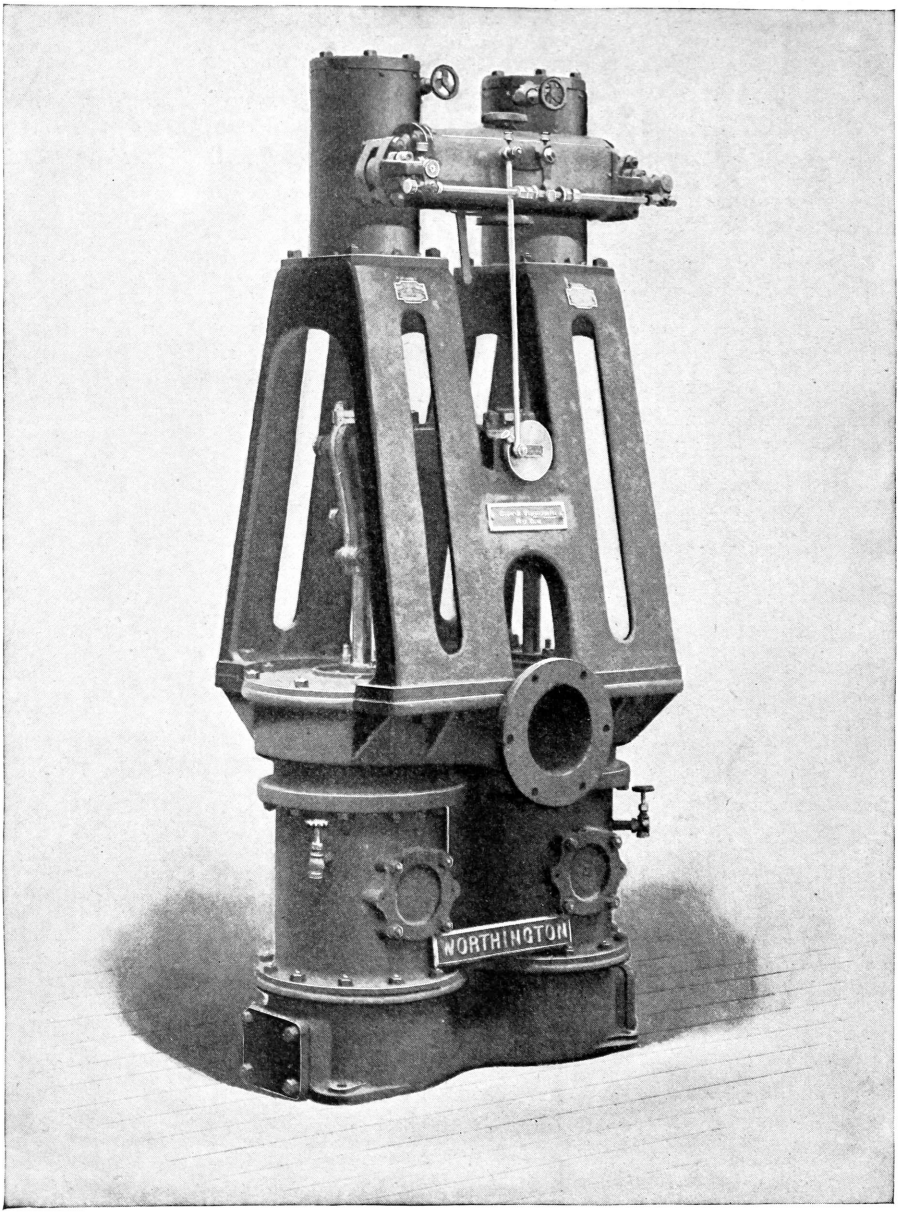
THE WORTHINGTON CENTRAL CONDENSER

The Worthington system of central condensation, by which the engines of an entire plant may be condensed by one condenser, possesses so many features of value that it is being extensively introduced into large power stations, rolling mills, and blast furnace engine-houses. It reduces the apparatus to the simplest form and at the same time allows the use of more economical types of condenser and pumps than is possible with relatively small individual condensers for each engine unit. Attendance and wear and tear are reduced to a minimum, and the degree of vacuum obtained is higher than that with ordinary air pumps and condensers. Any number of engines scattered over an extended area may be exhausted into the system, and part of them may be started up and shut down without interfering with the others.

A characteristic of the system is the use of separate water and dry vacuum pumps. The former, to handle simply the water, are usually provided with compound or triple expansion steam cylinders, and the latter, to exhaust the air from the pipe system, are designed on most economical lines, which is made possible by the fact that the air is entirely free from water.

Either the jet or surface principle of condensation may be employed, with the special advantages that belong to each. The former is to be used where good water may be had for boiler feeding, and the latter is desirable where the water is impure and the condensed steam from the engine is preferred. This subject is too extensive to be more than mentioned in this place, but further particulars may be had at the branch offices or by correspondence.

THE WORTHINGTON VERTICAL AIR PUMP OR CONDENSER



CAPACITY, 800 H.P.

THE WORTHINGTON VERTICAL AIR PUMP OR CONDENSER

WITH CROSS COMPOUND STEAM CYLINDERS

The demand for an air pump or jet condenser to occupy the least possible floor space, and still have all its internal parts easily accessible, has led to the design and construction of the Worthington Vertical Air Pump, which represents the latest advancement that has been made in this class of apparatus. The cut on the opposite page shows the pump with the condensing chamber removed. This chamber is usually placed at the rear and connects directly with the channel plate at the bottom of the pump. The opening in front is for the discharge water.

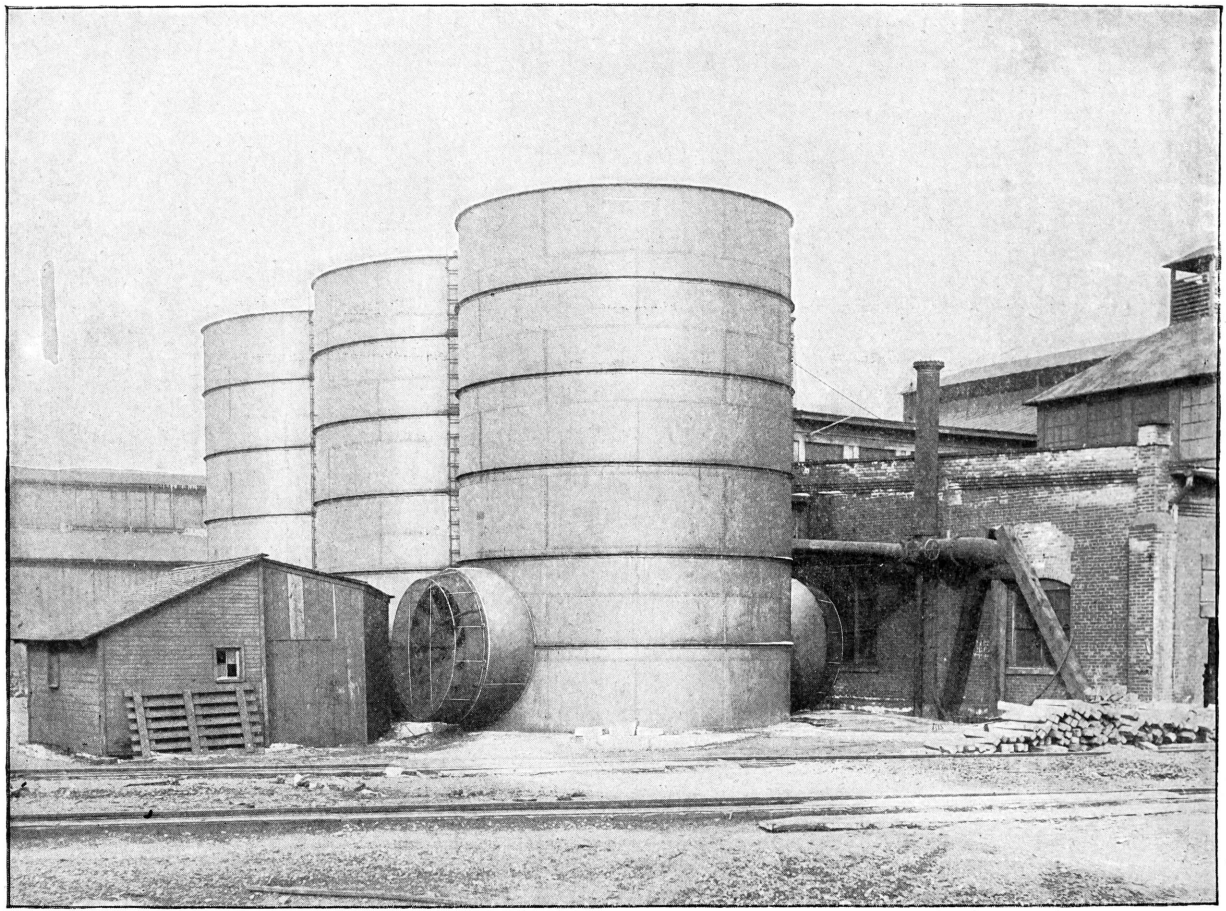
It is a pump of great simplicity and strength. Each side of the pump is single acting, the buckets being of the form used for many years in attached air pumps on marine service. The two sides are connected together by a beam and links attached to the cross-heads. As one side comes down and does but practically little work, the other side makes an up-stroke and does full work in evacuating the condenser to which the suction is attached. The steam cylinders are cross-compounded. The high pressure cylinder on one side exhausts through the valve chest to the low pressure on the other side of the pump. This is a very simple arrangement, and the benefit of compounding is obtained without complication, there being practically no more parts than with simple steam cylinders, each taking live steam, and with no attempt to use the steam expansively. The valve motion is extremely simple and durable. Aside from the outside rod which moves the small pilot valves at the ends of the steam chest there is only one moving part, which consists of two piston valves mounted upon and rigidly secured to a steel rod, both valves moving together and giving steam alternately to one side and the other as the positions of the buckets require.

The water cylinders, suction valve plate, buckets and piston rods of the air end are of the very best composition for the purpose. The steam cylinders are covered with non-conducting material and lagged with Russia iron. Each pump is fitted with a reservoir lubricator, which conducts, by means of tubing, lubricating oil to the journals of the moving parts. The entire machine is exceedingly compact, and at the same time very accessible in all its parts.

Diameter High Pressure Steam Cylinder.	Diameter Low Pressure Steam Cylinder.	Diameter Air Cylinders.	Length of Stroke.	Diameter Exhaust Opening of Condenser.	Diameter Injection Pipe of Condenser.	Telegraphic Code Word for Condensers.	Telegraphic Code Word for Air Pumps.
3½	6	8	6	5	3	Octagon	Odour
6	10	10	8	8	4	Octarchy	Ofenbank
6	10	12	8	10	4	Octavos	Offsets
6	10	12	12	12	5	Octavum	Offsetting
6	10	14	12	14	7	Octodon	Oftenness
7½	12	16	12	14	7	Octopus	Oftentide
7½	12	18	12	16	8	Ocularly	Oftimes
9	16	20	12	16	8	Oculista	Olfactive
9	16	20	15	16	8	Ocultadas	Olfactory
9	16	22	15	18	10	Ocultado	Olitory
12	20	25	18	18	10	Oddity	Oliva
12	20	30	18	20	10	Oddness	Olivary
14	25	34	18	24	12	Odiant	Olivile
16	28	40	18	28	14	Odiously	Ollite
18	32	45	24	..	..	Odiousness	Olympos

The above sizes are those usually kept in stock, but other sizes for special services can readily be furnished.

These machines can be built with simple steam cylinders, but they are not recommended except in special cases; for example, where the steam pressure is very low.



THE WORTHINGTON SELF-COOLING CONDENSER

As this machine produces vacuum without natural water supply, its value is at once apparent to practical men. By its use is afforded the opportunity to apply to any steam engine a condenser of approved and well-known efficiency. It gives to all users of steam power a means of economy heretofore unavailable except to those whose engines are in close proximity to an abundant natural water supply. Non-condensing engines in any locality can, by attaching the Worthington Self-Cooling Condenser, be run condensing, with all the benefits which accrue by the use of a vacuum.

The subject is obviously of great interest to mill owners, electric light and electric railway managers, and to all users of steam power, as a very large number of steam engines in mills and in electric light plants are situated so that an adequate supply of water cannot be obtained for the ordinary method of condensation, and consequently are non-condensing.

Those companies with generating power plants away from a natural water supply such as a river, or a canal, are severely handicapped in the matter of cost of power by competitors who have been more fortunate in the locations selected, and who, by means of condensation, are able to produce power at very much less expense. On the other hand, it may be said that sites along water fronts in large cities are expensive, and are often at a long distance from the centre of distribution of the electric current, making necessary the use of lengthy and costly conductors to transmit the current. By the use of the Worthington Self-Cooling Condenser, the advantages of condensation can be added to those of central and already determined locations.

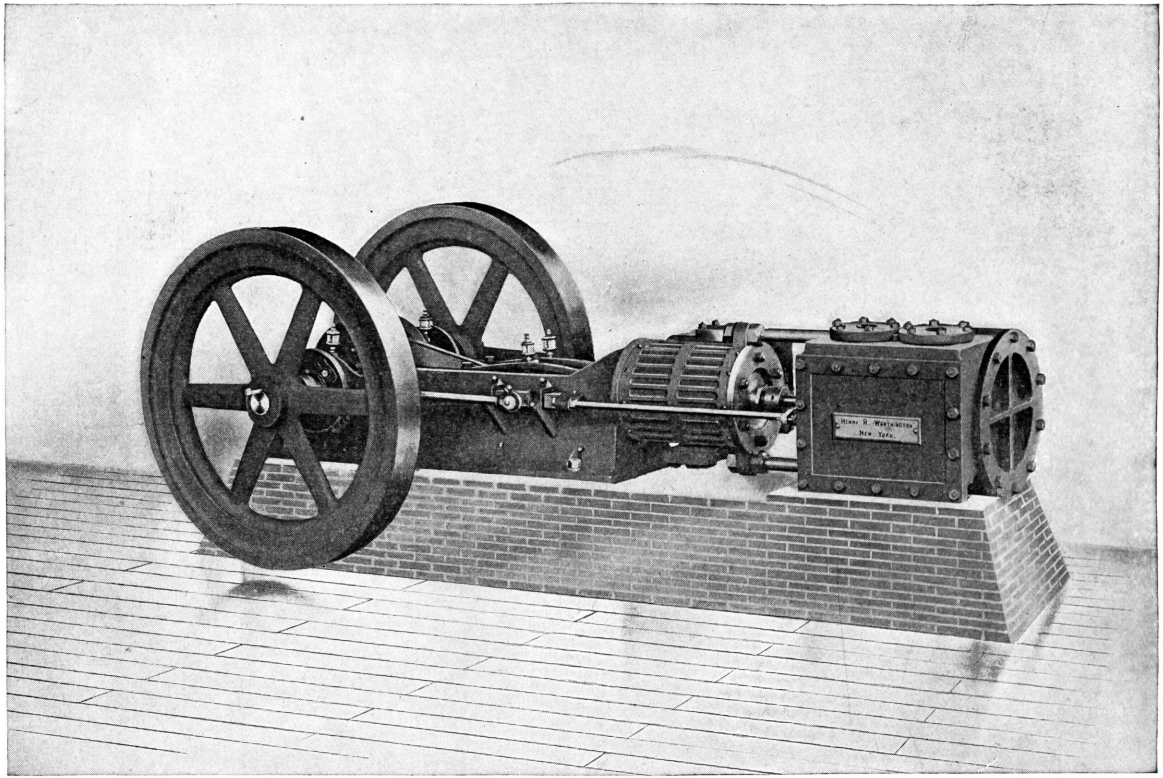
In the installation of new plants, compound condensing engines can be used with a resulting steam economy thirty to forty per cent. greater than was ever possible with single cylinder non-condensing engines.

Often electric lighting stations are located near dwellings, and the noise of the escaping steam is found to be annoying. This difficulty will be entirely relieved by the application of the apparatus here offered.

The Worthington Self-Cooling Condenser consists of two parts: the condenser in which the exhaust steam of the main engine, or engines, is condensed, and the tower in which the heated discharge water from the condenser is cooled to proper temperature, to be used again in the condenser for the further condensation of the exhaust steam. As this process is carried on continuously, only a very small supply of circulating water is required.

The opposite illustration shows cooling towers of 5,000 horse-power capacity. The condensers may be of the jet type, as described on pages 57 and 58, or, if the conditions demand, surface condensers may be used. A special circular, that can be had on application, describes at length the various features and applications of this apparatus.

The Worthington Rotative Dry Vacuum Pump



THE WORTHINGTON ROTATIVE DRY VACUUM PUMPS

This machine possesses many new features, and is distinctively a dry pump, intended to handle air practically free from water. It finds its field of usefulness in connection with the Worthington Central Condenser System described on page 59, with Torricellian condensers used with vacuum pans, triple effects, stills, and other forms of evaporators in which the highest obtainable degree of vacuum is essential.

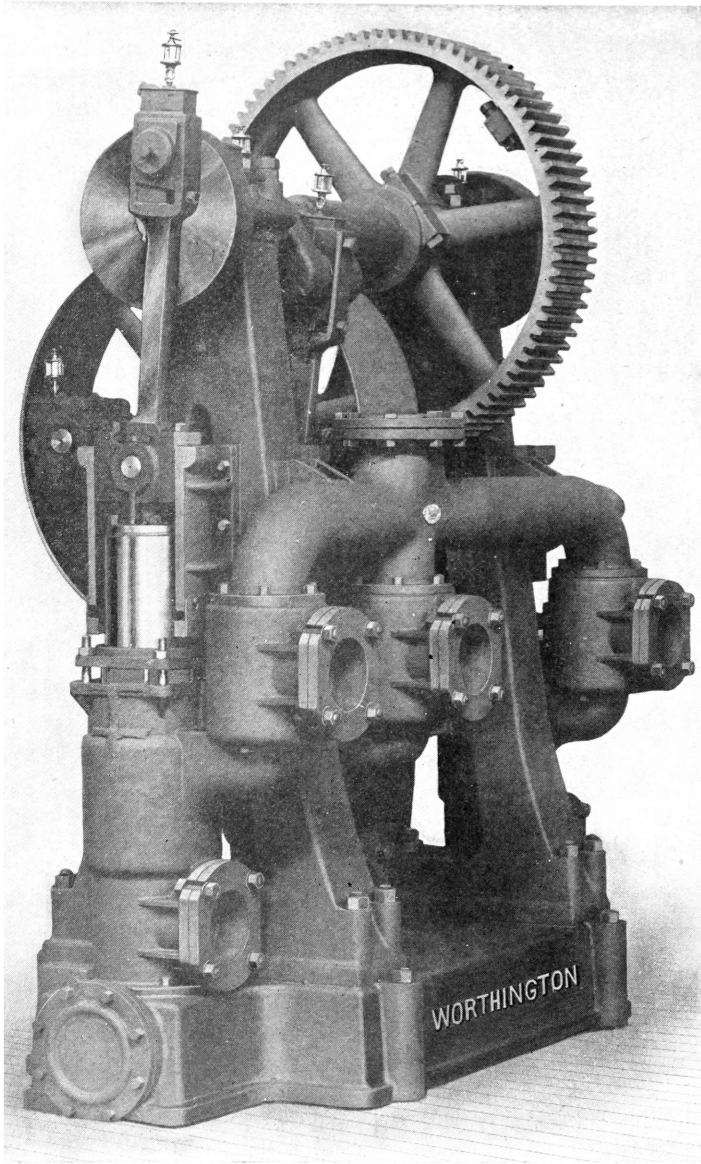
Unlike so-called dry vacuum pumps that require a considerable quantity of water in the cylinders to lubricate them and to fill the clearance spaces, this machine needs none at all in the cylinders, as the pistons are lubricated by oil in the same manner as the steam cylinders, and the clearance spaces are reduced to a minimum simply because, there being no water, large passages are unnecessary. A very small amount of water is allowed to pass through the jackets to keep the cylinders cool and to preserve the lubricating effect of the oil. Not only is a saving in water made by this machine, but the very doubtful method of putting into the cylinders water that may carry sand and grit is entirely avoided.

It will be seen from the opposite cut that both the steam and the vacuum pistons are on the same piston rod. The steam valve is a balanced slide valve with an adjustable eccentric to vary the point of cut-off according to the steam pressure. The air valve is also positively driven by an eccentric on the shaft, and so set as to open the ports fully at the proper time, leaving an unobstructed passage for the attenuated air and vapor to enter the cylinder. The absence of water and the positive control of the suction air valves permits a reasonably high rotative speed, and, unlike other pumps, the capacity for handling air is practically in proportion to the speed.

The following sizes are usually kept in stock, but any size will be built for special service:

Diameter of Steam Cylinder.	Diameter of Vacuum Cylinder.	Length of Stroke.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.			Telegraphic Code Word.
			Steam Pipe.	Exhaust Pipe.	Air Pipe.	
6	12	12	2	2½	3	Olynthos
9	12	12	2	2½	3	Olynthum
9	16	12	2	2½	4	Ombres
12	16	12	3	3½	4	Omilia
10	18	18	3	3½	5	Omslag
12	18	18	3½	4	5	Onerous
12	22	18	3	3½	6	Ongood
14	22	18	3½	4	6	Onosma

The usual running conditions are from 30 to 120 revolutions per minute. Where a lesser number is particularly desired, the result can be accomplished by placing two side by side on a single crankshaft with the cranks set 90 degrees apart.



WORTHINGTON TRIPLEX PUMP
VERTICAL PATTERN

WORTHINGTON ELECTRIC PUMPS

Electrically-driven pumps have been made the subject of most careful study, and special facilities have been secured for their manufacture. We are prepared to submit complete bids and specifications on electric pumps for any service, including high grade cut gearing and electric motors. Special designs have been made to cover the requirements of hydraulic elevator service, mine service, water works supply, irrigation, fire protection, or, in short, any service where electric motive power can be used to advantage.

We would be glad to discuss the merits and relative economy of pumping by electricity with all parties interested in the subject, and will send our special Electric and Power Pump Catalogue on application. The success of this kind of apparatus, however, depends so much upon the careful selection, not only of the size, but type of machine to be used, that full particulars of the service and the nature of the electric current should be sent to this office or to our nearest branch house when asking for estimates.

All quotations and sales of electric pumping engines are made upon the understanding that while this Company is responsible for their design, workmanship and capacity, it cannot guarantee a total absence of noise in the operation of their gearing; that more or less noise and vibration are necessarily incidental to the use of motors and gears on any electrically driven machines.

The limited space in this catalogue only permits us to illustrate a few of the many designs.

THE WORTHINGTON TRIPLEX PUMP

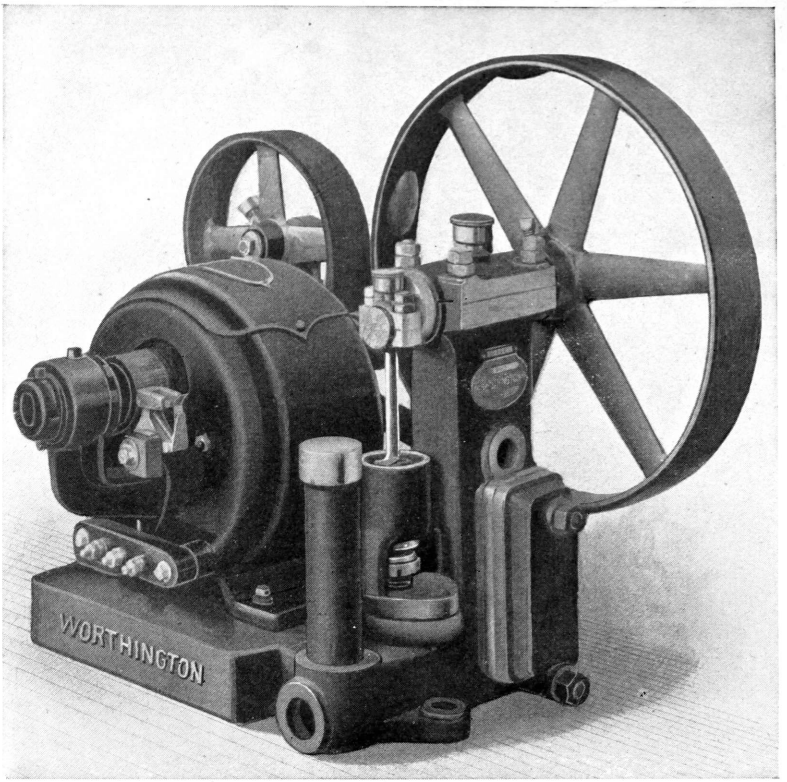
VERTICAL PATTERN

This pump, shown on the opposite page, has three plungers working through outside-packed stuffing boxes, the cranks being set at 120 degrees to each other. This insures a regular flow of water through the delivery and a practically constant load on the driving engine. The crossheads are guided, the connecting rods are made of cast steel, the bearings are babbitt, the gears are machine-cut, and all the details made in accordance with the best accepted practice. The cut shows the countershaft fitted with driving pulley for belted connection, but the same pump could be geared directly to an electric motor carried on an extended bed-plate, making the machine as a whole compact and self-contained.

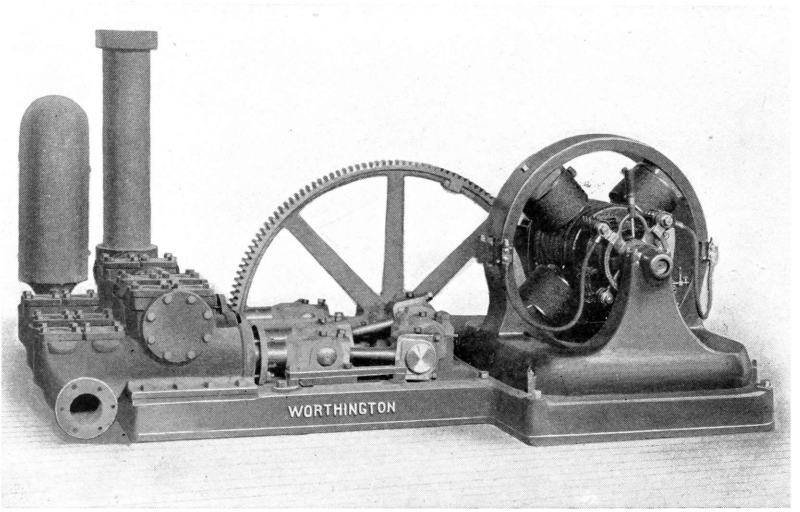
These pumps are built in sizes having capacities from ten gallons to a thousand gallons per minute.

SEND FOR SPECIAL ELECTRIC AND POWER PUMP CATALOGUE.

The Worthington Electric Pump



Worthington House Tank Electric Pump



Worthington Triplex Pump
Horizontal Pattern

WORTHINGTON ELECTRIC PUMP
FOR
HOUSE TANK AND SIMILAR SERVICE

These pumps can be used for a great variety of purposes, but are specially intended to supply the reservoir tanks of residences or office buildings where the pressure carried on the city main is not sufficient to elevate the water above the lower stories. They can be located anywhere where electrical current is available, and require little or no attention after once installed. The capacities of the two standard sizes are 250 gallons and 500 gallons per hour, respectively. The actual amount of power consumed varies between ¼ H. P. and 1 H. P., depending upon the head pumped against.

A special feature is that there are no gears, and consequently no disturbing noise, which is unavoidable even with the best cut gearing. As shown in the cut, the motor is connected by a belt running over an idler. The idler is acted upon by a spring, keeping a constant tension on the belt.

For a slight additional charge we will furnish a patented snap switch for stopping and starting the pump automatically. This arrangement insures a constant supply of water always ready for immediate use.

THE WORTHINGTON TRIPLEX PLUNGER PUMP
HORIZONTAL PATTERN

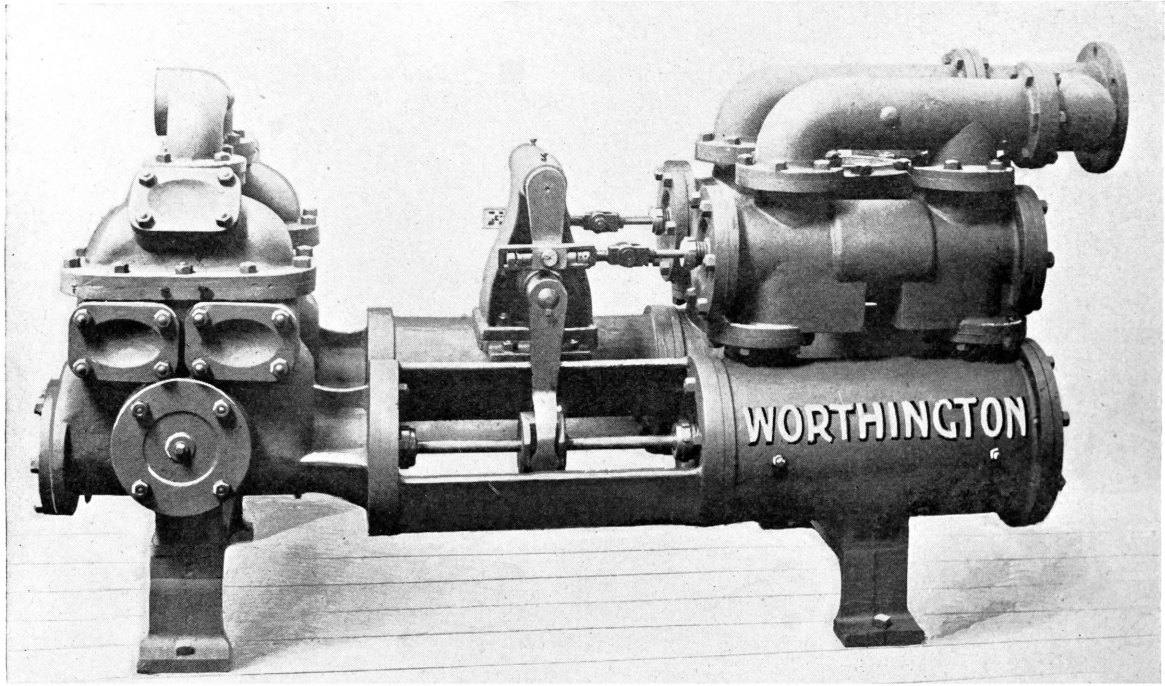
This cut represents one of the latest developments in the electric pump line. The pump has three single-acting water plungers, each working through an outside-packed stuffing box. The water valves are in separate pots, there being two suction and two discharge valves for each plunger. The connecting rods, crossheads, crank shaft and all other working parts are designed in accordance with the best practice.

The electric motors are specially wound low speed machines, carried on the same bed-plate with the pump. The motor is connected to the pump by a *single reduction of gears*, the pinion being carried on the armature shaft and the spur gear on the main pump shaft. This does away with an extended bed-plate, countershaft and additional set of gears, and enables us to offer a very compact and self-contained machine.

We have a complete line of patterns running from 2 x 4, capacity 15 gallons per minute, to 8 x 8, capacity 300 gallons per minute, the pressures varying from 250 lbs. to 1,000 lbs. to the square inch, and will be glad to make quotations on application. Full particulars of the service should be sent when asking for an estimate.

SEND FOR SPECIAL ELECTRIC AND POWER PUMP CATALOGUE.

The Worthington Water Motor



THE WORTHINGTON WATER MOTOR

The cut on the opposite page illustrates a Worthington Water Motor of ordinary size. These machines are designed to be driven by water pressure instead of steam. In their construction they do not differ materially from the Standard Worthington Steam Pump, except that the driving cylinders are provided with extra large passages suitable for the prompt and easy flow of the water.

A large number of these motors are in use, giving excellent satisfaction, and under various conditions of service as regards driving head, pumping head, and quantity of water required to be pumped per minute, ranging from one gallon per minute to over a million gallons in twenty-four hours.

As the conditions of driving head and pumping lift vary in every case, it is always necessary, in designing these motors, to know the head in feet, or pounds per square inch, and quantity in gallons per minute available for driving the motor; also the gallons per minute to be pumped, and against what head or pressure; also whether the water to be pumped is the same as that used for driving the machine or not.

For the above reasons we cannot furnish a regular list of sizes, as each demand, having different conditions, requires a special proportioning of the driving and pumping cylinders to suit the case.

When the following information is furnished, Worthington Water Motors adapted for any conditions of service and of any capacity can be furnished:

1st. Height to which the water is to be pumped, its quality, and length of delivery pipe from motor to point of delivery.

2d. Head in feet, or pounds pressure per square inch, under which the water to be used in driving the machine will enter the cylinder, and the quantity available.

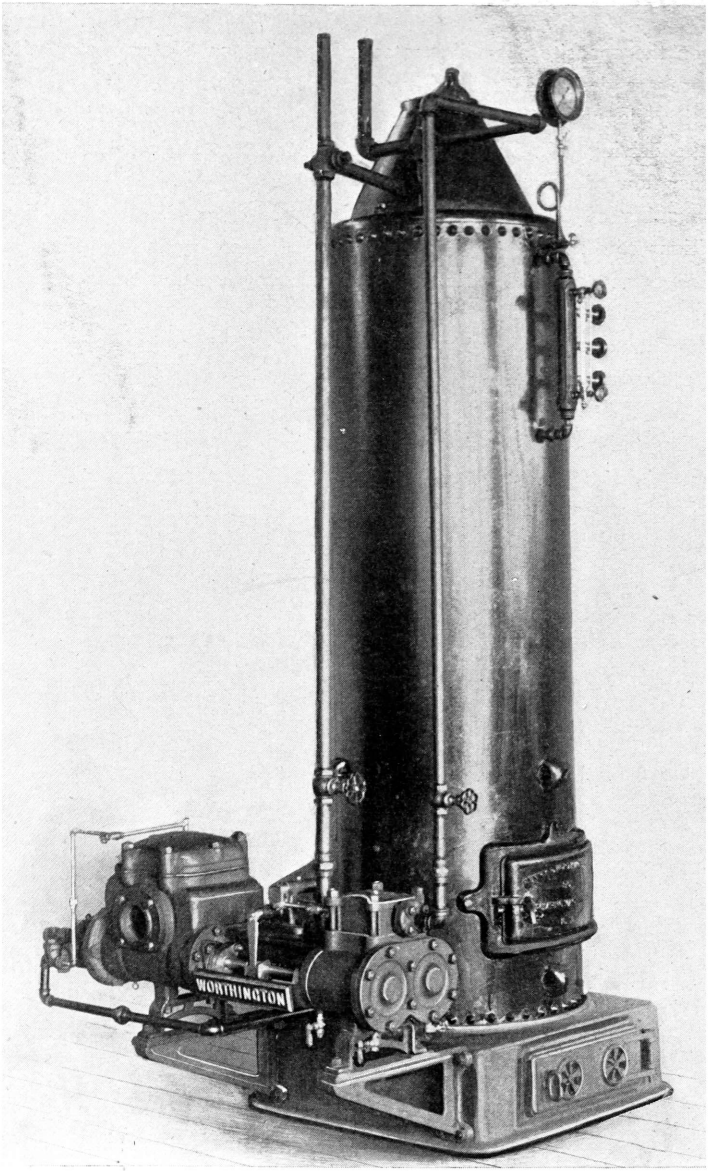
3d. The length of supply pipe from fountain head to the machine.

4th. Whether the pump suction can be taken from the driving supply pipe or from some other source.

The Worthington Water Motor received an award at the World's Columbian Exposition, which reads as follows:

"Two pressure cylinders, worked with water pressure at one end, drive two pumps at the other. The valve motion is a tappet motion, one piston rod giving motion to the valve on the other cylinder. It may be regarded as an Hydraulic Relay or pressure intensifier. It is a very useful appliance, and can be employed to pump water at a long distance, instead of having an isolated steam plant, which would require more attention, and, in many cases, an extra boiler and attendant."

The Worthington Steam Pump and Boiler



THE WORTHINGTON STEAM PUMP AND BOILER

The illustration on the opposite page represents the Worthington Steam Pump and Boiler, complete with auxiliary feed, boiler base, smoke bonnet, shaking and dumping grate, water columns, 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 fittings.

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 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 end feed, attached to one of the piston rods. This is the most durable, safe and certain means of supplying the boiler with water that can be used. This apparatus is easily understood and managed. It is simple, compact, durable, economical and efficient, and was designed with a special view to meeting the pumping requirements of Railroad Water Stations, Quarries, Brick Yards, Coffer Dams, Country Residences and Hotels, and all isolated places where a complete independent pumping plant is in demand. The Low Service or Tank Pumps are suitable only for places where water is to be forced not higher than fifty to seventy-five feet.

It is necessary that full particulars of the duty to be performed should be furnished with all orders or inquiries.

FOR GENERAL SERVICE

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, varying with kind of work and pressure.	Gallons delivered per minute by BOTH Plungers at stated number of strokes.	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.				Telegraphic Code Word.
							Steam Pipe.	Exhaust Pipe.	Suction Pipe.	Discharge Pipe.	
3	2	3	.04	100 to 250	8 to 20	2 7/8	3/8	1/2	1 1/4	1	Pabellon
4 1/2	2 3/4	4	.10	100 " 200	20 " 40	4	1/2	3/4	2	1 1/2	Pabone
5 1/4	3 1/2	5	.20	100 " 200	40 " 80	5	3/4	1 1/4	2 1/2	1 1/2	Pacensa
6	4	6	.33	100 " 150	70 " 100	5 5/8	1	1 1/4	3	2	Pachola
7 1/2	5	6	.51	100 " 150	100 " 150	7	1 1/2	2	4	3	Pacifico
7 1/2	4 1/2	10	.69	75 " 125	100 " 170	6 3/8	1 1/2	2	4	3	Packhof
9	5 1/4	10	.93	75 " 125	135 " 230	7 1/2	1 1/2	2	4	3	Paclite
10	6	10	1.22	75 " 125	180 " 300	8 1/2	2	2 1/2	5	4	Pactilis

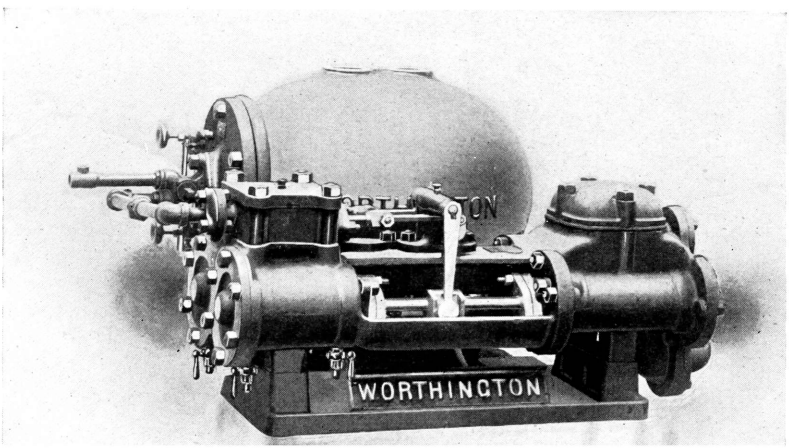
FOR TANK OR LIGHT SERVICE

4 1/2	3 3/4	4	.20	100 to 200	40 to 80	5 1/4	1/2	3/4	2 1/2	1 1/2	Pactole
5 1/4	4 3/4	5	.38	100 " 150	75 " 110	6 3/4	3/4	1 1/4	3	2	Paddeln
6	5 3/4	6	.67	100 " 150	130 " 195	8 1/8	1	1 1/4	4	3	Padelin
6	7 1/2	6	1.14	100 " 150	225 " 340	10 1/4	1	1 1/4	6	5	Padesoy
7 1/2	7 1/2	6	1.14	100 " 150	225 " 340	10 1/4	1 1/2	2	6	5	Padrasto
6	8 1/2	6	1.47	100 " 150	295 " 440	12	1	1 1/4	6	5	Pagack
7 1/2	6	10	1.22	75 " 125	180 " 300	8 1/2	1 1/2	2	5	4	Pailfuls
7 1/2	7	10	1.66	75 " 125	245 " 410	9 7/8	1 1/2	2	6	5	Paillis
7 1/2	8 1/2	10	2.45	75 " 125	365 " 610	12	1 1/2	2	6	5	Painful
9	8 1/2	10	2.45	75 " 125	365 " 610	12	2	2 1/2	6	5	Pairaba

A slight additional charge is made when Pumps are fitted with Brass Plungers and Piston Rods. To designate the sizes, give the diameters of Steam Cylinders and Water Plungers, and length of stroke.

THE WORTHINGTON AUTOMATIC FEED PUMP AND RECEIVER

PATENTS PENDING



WORTHINGTON AUTOMATIC FEED PUMP AND RECEIVER

PATENTED

The main difficulty met with in any attempt to design a device for automatically controlling the speed of a pump through the level of water in a tank is to secure a reliable form of float. It has been found practically impossible to make a hollow float that will stand water pressure and remain tight; so that in the place of the air tight copper balls, formerly used so extensively, various forms of displacement floats depending upon counterbalance weights to make them operative are now employed.

In the construction of receiver tanks used for handling the drainage from steam heating pipes and similar services, these weights are sometimes placed on levers operating on the outside of the tank and connected to the interior float by means of a stem passing through a stuffing box. The objection to this arrangement is found mainly in the stuffing box itself. which, if packed tight enough to be free from the chance of leakage, will often bind the stem so as to interfere with the proper operation of the float within.

The automatic arrangement illustrated herewith is believed to be freer from all the defeets common to this class of apparatus than any heretofore devised. As will be seen in the sectional view, a float of copper "A" is provided with a hole in the top through which the water as it enters the tank is allowed to flow until the float is entirely filled. Its weight, when filled with water, is counterbalanced by the iron weight "B" secured on the opposite end of the beam. As the float is an open one, the pressure of course is equal on the inside and out, so that there is no tendency to collapse. The rising and falling of this float, depending upon the level of the water in the tank, operates a balanced valve which controls the admission of steam to the pump. The stem of this valve passes through a stuffing box located within the tank, any leakage from which is caught by the tank, and is thus unobjectionable. As this stem has no work to perform except to move the balanced valve, it is of small diameter and its stuffing box so insignificant in size that even should the packing tend to stick on the stem, it could not exert friction enough to interfere in any way with the function of the float.

It will be seen that all the moving parts of the apparatus are attached to the head, with which they can be withdrawn, should occasion require it. The journal on which the beam operates is made with special reference to the situation and to its having to act without oil. The shape of the tank itself is such as to secure the greatest strength with the least weight.

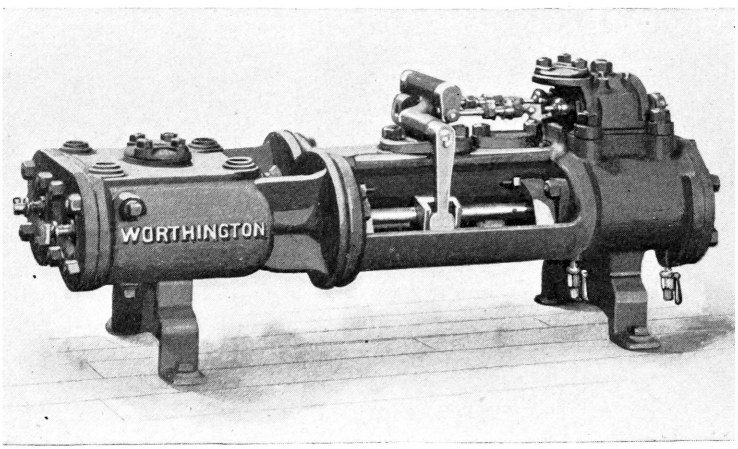
The patented feature of the combination of the controlling valve with the two-way one, located just beyond it in the same casting, and so arranged as to permit, when desired, the steam to pass directly to the pump without passing through the balanced valve, is embodied in this arrangement, and is one that has always been appreciated by steam users throughout the country.

The Worthington Automatic Feed Pump and Receiver is made in four sizes, according to the following list:

No.	Size.	Amount of Radiating Surface it will Drain.	APPROXIMATE DIMENSIONS.			Telegraphic Code Word.
			Length.	Width.	Height.	
1	3 x 2 x 3	5,000 square feet	3 ft. 1 in.	2 ft. 6 in.	23½ in.	Quacha
2	4½ x 2¾ x 4	12,500 " "	3 " 3 "	2 " 9½ "	23½ "	Quader
3	5¼ x 3½ x 5	25,000 " "	3 " 9 "	3 "	23½ "	Quadrelle
4	6 x 4 x 6	40,000 " "	4 " 2 "	3 " ½ "	23½ "	Quadrin

We can also supply these receivers for use in connection with electric pumps, automatically controlled, if desired.

THE WORTHINGTON AIR COMPRESSOR



SIZE, 5¼ x 3½ x 5

THE WORTHINGTON AIR COMPRESSOR

The many new uses to which compressed air has recently been applied, and the increased demand for a reliable and simple machine for operating air hoists, rock drills, deep well air lifts, mine pumps, pneumatic tools, and many other purposes, have led to the development of the Worthington Duplex Direct-Acting Air Compressor.

Compressed air is the cleanest, most convenient, and in many cases the most economical transmitting agent. We continually hear of new and successful applications, and receive reports from engineers who have made a marked improvement in some part of their plant by substituting compressed air for steam or electricity. It offers many advantages where there is any material distance between the points where the power is generated and where it is to be applied. However, a careful study of all the conditions is necessary in order to determine which is preferable. Because wire is cheaper than pipe, it does not follow that electricity is more economical than compressed air.

The following is a list of our standard sizes of air compressors, together with their capacities in cubic feet of free air per minute, at normal piston speed. These compressors have high pressure steam cylinders only. In cases where the boiler capacity is limited, where fuel is costly, or where, for other reasons, it is desirable to save steam, we can furnish compound steam cylinders, either condensing or non-condensing, for any of the specified sizes having strokes greater than five inches. By compounding the steam cylinders, it is estimated that a saving in fuel of from thirty to thirty-five per cent. will be effected.

Diameter of Steam Cylinders.	Diameter of Air Cylinders.	Length of Stroke.	Capacity in Cubic Feet of Free Air per minute.	Diameter of Steam Pipe.	Diameter of Exhaust Pipe.	Diameter of Outlet.	Telegraphic Code Word.
*4½	3	4	4	½	¾	1	Rabacal
*4½	4	4	6½	½	¾	1	Rabalde
5¼	3½	5	6¼	¾	1¼	1	Rabalva
*5¼	4¾	5	11	¾	1¼	1	Rabbinica
*5¼	6	5	16½	¾	1¼	1	Rabanus
6	3½	6	7	1	1¼	1	Rabbi
*6	4¾	6	12	1	1¼	1	Rabbino
*6	6	6	19½	1	1¼	1	Rabello
6	6	6	19½	1	1¼	1	Rabeta
*6	8¼	6	38	1	1¼	1½	Rabisco
*7½	8¼	6	38	1½	2	1½	Rabiza
7½	6¾	10	52	1½	2	2	Rabonnir
9	6¾	10	52	2	2½	2	Rabote
10	6¾	10	52	2	2½	2	Rabotons
7½	9	10	104	1½	2	2½	Rabusca
10	9	10	104	2	2½	2½	Racamas
12	9	10	104	2½	3	2½	Raccolta
14	9	10	104	2½	3	2½	Raccord
10	12	10	188	2	2½	3	Racemabis
12	12	10	188	2½	3	3	Races
14	12	10	188	2½	3	3	Rachitis

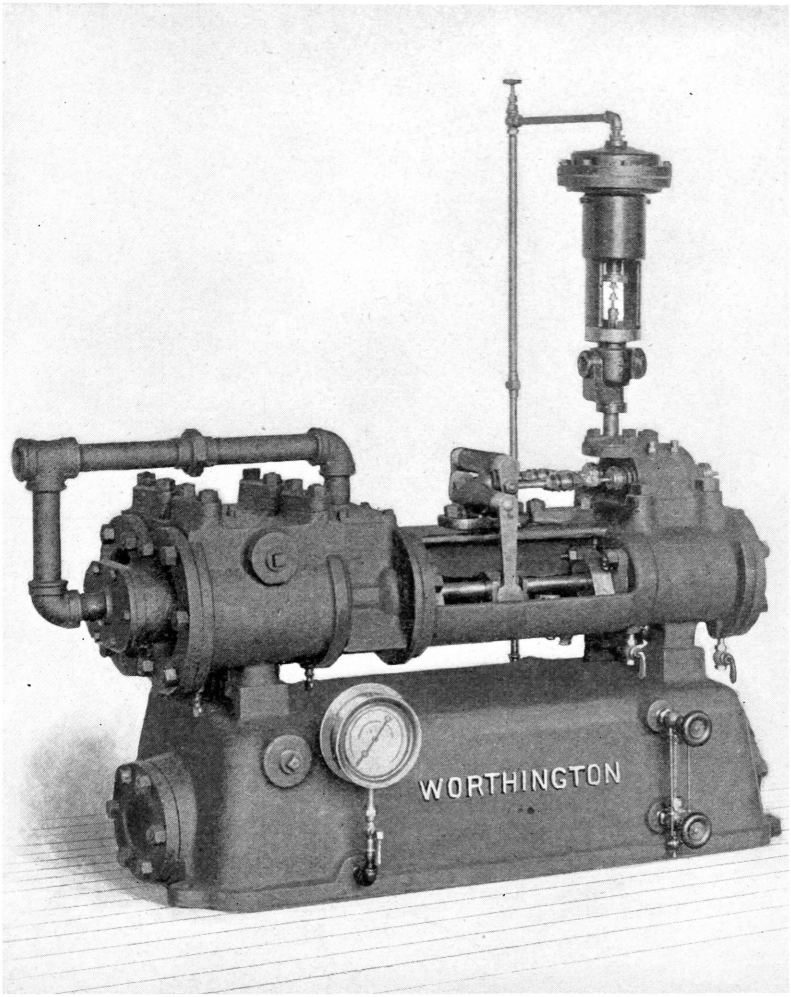
* Not jacketed.

A slight additional charge is made for fitting with brass air pistons and piston rods; also for bed-plates, as shown in cut.

When asking for estimate, state quantity in cubic feet of FREE AIR *per minute, and maximum pressure. Prices on belt-driven Air Compressors, on application.*

THE WORTHINGTON BEER RACKING PUMP

PATENTED



SIZE, 5¼ x 6 x 5

THE WORTHINGTON BEER RACKING PUMP

The Worthington Beer Racking Pump and Reservoir is the result of a continually increasing demand among brewers for an inexpensive and at the same time a reliable machine for racking beer.

This apparatus, which embodies many recent improvements, is entirely new, having been especially designed to meet the requirements of the service for which it is intended.

As will be seen from the cut on the opposite page, the Compressor is mounted on an Air Reservoir, of such dimensions as to give proper storage capacity, this Reservoir also serving as a bed-plate. The air cylinders are composition lined, and the piston rods are of brass. Each machine is fitted with a lubricator, glass water gauge, pressure gauge, drip cocks and automatic air pressure regulator complete.

As evidence of its superiority we need only call attention to the following features in which it differs materially from all other machines offered for the same purpose.

The Pressure Regulator automatically controls the speed, slowing down and finally stopping the pump when the desired air pressure is obtained, and gradually starting up again when the air is withdrawn from the Reservoir.

The entire apparatus is compact, durable and self-contained, has no intricate working parts liable to get out of order, and requires little if any attention on the part of the engineer.

To select the size best adapted to any special case, it is necessary when ordering to state:

The maximum *gauge* pressure against which the Compressor is to work;

The number of cubic feet of air at *atmospheric pressure* required per minute;

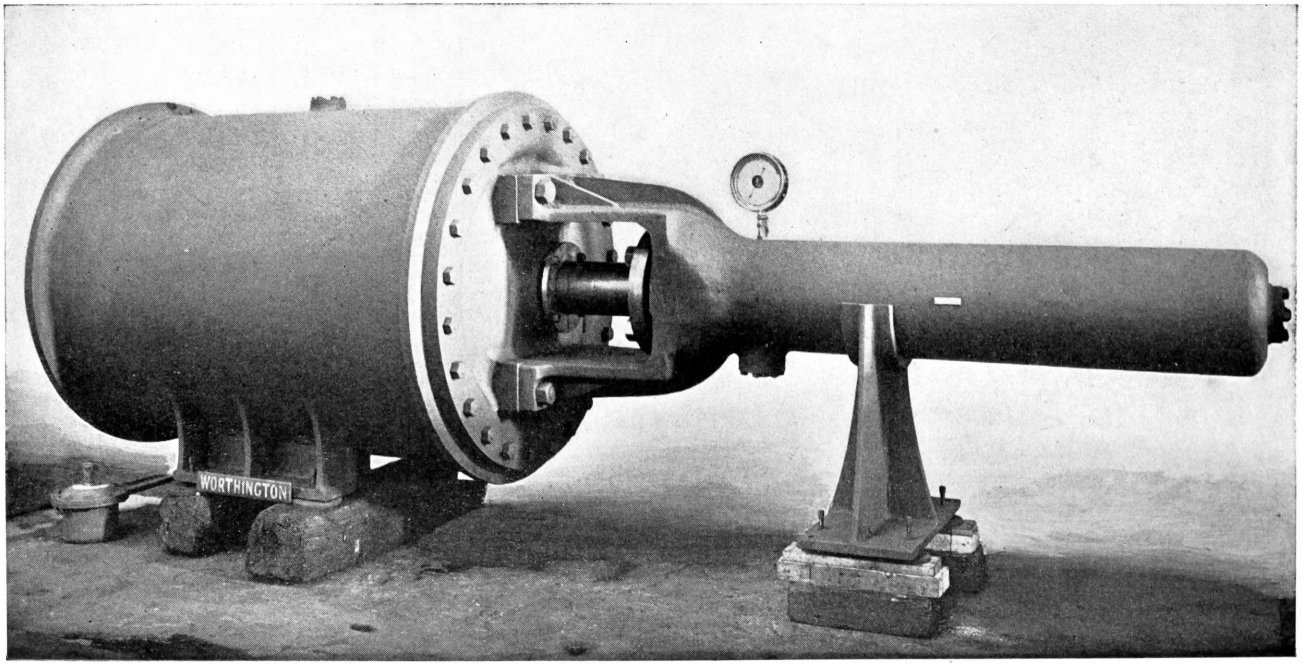
The available effective steam pressure.

The following sizes, which are constantly kept in stock, can be furnished on short notice. The larger machines differ somewhat in design from that shown in the cut, but the same principles apply to all sizes.

Diameter of Steam Cylinders.	Diameter of Air Cylinders.	Length of Stroke.	Annual Capacity of Brewery.	SIZES OF PIPES FOR SHORT LENGTHS. To be increased as length increases.				Telegraphic Code Word.
				Steam Pipe.	Exhaust Pipe.	Inlet Pipe.	Outlet Pipe.	
5¼	6	5	20,000 to 50,000 bbls.	¾	1¼	1½	1	Racimar
6	8¼	6	50,000 " 100,000 "	1	1¼	2	1½	Racimo
7½	9	10	100,000 " 150,000 "	1½	2	3	3	Racktau
9	12	10	150,000 " 200,000 "	2	2½	4	3	Racoma

To designate the sizes, give the diameters of Steam and Air Cylinders, and length of stroke.

THE WORTHINGTON STEAM ACCUMULATOR



THE WORTHINGTON STEAM ACCUMULATOR

The cut on opposite page illustrates a Horizontal Steam Accumulator covered by Letters Patent. It consists of an ordinary steam cylinder such as would be used in a steam engine, excepting that it has no ports or valve, combined with a ram cylinder similar to that of a weighted accumulator. Instead of a weight, a steam piston, acted on by a fixed steam pressure, exerts the necessary force on the ram. The ram is securely bolted to the piston and passes through two stuffing-boxes, one in the steam cylinder head and the other in the ram cylinder. The stuffing-box in the steam cylinder head is lightly packed, as its only office is to prevent the leakage of the exhaust steam, which is let into the back end of the steam cylinder to keep hot the walls of the cylinder and the piston.

The supply of steam to the pump is regulated to meet the variations of consumption of water in the following manner: The steam supply to the pump is taken from the interior of the accumulator steam cylinder through a perforated regulating pipe.

The position of the accumulator steam piston, which depends on the amount of water stored in the ram cylinder, governs the number of holes in the regulating pipe which open into the interior of the steam cylinder, and so controls the amount of steam supplied, and hence the speed of the pump. In service, as the ram cylinder fills, the speed of the pump decreases, until just before the steam piston reaches the head of the accumulator cylinder all the holes in the regulating pipe are shut off by the sleeve in the steam piston, thus stopping the pump. As the water is drawn off from the ram cylinder, the number of holes uncovered in the regulating pipe gradually increases until enough are open to drive the pump at its full speed. By this arrangement variations in the speed of the pump are gradual, which is essential to the quiet operation of a heavy pressure pump on a varying consumption of water.

The condensation of steam in the regulating pipe and heating of the ram are avoided by a wall of non-conducting material between the inside wall of the ram and the outside of the regulating pipe.

The steam in the steam cylinder is maintained at a constant pressure by means of a reducing valve located in the steam pipe just before it enters the cylinder. This valve is set at a pressure not exceeding the minimum pressure carried in the boiler, thus insuring a constant pressure at all times in the cylinder.

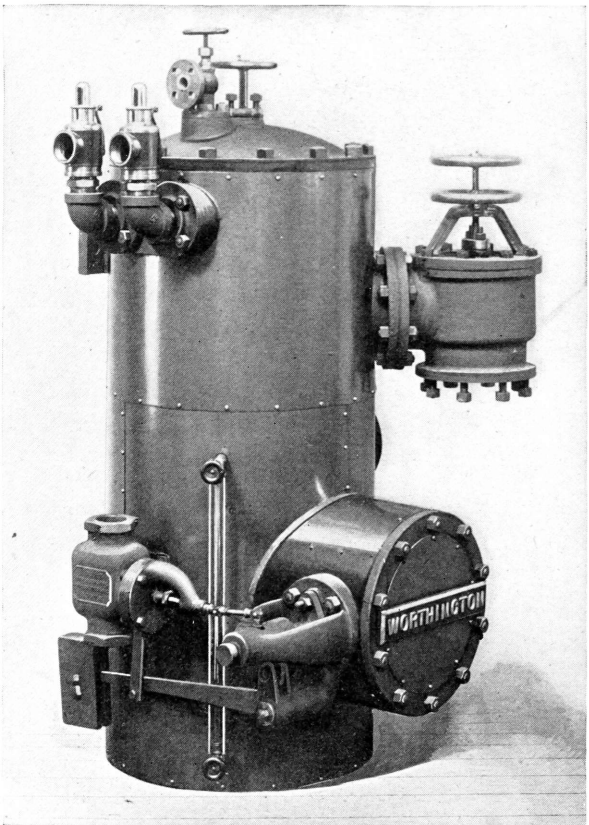
The advantages of this accumulator over the ordinary weighted accumulator can be readily understood, being so apparent as to hardly warrant calling attention to them. The most important and marked difference is in the effect on the water pressure. The steam accumulator is not subject to the tremendous shocks and jars due to the momentum of the weights of the weighted accumulator. The moving parts of the steam accumulator being so light that momentum is not a factor, the machine is very sensitive and the variations of the water pressure very slight. As the steam pressure is regulated by a reducing valve, this can be very carefully adjusted and varied at will.

The steam accumulator can be adapted to any space, as it can be placed either horizontally or vertically, and as it is not heavy it can even be hung from roof beams, if necessary.

At first glance, the condensation of a steam accumulator might seem to be quite an item, but when it is understood that the steam pressure is constant on one side of the piston, and that the cylinder is not being constantly filled and exhausted like a steam engine, it will be seen that the only loss by condensation is from radiation, which, when the cylinder is well clothed, amounts only to about one per cent.

THE WORTHINGTON MARINE FEED WATER HEATER

PATENTED NOV. 1, 1892; OCT. 17, 1893



ove illustration is taken from an Auxiliary Heater used with an Engine of 6,000 H.

THE WORTHINGTON MARINE FEED WATER HEATER

The advantages to be gained by feeding hot water to boilers are so well understood and appreciated that it is unnecessary to mention them here, but as most of the devices heretofore built for the purpose have proven so unsatisfactory, through their uncertainty of action and liability to get out of order, the endeavor has been to avoid the causes of these difficulties in the Worthington Marine Feed Water Heater, and make it as simple as possible. That it is an apparatus that is reliable, efficient, and durable is shown by the performance of those that have been in practical service for the past seven years on board a number of the largest and swiftest transatlantic and coasting steamships.

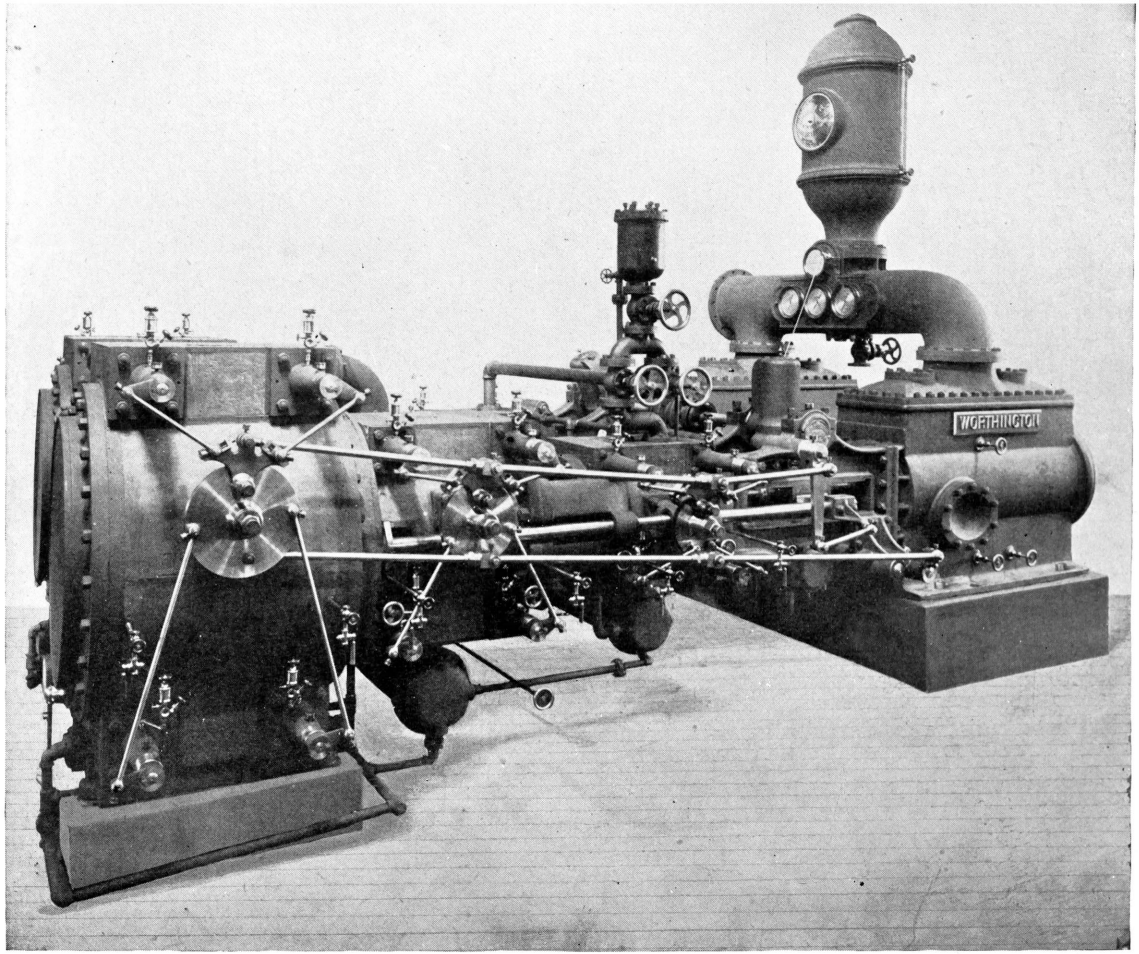
The Worthington Marine Feed Water Heater, shown on the opposite page, although equally suited for land use in connection with condensing or non-condensing engines, was specially designed for use in connection with triple expansion and quadruple expansion marine engines for heating the feed water by utilizing the heat in the exhaust steam from the auxiliaries; and where this is not sufficient, using live steam, or steam from the intermediate or low-pressure receivers of the main engines. In the case of marine boilers working under heavy pressures, the practice of feeding with water at high temperatures not only leads to economy of fuel, but also increases the life of the boilers, and relieves them of the strains due to expansion and contraction.

Heating the feed water by live steam, or steam from the intermediate receivers, however, secures but a comparatively small economy, as the main engines are thus robbed of steam capable of still performing *useful* work. The utilization of exhaust steam, after performing *all* its *useful* work, containing as it does nearly the same number of heat units as live steam, or steam from the intermediate receiver, gives all the advantages derived from using live steam, besides *economizing* the heat which would be rejected and lost in the condenser.

It is with the view of securing the greater economy to be gained by utilizing the exhaust from the auxiliaries that the Worthington Feed Water Heater is offered. It is equally suitable for live steam, but such use is only recommended where there is not sufficient exhaust steam for heating the feed water to the desired temperature. On several large steamers, where only exhaust steam from the auxiliaries is used, the temperature of the feed water is raised by the Worthington Heater from between 130 and 140 degrees Fahr., at which it leaves the hot-well, up to 210 to 215 degrees Fahr. In modern steamships, especially those of large size employing numerous auxiliary engines, considerable economy is effected by turning the exhaust steam into a heater, instead of into the condenser, where its heat is *practically lost.*

As an example of the economy to be secured by the use of this heater, the record made by one in use on a triple expansion engine of 10,000 H. P. using about 15 pounds of steam per I. H. P. per hour may be given. The temperature of the water is raised by the Heater from that of the hot-well, which is not above 120 degrees, to a temperature of 210 degrees, an increase of 90 degrees, which corresponds to a saving of 13,500,000 heat units per hour. Assuming that one pound of coal will give out 11,000 heat units, the saving is about 1,230 pounds of coal per hour, or 13 tons per day, and as this engine averages 200 working days per year, a saving in coal of 2,600 tons is effected, the cost of which would pay for the Heater and pumps several times over.

A special catalogue, descriptive of the Worthington Marine Feed Water Heater, will be furnished on application.



THE WORTHINGTON HIGH DUTY TRIPLE EXPANSION PUMPING ENGINE

WORTHINGTON WATER WORKS PUMPING ENGINES

The Worthington Pumping Engine in its earliest form was first applied to water works service for the city of Savannah, Ga., in the year 1854. Six years later the improvement known as the Duplex valve motion was invented, and from that time Worthington engines have been so extensively introduced for the supply of water for cities and towns, that to-day there are more of them in use than those of all other types combined.

Since the erection of the first Worthington Engine, over forty years ago, the demands of a most varied and extended service have resulted in the perfecting of seven distinct types of the machine, each possessing distinctive features and improvements adapted to its class of work. In small water works, where the power and capacity are moderate, and where economy in fuel consumption is of little consequence, the pumps for general service, illustrated on pages 12 and 18, are found to be appropriate and satisfactory. When as the magnitude and importance of the plants are somewhat increased, and attention begins to be attracted to the question of more economical operation, a pump better adapted for the service would be the Compound class, illustrated on pages 16 and 22. A still higher and more important class of station would call for the Compound Condensing Engine. The latter type has been most extensively used, and through a range of capacity extending from 2,000,000 up to 30,000,000 of gallons daily.

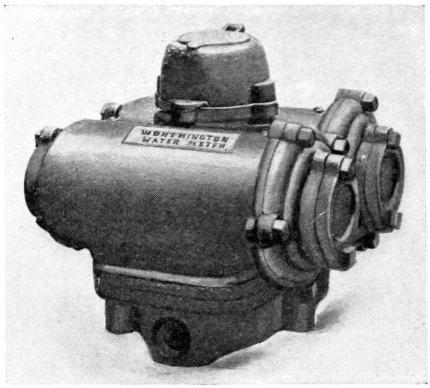
As the demand for even greater economy in fuel was made manifest, the Worthington Engine, keeping abreast of the times, developed into the Triple Expansion, the High Duty Compound, High Duty High Ratio Compound, and the High Duty Triple Expansion forms. These latter embody all the refinements and improvements found in the latest and most advanced practice in steam and hydraulic engineering.

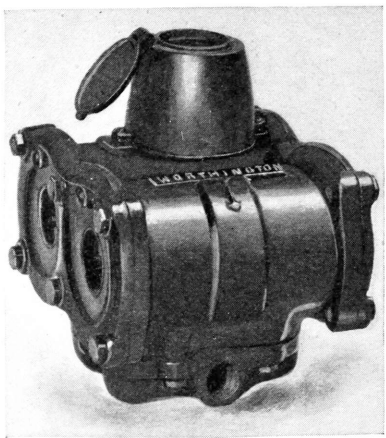
In the past 45 years upward of 1,600 Worthington Pumping Engines of record have been built and furnished to water works in all parts of the world. Up to January, 1900, the aggregate daily capacity of all the Worthington pumping engines in water works service was over 5,132,000,000 gallons, equalling about 3,564,000 gallons per minute.

The illustration upon the opposite page represents the Worthington High Duty Triple Expansion Pumping Engine. This engine is extensively used in the leading pumping stations throughout the world, where the high cost of fuel necessitates the employment of an engine of the highest economy, combined with simplicity of construction, absolute reliability, and safety. It also possesses the advantage of requiring very little space and inexpensive foundations.

Estimates will be furnished upon application for Pumping Engines of any type and capacity for water works service, sewage, irrigation, etc.

The Worthington Water Meter





THE WORTHINGTON WATER METER

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 consumers and manufacturers; by oil and gas companies, for measuring oil; and for many other liquids in connection with tanks, retorts, and fuel oil burners. The Worthington Meter is in use on a wider variety of services than any other type.

It has been fully tested by the principal Water Works Companies in the United States and Canada, having been in use for over forty years; and, while the general principle on which the meter acts remains the same, it has been made the subject of careful study and improvement. The principle of the reciprocation of plungers, each stroke of which is recorded on the counter, insures a meter which is positive and cannot pass the fluid to be measured unless properly at work. In this important respect it differs from "Inferential" and "Rotary" meters, through which the flow of water is almost uninterrupted even if the meters chance to cease working. The water valves are plain slide valves, directly acted on by plungers, thus dispensing with levers, rockshafts or similar contrivances. It is of great importance that the meter selected should be of a size adapted to the work. The greatest quantity of water to be drawn per minute should, therefore, govern the selection of the proper size on ordinary water works service. For measuring crude oil, naphtha, or oil fed to burners, both maximum and minimum amount required per minute, the minimum head under which the oil will come to the meter, and the general arrangement of the pipe distribution, will govern its selection, and should be stated in all cases.

To put up and start the meter, place it in a level position with the counter up; connect the supply pipe with the meter at the hole marked "Inlet." The outlet pipe is on a line with the inlet on the opposite side of the meter. 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 reading of the counter, and by subtracting the reading taken at any time from that last taken, the consumption of water for the intermediate period is obtained. The flow of water should be perfectly continuous so long as the water is being drawn through the meter.

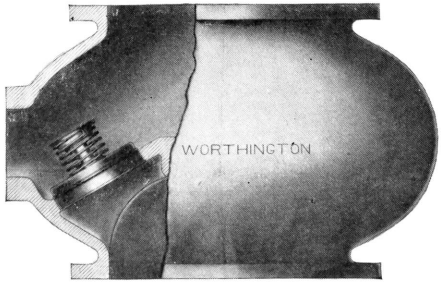
Size of Opening.	Greatest proper quantity per minute.	TELEGRAPHIC CODE WORDS.		
		Meter.	Brass Couplings.	Permanent Box.*
⅝ inch pipe.	1½ cubic ft. or 11¼ galls.	Sabajam	Sabunde	Saconite
¾ "	3 " 22½ "	Sabaye	Sabus	Sacras
1 "	5 " 37½ "	Sabbire	Sacalao	Sacrifia
1½ "	6 " 45 "	Sabelen	Saccate	Sacrilega
2 "	8 " 60 "	Sabinar	Sacchi	Sacrolli
3 "	23 " 172 "	Saboga	Sacello (Screw Flanges.)	
4 "	60 " 450 "	Saborida	Sachola (Screw Flanges.)	
6 "	120 " 900 "	Sabtah	Sackuhr (Screw Flanges.)	

* 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. Ordinary rough boxing charged for at cost.

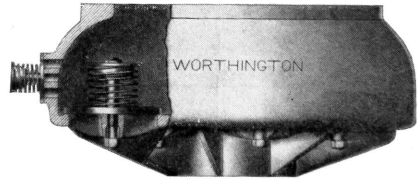
The quantities given in the second column of the above table represent a rate of delivery that can be exceeded with this machine, but which should be accepted as the maximum at which it is advisable to run any water meter continuously. Whenever, in the effort to make a small machine answer for a large one, this rate is exceeded, a greatly increased wear and tear are invariably the consequence.

A special catalogue, fully descriptive of the Worthington Water Meter, will be furnished on application.

The Worthington Check and Foot Valves

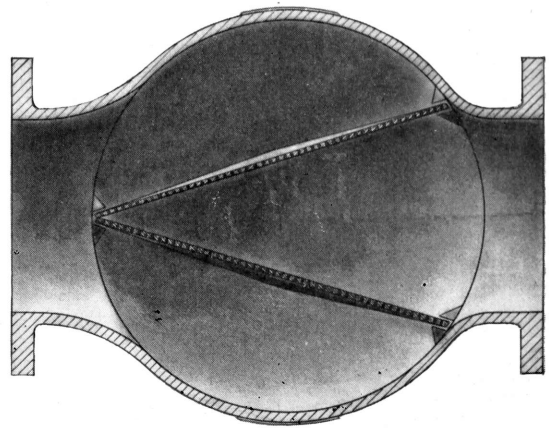


CHECK VALVE
8 IN. AND OVER



FOOT VALVE
12 IN. AND OVER

The Worthington Strainer-Box and Strainer



THE WORTHINGTON STRAINER-BOX 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 design and adoption of the arrangement shown in the illustration opposite.

As will be seen by an examination of the illustration, the strainer consists of a cylindrical casting with removable cover having nozzles which permit its being placed in the horizontal part of the suction pipe forming a section of the same. The strainer proper consists of two cast brass grated plates which rest in vertical grooves, being so placed as to give the maximum area and offer the least resistance to the flow of the water. The plates can be readily removed and cleaned.

This strainer can in some cases be connected direct to the suction flange of the pump, but in order not to interfere with the removal of water cylinder heads it is recommended that a section of pipe or spool piece be interposed between the strainer and the pump.

Special strainers of larger sizes than those included in the list can be furnished.

Diameter Suction Pipe.	Diameter of Flanges.	Distance Face to Face.	DIMENSIONS OF BOX.		Telegraphic Code Word.
			Width.	Height.	
1½	Screwed	7	6	5½	Tabacoso
2	Screwed	9	7½	6½	Tabaleos
3	7½	11	9	8	Taballo
4	8½	16¼	11	9	Tabanca
5	9½	17½	12	12	Tabarder
6	10½	19½	14	14½	Tabarrino
8	13	22	17	18	Tabaxir
10	15	28	21	22½	Tabbying
12	17½	32	24	28	Tabefied
14	19½	45	22	23½	Tabelion

THE WORTHINGTON CHECK AND FOOT VALVES

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.

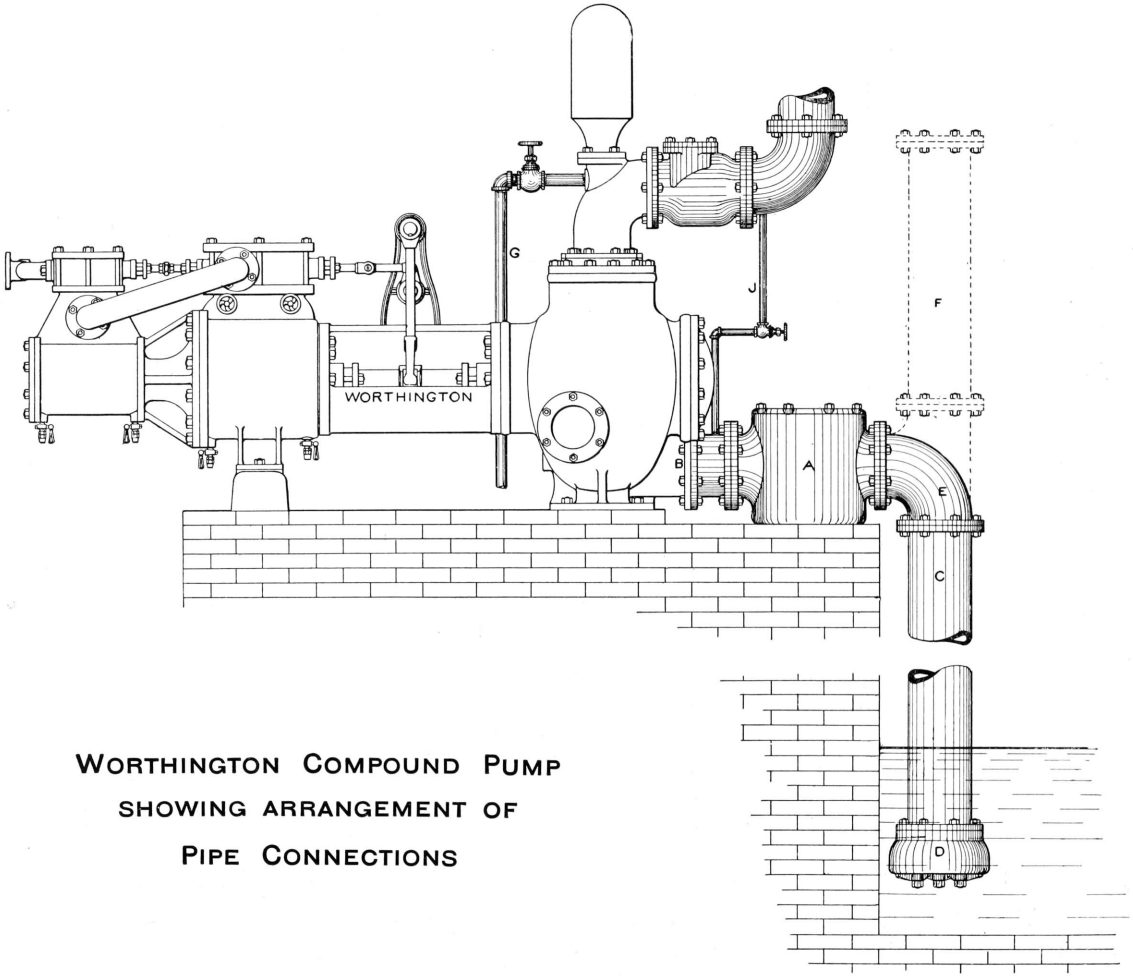
For the larger sizes of Foot Valves is provided an attachment, shown in the illustration on the opposite page, designed to relieve the valve and the supply pipe of any undue internal pressure to which they might be subjected. This is, in many cases, a very necessary safeguard, as with pumping machinery 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.

CHECK VALVES.				FOOT VALVES.			
Size in Inches.	Telegraphic Code Word.	Size in Inches.	Telegraphic Code Word.	Size in Inches.	Telegraphic Code Word.	Size in Inches.	Telegraphic Code Word.
2½	Tabergite	12	Tablon	2½	Tacao	12	Tacitly
3	Tabescent	14	Tabloza	3	Tacarian	14	Tacitus
4	Tabicamos	16	Tabraca	4	Tachim	16	Tactical
5	Tabicar	18	Tabuda	5	Tachino	18	Tactito
6	Tabido	20	Tabulato	6	Tachori	20	Tactility
7	Tabific	24	Tabulista	7	Tachoso	24	Tactos
8	Tablado	30	Tacanho	8	Tacibile	30	Tadpole
10	Tablares	36	Tacanica	10	Tacita	36	Tafetan

Unless otherwise ordered, these valves have 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.



WORTHINGTON COMPOUND PUMP
SHOWING ARRANGEMENT OF
PIPE CONNECTIONS

Arrangement of Pipe Connections

The cut on the opposite page is presented for the purpose of showing those not fully acquainted with the subject, a good arrangement of pipe connections, together with the attachment of Strainer-Box and Strainer, and Check and Foot Valves, described on pages 88 and 89.

On the suction pipe, *C*, is a foot valve, *D*, which keeps the pipes 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 strainer-box and strainer, shown at *A*, is described on page 89.

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

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

The "charging pipe," *J*, connecting the delivery pipe *beyond* the check valve with the suction chamber or suction pipe 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 opening is on the end of the pump at the flange, *B*.

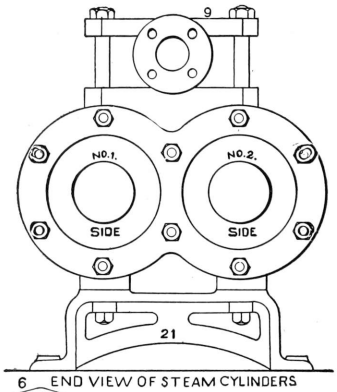
If any difficulty is experienced in making a pump work properly when first started, it will generally be found to proceed from imperfect connections, or from the temporary stiffness to be expected in a new machine.

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.

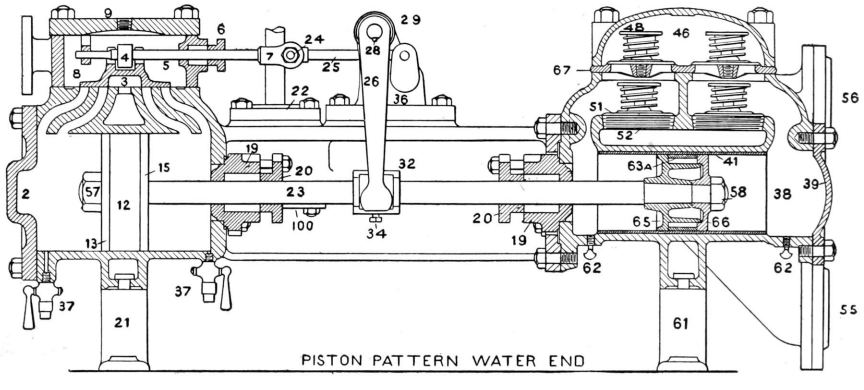
It often happens that a pump refuses to lift water while the full pressure against which it is expected to work is resting upon the force valves, for the reason that the air within the pump chamber is not dislodged, but only compressed by the motion of the plunger. It is well, therefore, to arrange for 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 PARTS OF THE WORTHINGTON PUMP

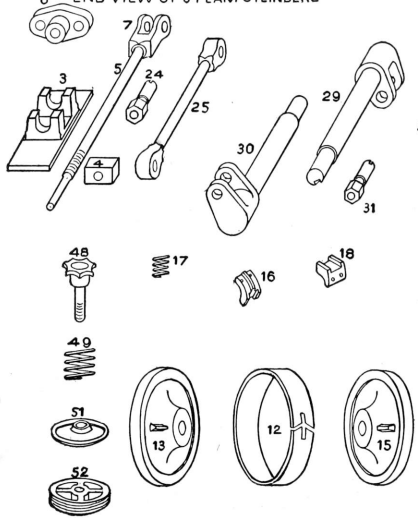
Of Six Inch Stroke and under having Shop Number ABOVE 120,000.

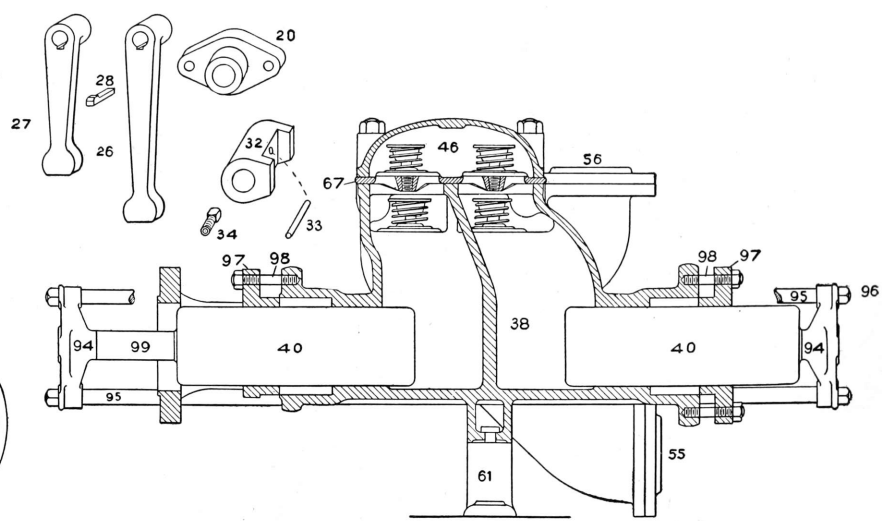


6 END VIEW OF STEAM CYLINDERS



PISTON PATTERN WATER END





OUTSIDE PACKED PLUNGER PATTERN WATER END

THE PARTS OF THE WORTHINGTON PUMP

☞ *This List refers only to Pumps of Six Inch Stroke and under having Shop Number* ABOVE 120,000.

In ordering parts, state their name and number as below, also the size and the shop number of the Pump.

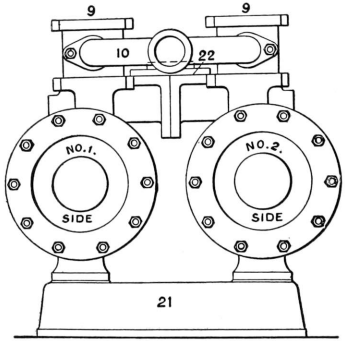
Numbered List of Parts illustrated on the opposite page.

1. Steam Cylinder (No. 1 and No. 2).
2. Steam Cylinder Head.
3. Slide Valve.
4. Valve Rod Nut.
5. Valve Rod.
6. Valve Rod Gland.
7. Valve Rod Head.
8. Steam Chest.
9. Steam Chest Cover.
12. Piston Ring.
13. Piston Follower.
15. Piston Body.
16. Piston Tongue.
17. Piston Tongue Spring.
18. Piston Tongue Bracket.
19. Piston Rod Stuffing-box.
20. Piston Rod Stuffing-box Gland.
21. Steam Cylinder Foot.
22. Exhaust Screw Flange.
23. Piston Rod.
24. Valve Rod Head Pin.
25. Valve Rod Link (long or short).
26. Long Lever.
27. Short Lever.
28. Rock Shaft Key.
29. Upper Rock Shaft.
30. Lower Rock Shaft.
31. Crank Pin.
32. Spool.
33. Spool Pin.
34. Spool Set Screw.
36. Cross Stand.
37. Blow Cock.
38. Water Cylinder.
39. Water Cylinder Head.
40. Plunger.
41. Cylinder Lining.
46. Force Chamber.
48. Valve Guard.
49. Valve Spring.
51. Valve.
52. Valve Seat.
55. Suction Screw Flange.
56. Delivery Screw Flange.
57. Steam Piston Nut.
58. Water Piston Nut.
61. Water Cylinder Foot.
62. Drain Cock.
63A. Solid Water Piston Ring.
65. Packed Water Piston Body.
66. Packed Water Piston follower.
67. Force Valve Plate.
94. Cross Head.
95. Side Rod.
96. Side Rod Nut.
97. Plunger Gland.
98. Plunger Gland Stud.
99. Plunger Connecting Piece.
100. Exhaust Blank Flange.

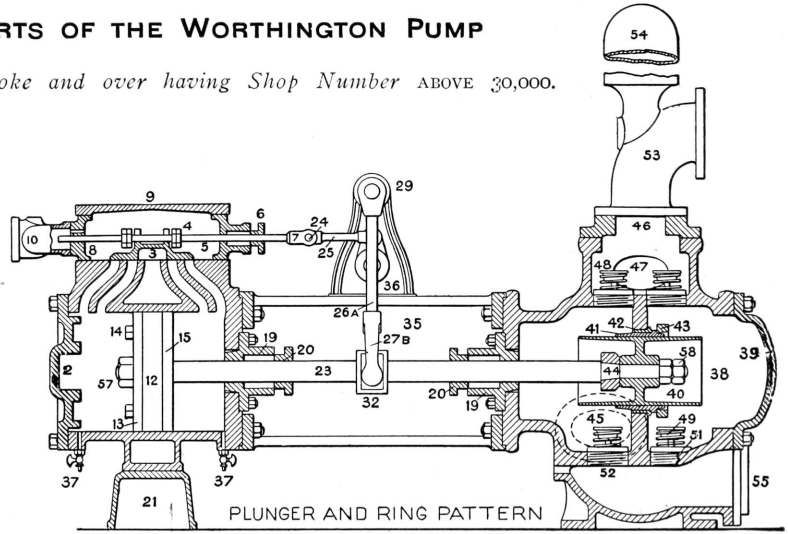
N. B.—A List of Parts of Pumps having Shop Number *under* 120,000 will be furnished on application.

THE PARTS OF THE WORTHINGTON PUMP

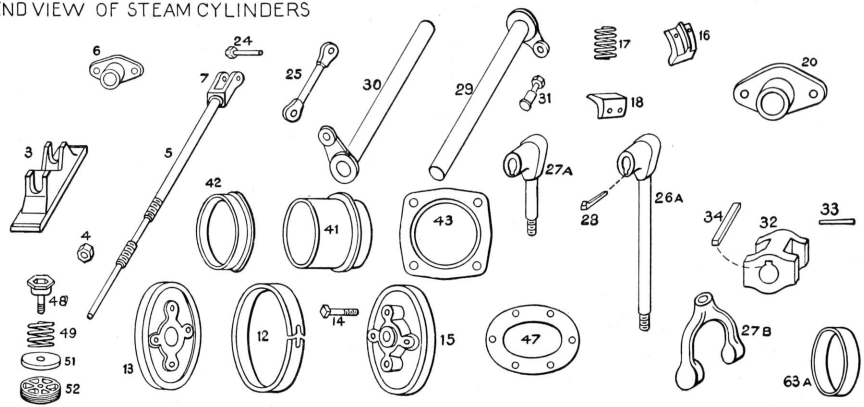
Of Ten Inch Stroke and over having Shop Number ABOVE 30,000.

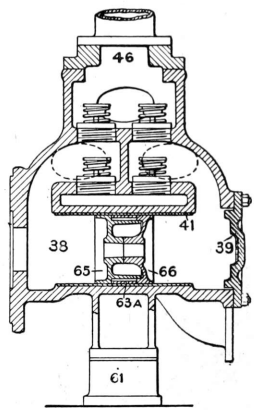


END VIEW OF STEAM CYLINDERS



PLUNGER AND RING PATTERN





PISTON PATTERN WATER END

THE PARTS OF THE WORTHINGTON PUMP

☞ *This List refers only to Pumps of Ten Inch Stroke and over having Shop Number* ABOVE 30,000.

In ordering parts, state their name and number as below, also the size and the shop number of the Pump.

Numbered List of Parts illustrated on the opposite page.

1. Steam Cylinder (No. 1 and No. 2).
2. Steam Cylinder Head.
3. Slide Valve.
4. Valve Rod Nut.
5. Valve Rod.
6. Valve Rod Gland.
7. Valve Rod Head.
8. Steam Chest.
9. Steam Chest Cover.
10. Steam Pipe.
12. Piston Ring.
13. Piston Follower.
14. Piston Follower Bolts.
15. Piston Body.
16. Piston Tongue.
17. Piston Tongue Spring.
18. Piston Tongue Bracket.
19. Piston Rod Stuffing-box.
20. Piston Rod Stuffing-box Gland.
21. Steam Cylinder Foot.
22. Exhaust Flange.
23. Piston Rod.
24. Valve Rod Head Pin.
25. Valve Rod Link (Long or Short?)

26a. Long Lever.

27a. Short Lever.

27b. Fork-end.

28. Rock Shaft Key.
29. Upper Rock Shaft.
30. Lower Rock Shaft.
31. Crank Pin.
32. Spool.
33. Spool Position Pin.
34. Spool Key.
35. Cradle.
36. Cross Stand.
37. Blow Cock.
38. Water Cylinder.
39. Water Cylinder Head.
40. Plunger.
41. Plunger Ring or Cylinder Lining.
42. Casing.
43. Binder.
44. Plunger Hub.
45. Water Cylinder Hand-hole Plate.
46. Force Chamber.
47. Force Chamber Hand-hole Plate.
48. Valve Guard.
49. Valve Spring.
51. Valve.
52. Valve Seat.
53. Delivery Tee.
54. Air Chamber.
55. Suction Flange.
57. Piston Nut.
58. Plunger Nut.
61. Water Cylinder Foot.

63a. Solid Water Piston Ring.

65. Packed Water Piston Body.
66. Packed Water Piston Follower.

N. B.—A List of Parts of Pumps having Shop Number *under* 30,000 will be furnished on application.

INDEX TO CODE WORDS IN THE LISTS

The Code Words for the various Pumps referred to in this Catalogue are arranged alphabetically, and will be found on the following pages:

AWARD OF CENTENNIAL EXHIBITION, 1876

AWARD OF INVENTIONS EXHIBITION, 1885

AWARD OF NEW ORLEANS EXHIBITION, 1884

AWARD OF PARIS EXPOSITION, 1889

AWARD OF ATLANTA EXPOSITION, 1895

AWARD OF WORLD'S COLUMBIAN EXPOSITION 1893

HENRY R. WORTHINGTON

HYDRAULIC WORKS

BROOKLYN

ESTABLISHED 1845