

CATALOGUE

NUMBER THREE

— OF —

WATER WHEELS,

HYDRAULIC APPLIANCES,

— AND —

MINING MACHINERY

MANUFACTURED BY

KNIGHT & CO.

SUTTER CREEK, AMADOR COUNTY, CAL., U. S. A.



RISDON IRON & LOCOMOTIVE WORKS,

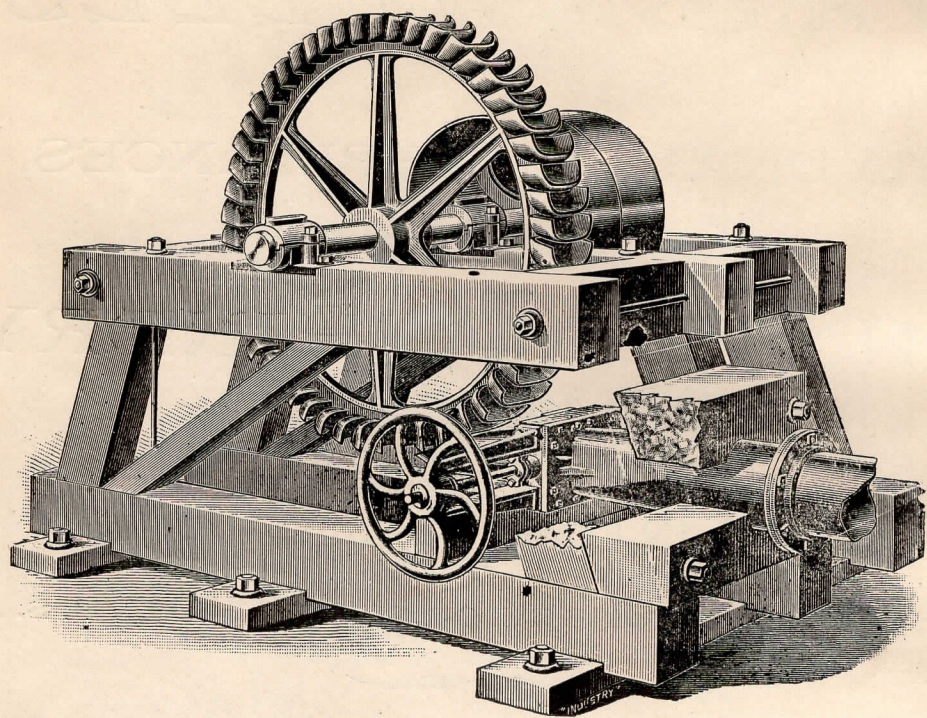
SOLE AGENTS,

S. E. COR. HOWARD AND BEALE STREETS,

SAN FRANCISCO, CAL.



⌘⌘⌘ JUNE 1, 1896. ⌘⌘⌘



The Knight Water Wheel.

About 30 years ago MR. KNIGHT, in common with others, made water wheels entirely out of wood; the buckets were shaped like Saw Teeth, and wooden flanges covered the sides of the buckets to confine the water; a round nozzle was used and the general results were considered at that time highly satisfactory.

The next step about two years later was to make a wooden wheel with iron buckets, giving them a curve and discharging the water toward the center of the wheel, still using, however, the round nozzle.

Two years later than this a man named COLEMAN patented a wheel which had a bucket shaped very much like the present PELTON BUCKET, the stream splitting and curving off to each side. He, for lack of means, we understand, did nothing with it.

After two or three years more had passed, MR. KNIGHT made an improvement by using a curved iron bucket and having the discharge toward the centre and to one side, much the same as the present COLLIN'S wheel, still using the round nozzle.

After continued experiments with the round nozzle he found it did not fill the general requirements; he could not cover enough bucket space along the periphery of the wheel, without covering an equal space in the width of the bucket, by increasing the diameter of the round nozzle.

This induced him to try an Elliptical or Oblong nozzle, and the first wheel of this character was placed in the Lamphear mine at Mokelumne Hill, and it was quickly followed by two others, so satisfactorily did they work.

From these wheels sprang the present KNIGHT WATER WHEEL, for here it was he conceived the idea of abandoning entirely any direct modification of the round nozzle, and made the opening a narrow rectangular slit.

The round nozzle did well enough where small quantities of water were used, but upon using considerable water the nozzle became so large that while the upper edge could be brought near the wheel the lower edge was far away, and it reduced the power materially; so the slit was determined upon. More than one nozzle was also tried, but it did not prove satisfactory.

In 1875 the first wheel of the present style was placed in the Lincoln mine, at Sutter Creek, and from that time various improvements have been made in the size and arrangement of the slits in the nozzle and shape of the buckets, until at the present time MR. KNIGHT is manufacturing a wheel that for general utility and economy, challenges competition.

The slit form of opening in the nozzle presents a number of vital points,

1st. It allows the nozzle to be made to the curve of the wheel, and thus each part of the opening can be brought to within a bear clearance distance of the buckets: all portions of the water thus enter the buckets with the same force.

2d. If it is desired to increase or diminish the power of the wheel it is not necessary to open or close the gate and thereby throttle the power out of the water by diminishing its pressure, but it is merely necessary to lengthen or shorten the slit by means of a steel slide, as shown in the engraving, and also on page 19.

The shape of the nozzle thus remains the same and the pressure is neither increased nor diminished, but remains constant.

3d. No matter whether the slit be lengthened or shortened, the amount of water striking a running inch of bucket is a constant quantity, and thus the curves on the bucket can be constant and the head remaining the same. The same conditions will exist when 50 H. P. is given out as for 10, and thus the economy of the wheel is unaltered.

This can never be the case with a round nozzle, for if the curves on the buckets are made for a 2-inch nozzle and a 3-inch nozzle to put on, the relation between the curves on the bucket is destroyed and the economy altered.

4th. The slit affords an easy opportunity of operating a governor, as explained on page 23.

Many have objected to the slit nozzle because it seems the natural thing, from long association with pipes and hose nozzles, that water should come out of a round opening; but upon investigation and actual experiment they will find the rectangular slit to be the most economical for general purposes.

There are over 300 KNIGHT WHEELS in operation in California, and many have gone to various parts of the world and all are giving satisfaction.

Numerous attempts have been made by other wheel manufacturers to displace the KNIGHT WATER WHEEL with their own, but in all instances where the personal feeling of friendship or money consideration did not enter into the question, they have failed, and of their successes we know of but two or three.

The matter of the so-called "Grass Valley test" we have reserved for special treatment in another part of our catalogue.

All parties desiring a first-class water wheel, one which we will guarantee in all respects, would do well for themselves by communicating with us before purchasing. We are always ready and pleased to furnish all information gratis, and the estimates and calculations made by our engineers we are always ready to back up. We contract to deliver water power machinery in running order, as well as F. O. B. cars at Ione, Amador County, Cal.

Notice to Purchasers.

In ordering give information mentioned below. Give address or shipping mark in full, so no mistakes will be made. Prices in this catalogue will be adhered to as closely as possible; we reserve the right, however, to change prices without notice.

As we use every precaution in packing and shipping our machinery no allowance can be made if goods are damaged either in direct shipments or enclosure through other houses.

Boxing if required will be charged at cost.

All goods are delivered at Freight Depot, Ione, Amador Co., Cal., free.

Remittance can be made either by bank draft, payable to our order, or cash sent by any of the Express companies, or by P. O. Money Order. If cash is sent by mail the letter should be registered.

Remittances are in all cases at the risk of sender.

For goods ordered by express and bill to be collected on delivery, a small remittance should accompany order.

Express charges for collection will be added to the amount of bill.

Regular customers are allowed 30 days' time on payments.

Purchasers who find anything wrong with any of our manufactures are requested to notify us at once, and if we have made any error we will rectify same at our expense.

Correspondence is solicited from all parties thinking of using water power, and estimates and information will be furnished free of cost.

Information Correspondents Should Give in Writing for Water Wheels.

1. Head of water, measured from ditch or water source to point of application, in vertical feet.
 2. Amount of water per minute in inches, cubic feet, or gallons.
 3. Power expected to be realized; if unknown, describe the machinery to be run.
 4. Distance of ditch or water source from water wheel, measured along the ground, for length of pipe.
 5. If for pumping purposes, how much water is to be pumped and how high.
 6. If you have counter-shafts, or other shafts to belt to, give speeds of same.
 7. State whether you want reversible wheels, hydraulic gates or governors in connection with your work.
 8. State whether water is clear or muddy.
-

2500 HORSE POWER.

By giving attention to the following directions any one will be able to erect the wheel properly:

Frame all the timbers as shown in the cuts, following the sizes as marked, and bolt them together firmly.

Set the frame work on level ground and tamp in the dirt firmly about the mud sills. It is immaterial at what angle the water pipe leads to the wheel; it will work equally well on the top, bottom or any intermediate position, but as the lowest position gives the most power, the nozzle is generally placed on the bottom. At all events it is only necessary that the curve of the nozzle shall be concentric with the wheel, and $\frac{1}{4}$ of an inch away from it, and the slit should be midway of the width of the buckets. The nozzle once in place should be bolted firmly to prevent it getting against the wheel. Plank the bottom of the tail race and board up the wheel from the boxes down on the outside of the timbers; this allows free space for the water to leave the buckets and gives more room to work in, should it be necessary to change the nozzle.

Put a trap door on the side, opposite the nozzle, so a man can get in and take it off if necessary.

Cover over the wheel from the boxes up on the inside of the timber so as to leave the boxes in sight for oiling and adjustment. Make this cover loose so it can be taken off should it become necessary to raise the wheel or otherwise work at it.

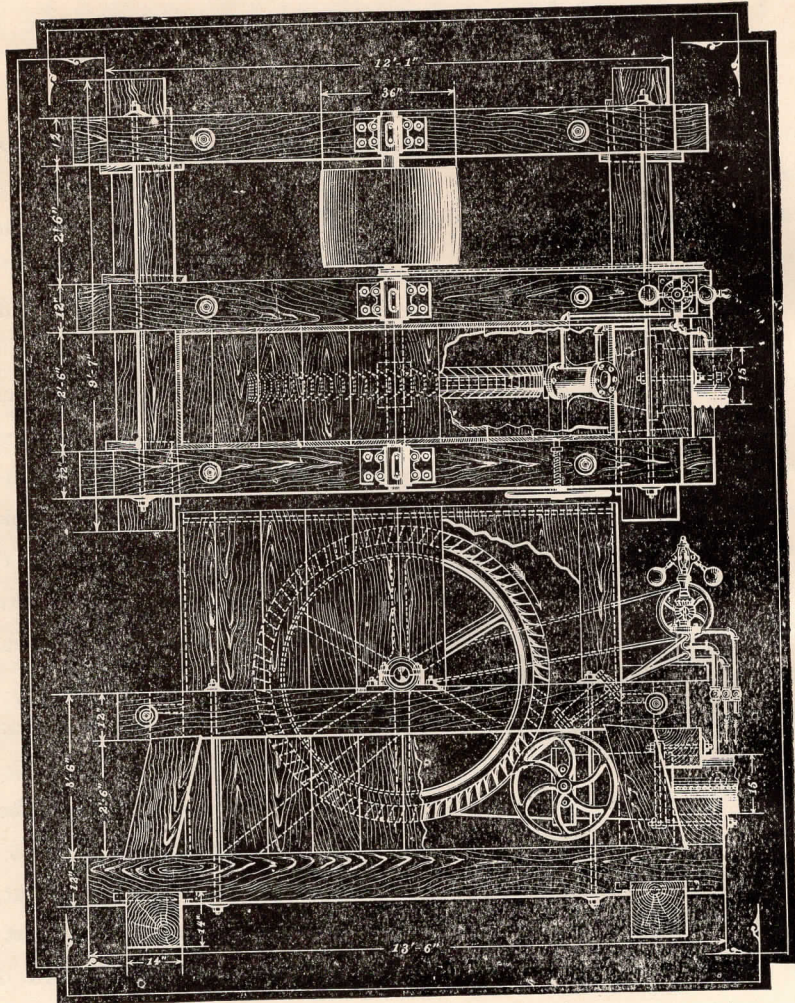
After the water is turned on the speed is adjusted by moving in or out the steel slide in the nozzle until the exact number of revolutions is obtained; while doing this the gate should be wide open.

In closing the water gate be sure and shut it completely off; otherwise the water will wear away the seat so that it will always leak. A screen should be placed above the sand box in the flume, else the nozzle is liable to become clogged with leaves and sticks and delays occur.

RUNNING OVER 2000 STAMPS.

Knight's 6-Foot Water Wheel.

METHOD OF SETTING.



The above wheel is 6 feet in diameter and is used in conjunction with the No. 4 gate and nozzle, and is intended for heads from 60 feet to 600 feet. The cut is made to show the way a water wheel should be boxed, or cased, and placed in position; and if the wheel should carry water around with it make a hole in back end of housing and put in a large pipe, or square box, to let the air in. This will allow the air to enter and water to fall from the wheel.

The above wheel is 6 feet in diameter and is used in connection with the No. 4 gate and nozzle, and is intended for heads from 50 to 700 feet. It is shown with hydraulic governor attached. It will develop the following speed:

The wheel will develop the following power:

50 H. P. under a head of 50 feet.	125 H. P. under a head of 150 feet.
75 H. P. under a head of 75 feet.	175 H. P. under a head of 225 feet.
	250 H. P. under a head of 300 feet.

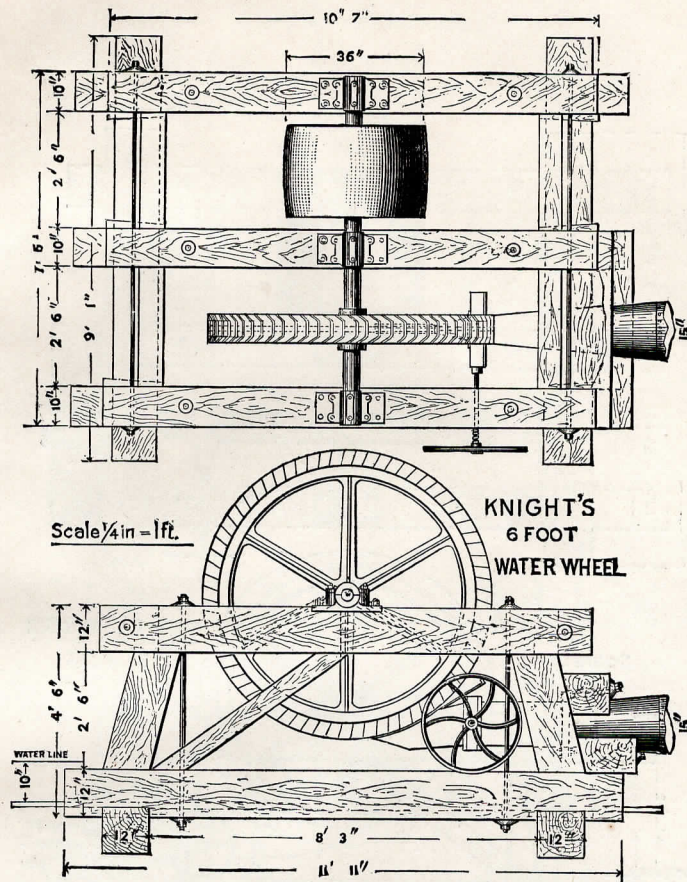
We have larger gates and nozzles for the same water wheel that will increase the power to 500 H. P.

In this case a larger shaft and stronger frame work is required.

The weight is about 4000 lbs., depending on size of pulley required.

RUNNING OVER 2000 STAMPS.

Knights 6-Foot Water Wheel.



The above wheel is 6 feet in diameter and is used in connection with the No. 3 gate and nozzle, and is intended for use under heads from 50 feet to 300 feet.

This water wheel is commonly used for driving 40 and 60 stamp mills under a head of 200 feet and upwards.

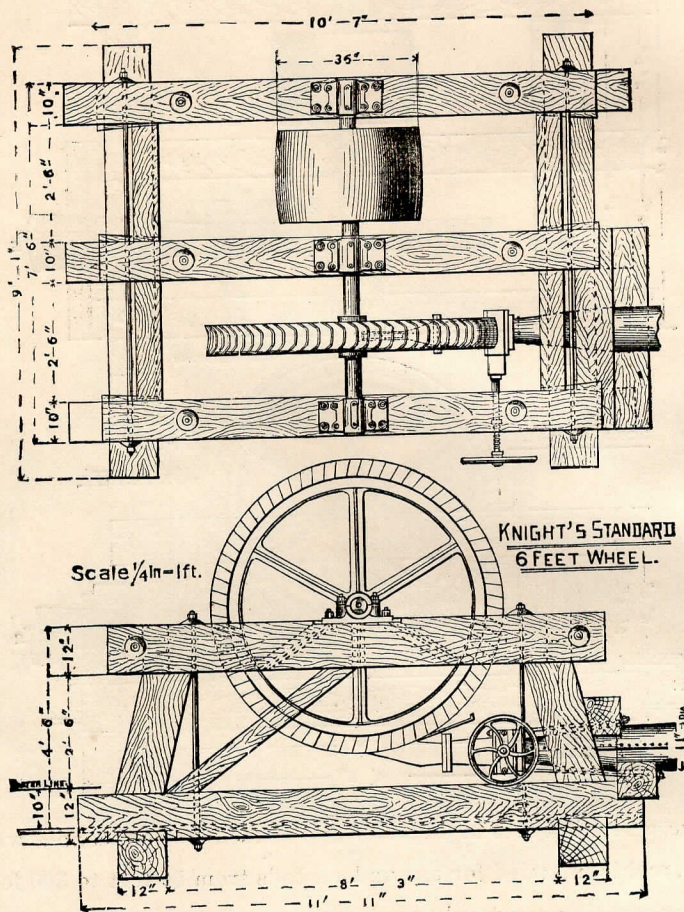
This wheel will develop the following power:

25 H. P. under a head of 50 feet.	75 H. P. under a head of 100 feet.
50 H. P. under a head of 75 feet.	150 H. P. under a head of 200 feet.
200 H. P. under a head of 300 feet.	

The weight of this wheel complete is about 3200 lbs., depending on how large a pulley is required. We furnish pulleys of any reasonable size that the speed may require. The same is true of all the other wheels.

RUNNING OVER 2000 STAMPS.

Knight's 6-Foot Water Wheel.



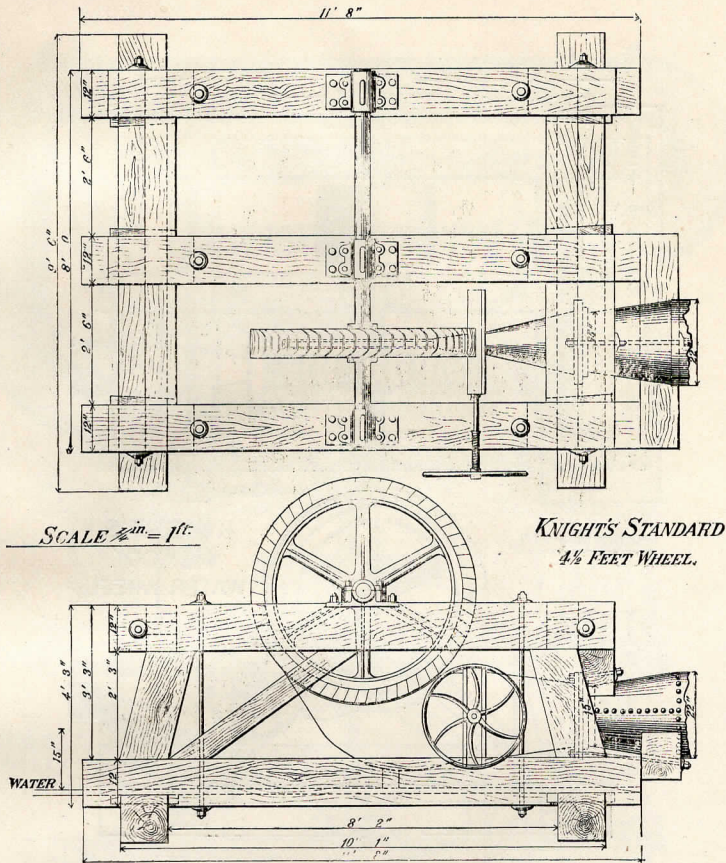
The above wheel is 6 feet in diameter and is used in connection with the No. 2 gate and nozzle, and is intended for heads from 100 to 500 feet, and requires but a small amount of water.

The wheel will develop the following power:

35 H. P. under a head of 100 feet.	100 H. P. under a head of 300 feet.
75 H. P. under a head of 200 feet.	150 H. P. under a head of 400 feet.
175 H. P. under a head of 500 feet.	

Weight, about 2400 lbs., depending on amount of power and size of pulley required.

Knight's 4½-Foot Water Wheel.



The above is the Knight 4½-foot wheel used in connection with the No. 5 gate and nozzle, and intended for heads from 10 to 75 feet. It is well adapted to quartz mills, for the speed is such that you can belt direct from the water wheel pulley to the cam shaft, thus avoiding the counter-shaft, which is an item in economical construction and operation.

The wheel will develop the following power:

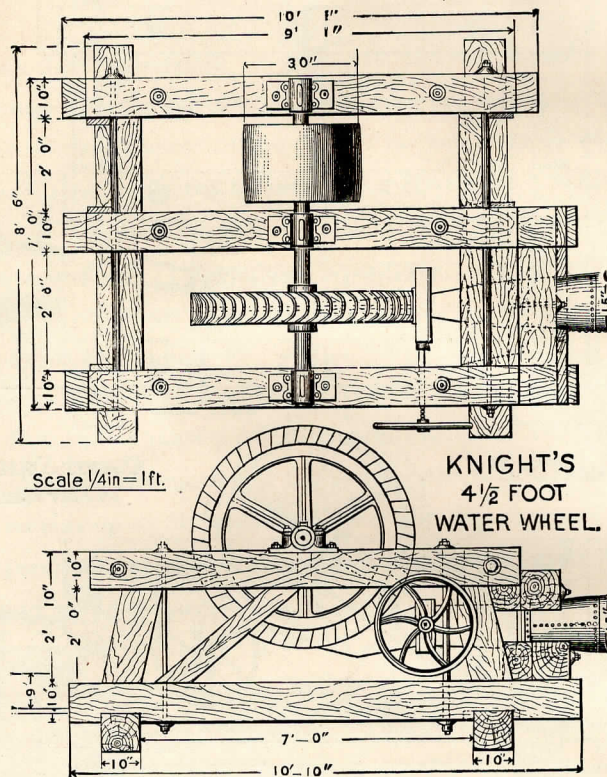
- | | |
|-----------------------------------|------------------------------------|
| 15 H. P. under a head of 10 feet. | 70 H. P. under a head of 50 feet. |
| 35 H. P. under a head of 25 feet. | 100 H. P. under a head of 75 feet. |

For this wheel add \$35.00 to the regular price list of wheels the same diameter and power.

Weight, 2500 to 3500 lbs., according to power required.

RUNNING OVER 2000 STAMPS.

Knight's 4½-Foot Water Wheel.



The above wheel is 4½ feet in diameter and is used in connection with the No. 3 gate and nozzle, and is intended for use under heads from 50 feet to 300 feet.

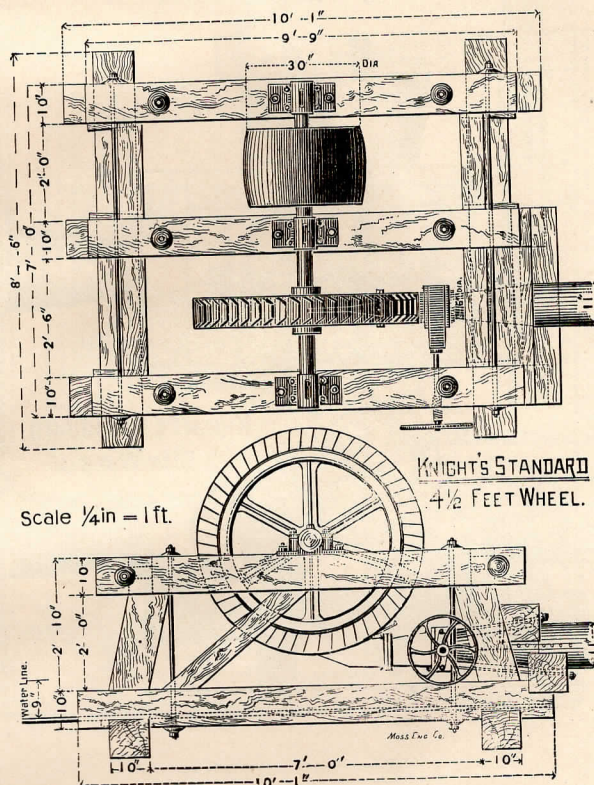
This is the common size used for driving hoisting works, quartz mills, air compressors and sawmills. For sawmill use the patent hydraulic gate and nozzle is used, which saves the water between cuts, and for which an extra price is charged, as per list on page 24.

This wheel will develop the following power:

15 H. P. under a head of 50 feet.	50 H. P. under a head of 100 feet.
30 H. P. under a head of 75 feet.	100 H. P. under a head of 200 feet.
200 H. P. under a head of 300 feet.	

Weight, 1800 to 2400 pounds, according to horse power required.

Knight's 4½-Foot Water Wheel.



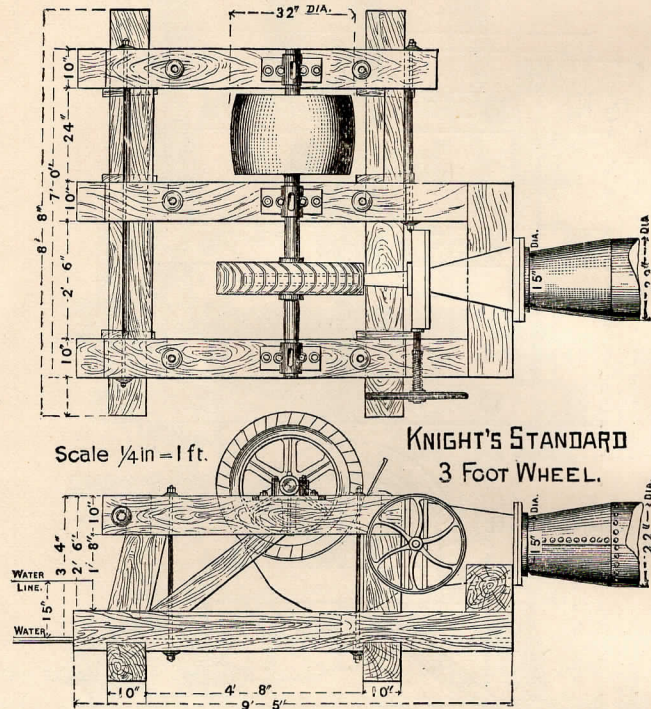
The above wheel is $4\frac{1}{2}$ feet in diameter and is used in conjunction with the No. 2 gate and nozzle, and is intended for heads from 100 feet to 500 feet.

The wheel will develop the following power:

15 H. P. under a head of 100 feet.	75 H. P. under a head of 300 feet.
30 H. P. under a head of 200 feet.	100 H. P. under a head of 400 feet.
175 H. P. under a head of 500 feet.	

Weight, from 1400 to 2200 pounds, depending on the power required.

Knight's 3-Foot Water Wheel.



The above wheel is 3 feet in diameter and is used in connection with the No. 5 gate and nozzle, and intended for heads from 10 to 75 feet.

The wheel will develop the following power:

15 H. P. under a head of 10 feet.

70 H. P. under a head of 50 feet.

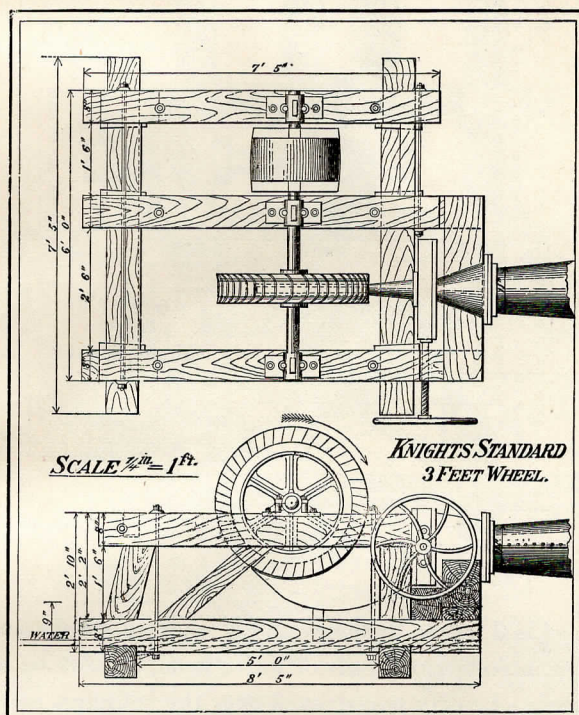
35 H. P. under a head of 25 feet.

100 H. P. under a head of 75 feet.

For this wheel add \$35.00 to the regular price list of wheels the same diameter and capacity.

Weight, 2000 to 3000 pounds, according to power required.

Knight's 3-Foot Water Wheel.



The above wheel is 3 feet in diameter and is used in connection with the No. 4 gate and nozzle, and is intended for heads of water from 25 to 100 feet.

The heaviest piece is the water wheel, which weighs 350 lbs., and can be packed on a good mule.

This wheel will develop the following power:

10 H. P. under a head of 25 feet.

40 H. P. under a head of 60 feet.

20 H. P. under a head of 40 feet.

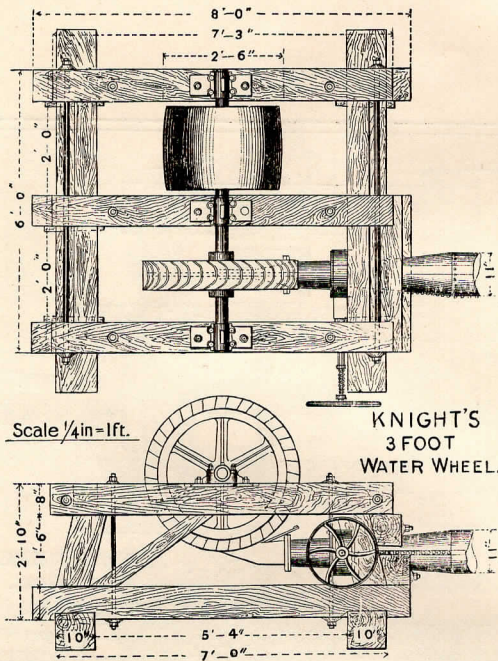
80 H. P. under a head of 100 feet.

For this wheel add \$20.00 to the regular price list of same size and power.

Weight 1500 to 2000 pounds, according to H. P. required.

RUNNING OVER 2000 STAMPS.

Knight's 3-Foot Water Wheel.



The above wheel is 3 feet in diameter and is used in connection with the No 2 gate and nozzle, and is intended for heads of water from 50 feet to 300 feet and over. It is a very light wheel and easily transported over the roughest mountain trails. The wheel itself, boxed, weighs about 300 pounds and is the heaviest piece.

This wheel is very desirable for use in sawmills where a high speed is required, saving the expense and trouble of gearing and countershafts. Where the head is high enough, they can be put on the saw shaft directly, and be operated by one of Knight's Patent Hydraulic Gates, by means of which the water can be closed off as the saw is going out of cut, and all the water saved between cuts, thus running the mill on about one-half the water.

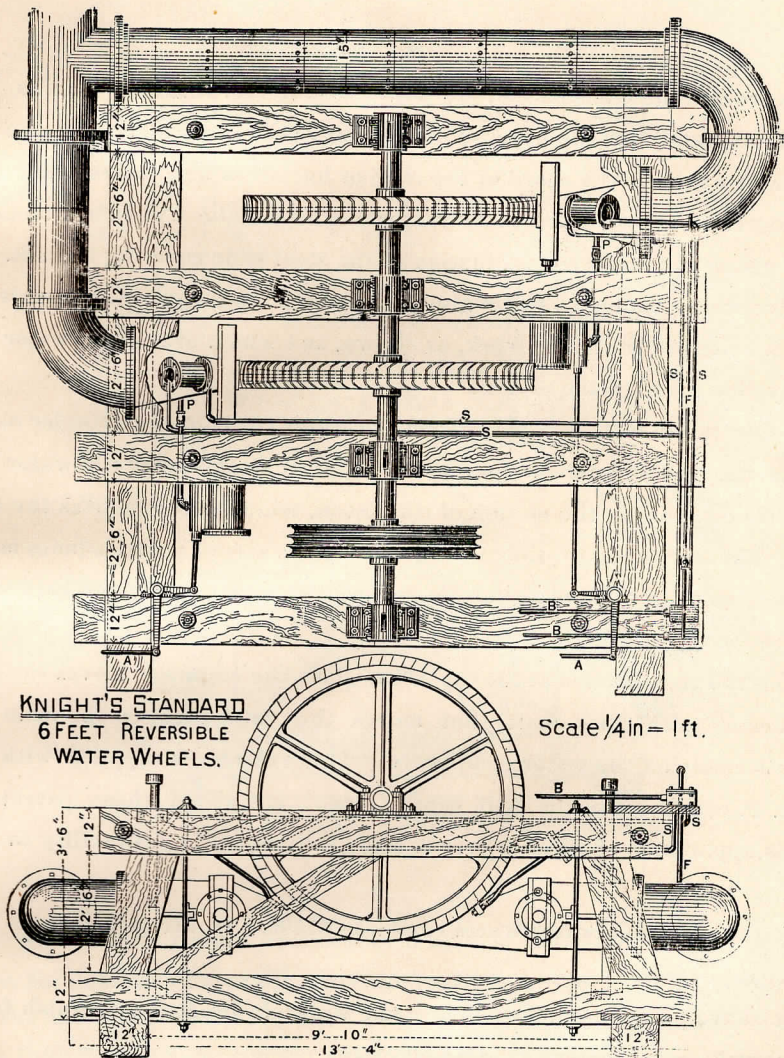
Extra charge will be made for the hydraulic gate attachment, for which see price list on page 21.

This wheel will develop the following power:

15 H. P. under a head of 75 feet.	35 H. P. under a head of 200 feet.
25 H. P. under a head of 100 feet.	75 H. P. under a head of 300 feet.
100 H. P. under a head of 400 feet.	

Weight, 1000 to 1500 pounds, according to H. P. required.

Knight's Reversible Water Wheel



The above represents the Knight 6-foot reversible water wheels used in connection with the number 4 gate and nozzle, under heads from 125 to 250 feet, and will develop from 100 to 200 horse power under the above heads. This is planned especially to take the place of engines working at mines, where owners wish to make the change in the least expensive way possible, in order to utilize water power instead of steam.

RUNNING OVER 2000 STAMPS.

We advocate the transmission of power to the reel shaft by manilla ropes or cotton, made expressly for the purpose. The nozzles are so arranged that the engineer can increase or diminish the speed of the cage or bucket as he chooses, while the hoisting is in progress. This is effected by means of a Hydraulic Cylinder attached to the nozzle, the piston rod being a continuation of the steel slide covering the slit. B. B. B. are two valve stems leading to the engineer's platform; these operate the valves in the water chests bolted to the frame work, as shown, and which are fed by water from the main supply pipe through the pipe F.

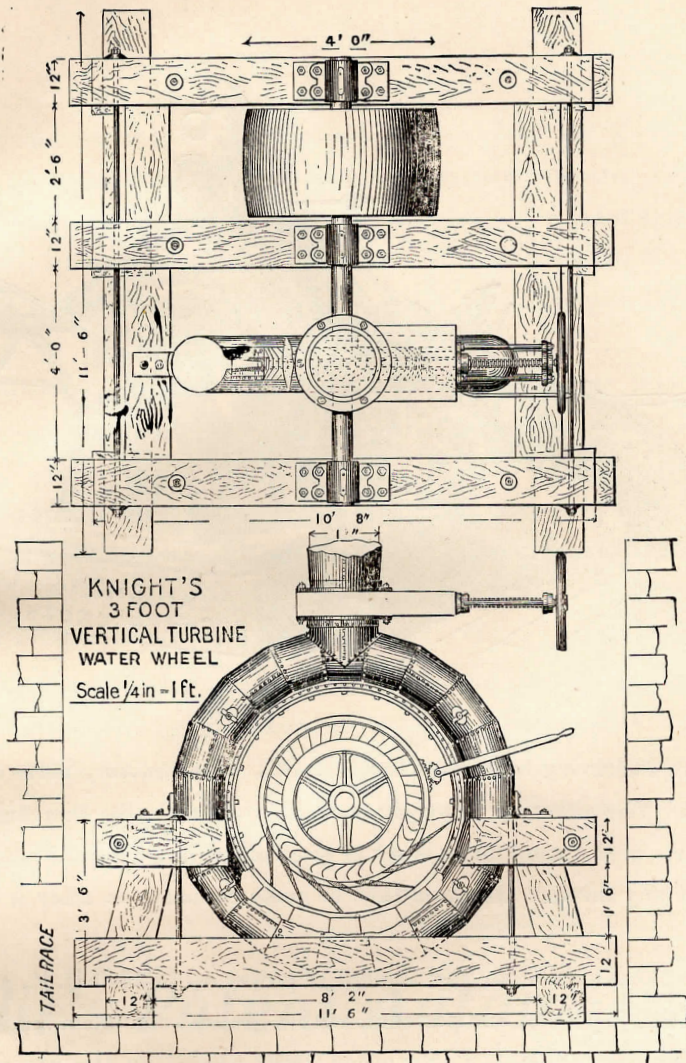
The four pipes S. S. S. S. lead from the water chest to the cylinder on the nozzles, and are the feed and exhaust pipes that supply and take away the water from that cylinder, thus controlling the motion of the piston, which in turn moves the slide back and forth. The increasing or diminishing thus of the size of nozzle admits more or less water and consequently increases or diminishes the speed to suit the kind of hoisting that may be desired at the time.

When the cage arrives at the top of the shaft the engineer moves the rod A. A.; this is connected to the rock shaft that moves the valve stem on the main hydraulic gates. This closes off the water completely. This cylinder is supplied with water by the pipe P. P. connected to the main supply pipe. By all of these patented contrivances, this application of water power is made fully equal in desirability to any steam engine.

Price of reversible water wheel complete \$1100. If the pressure is very high the cost would be less.

The above price does not include frame work. If desired, we furnish frame work and set everything in position for \$175.00 extra.

Knight's 3-Foot Vertical Turbine.

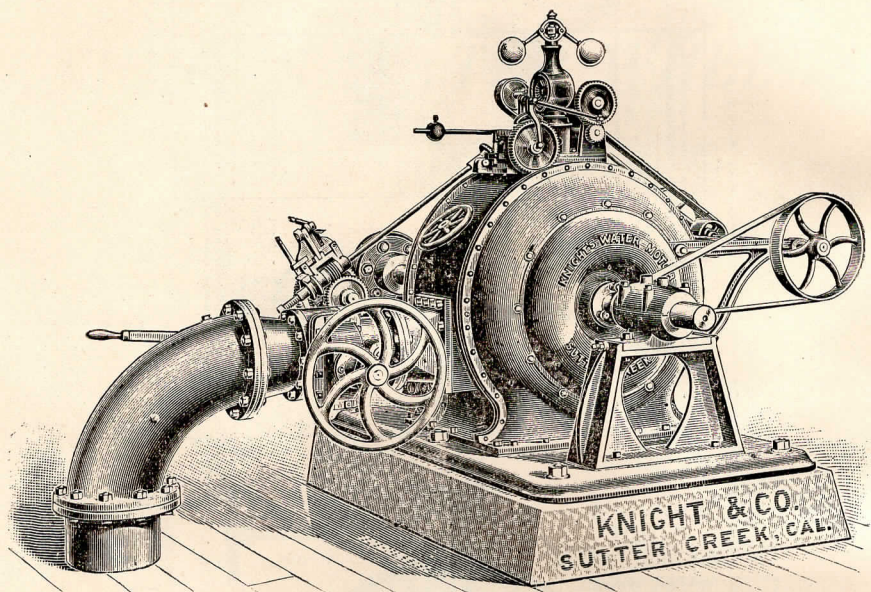


The above is Knight's 3 foot Vertical Turbine, which is intended to develop a large power under heads of from 10 feet to 50 feet. In the vertical elevation in the above cut, the frame work is cut away, and also a portion of the sheet-iron piping, in order to show the guide curves for conducting the water on to the buckets, and also to show the adjustable circular nozzle for regulating the power or speed, and which is operated by the hand-lever shown.

Prices quoted on application.

RUNNING OVER 2000 STAMPS.

Knight's Dynamo Motor.

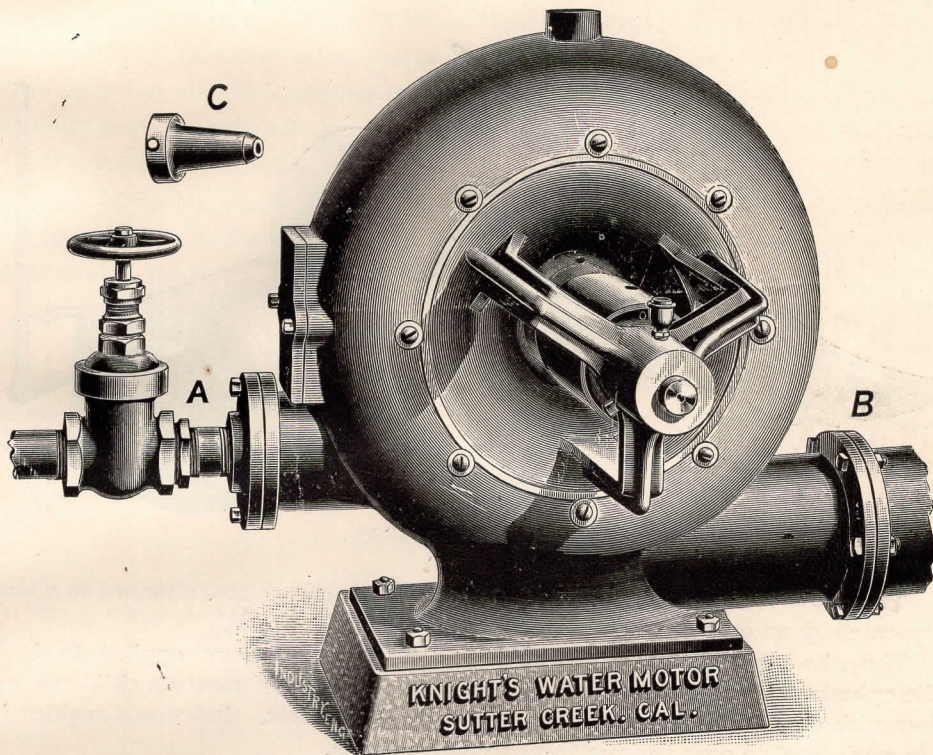


The above engraving represents the Knight's water motor, made expressly for use of dynamos. The governor is attached to the casing. By this manner of construction all parts of the machinery is set in line before it leaves the shop, so that it does not require any further attention than to make connections after it is placed on its foundation.

We build these motors for any amount of power up to 2000 H. P., and will guarantee a regulation of speed of one per cent, with a gradual change of load in one minute of time. We claim the advantage over other water wheels by the use of one wheel, where other makers adopt two to get the same power, which makes it less expensive in installing the plant. At times, when high speed is to be had, it is an advantage to connect direct to dynamos, avoiding belts and pulleys. We can develop 500 H. P. under a head of 400 feet, with a 17-inch wheel, giving 1100 revolutions. A motor of this description is now in use at The Amador Electric Railway and Light Co. Power House, Sutter Creek, Amador county, Cal.

Correspondence solicited and prices given on application.

Knight's Water Motor.



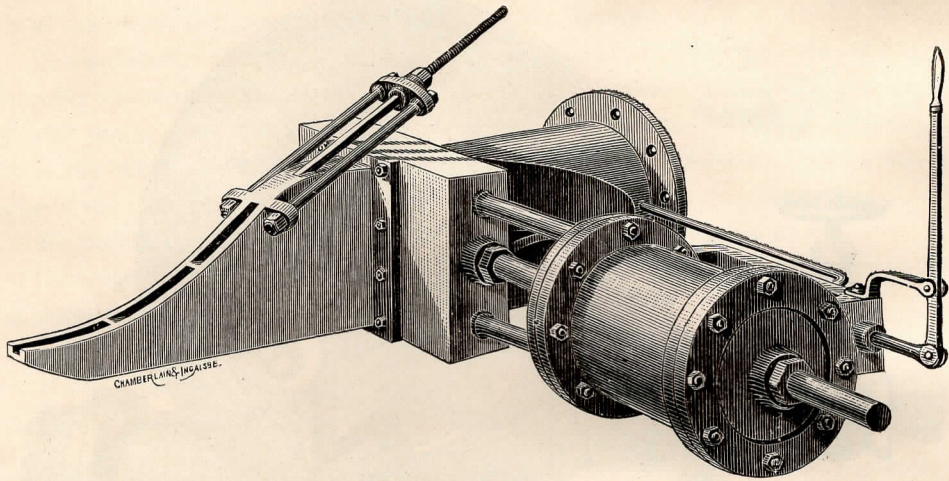
The above is a cut representing Knight's Water Motor, which is used for running fans, blowers, small electric plants, saws and all machinery where small powers are required.

We make four sizes of this style of motors: 6 in., 12 in., 18 in., and 24 in. Amount of power developed depends on head of water.

For prices and sizes see general price list, page 24.

RUNNING OVER 2000 STAMPS.

Knight's Patent Hydraulic Gate.



Patented Nov. 7, 1882.

The above is the cut of Knight's Patent Hydraulic Gate, attached to a nozzle and operated by an ordinary hand lever.

The gate is opened and closed by means of water pressure applied to the hydraulic cylinder which is attached to the gate stem. By this means a child can open or close with ease a 22-inch gate under a pressure of 500 feet, that would require two men to work hard to open in from three to four minutes.

By placing in the cylinder special exhaust ports the piston is made to close or open the gate at once or slowly.

Any one at a glance can see of what vital importance this contrivance is to water power machinery. No hoisting works can be properly constructed without it and a great saving can be effected, where a company has a dam or reservoir, by using this gate.

Take the case of a water wheel used in running a saw mill, where the power is used less than one-half the time. Without this contrivance, it would be necessary to run the water all the time on account of the great inconvenience in closing and opening the gate; but with this attachment, as soon as the cut is through, the water can be closed off; and if there is a reservoir, it accumulates, and the mill can be run on about one-half the quantity it otherwise would take.

The Idaho Mining Company of Grass Valley, who are using the Pelton wheel, purchased our patent Hydraulic Cylinder and all their attachments, for operating these wheels attached to their hoisting works.

Cut on page 15 shows two of these gates operating reversible wheels for hoisting.

Persons are hereby cautioned against using a Hydraulic Cylinder in any shape or form for closing a water wheel gate, as this is covered by our letters Patent, and we shall enjoin parties from using the same, and subject them to payment of damages.

Following is our price for the different sizes of plain gates and also Hydraulic gates:

No.	Opening of Valves. Inches.	No. of Openings.	Diameter of Hydraulic Cylinder. Inches.	Price of Gate Nozzle and Handwheel.	Price of Hydraulic Gate.
1	2 x 3	1	4	\$ 50	\$140
2	2 x 5	1	5½	75	180
3	2½ x 10	2	6½	100	210
4	3 x 15	3	8½	130	250
5	3 x 26	6	10	175	315

Hydraulic Gate includes rock shaft, boxes and levers.

Knight Hydraulic Hoisting Works

One of the principal uses to which water wheels are now put, is that of driving hoisting reels for mining purposes. Not only is it far more economical, but it gives a steady, reliable motion, and is much easier to operate than steam hoists.

All of our hoisting works are operated by Knight's Patent Hydraulic Gate, by means of which the engineer can, with the smallest movement of his lever, control the action of the water, stopping the cage instantly, if necessary.

It is generally intended, in most hoisting works, to lower the cage with the brake; but in some mines we have placed an additional wheel reversed on the shaft, for lowering with power. This is also fitted up with the hydraulic gate, and is independent from the other wheel, and can be used or not, as may be desired. Special mention is made of the reversible wheels on page 15.

We build any sizes that may be required of these hoisting works.

Our regular pattern list includes four sizes, orders for which we are ready to fill at the shortest notice.

All of our work we guarantee and deliver in running order, if required.

We furnish our hoisting works with either single or double reels, as may be required, prices for which we quote as follows:

No.	Diameter of Winding Drum.	Diameter of Friction Wheel.	Diameter of Sheaves.	Diameter of Water Wheels	WEIGHT. Lbs.	Price of Single Drum Machine.	Price of Double Drum Machine.	Additional Price for Reversible Wheel.
	Feet.	Feet.	Inches.	Feet.				
1	3	3.6	30	3	5000	\$ 650	\$ 850	\$200
2	4.4	5.0	48	4.6	10000	1100	1400	300
3	5.6	6.0	48	4.6	12000	1200	1500	500
4	7.6	8.6	60	6.0	24000	2000	2500	800

The following parties are using our Hoisting Works or our Patented Appliances:

Pacific Mine Placerville, Cal.
 El Dorado Water and D. G. Co..... Placerville.
 Butte Basin Mining Co..... Jackson, Cal.
 Patterson Mining Company ... Tuttle town, Cal.
 Lincoln Mining Company..... Sutter Creek, Cal.
 Sierra Buttes Company Sierra City, Cal.
 Idaho Mining Company..... Grass Valley, Cal.
 Kennedy Mining Company Jackson, Cal.
 South Spring Con..... Amador, Cal.
 Talisman..... Amador, Cal.
 Hector Gold Mining Co..... Sutter Creek, Cal.

Knight's Hydraulic Governor.

We manufacture, and can attach to all water wheels, our Hydraulic Governor for regulating the speed of the wheel to suit different requirements. One can be seen on page 6 of this catalogue, attached to a six-foot wheel. On the nozzle there is a Hydraulic Cylinder, which moves back and forth the steel slide in the slit of the nozzle, thus increasing and diminishing the flow of water and, consequently, the power and speed.

This cylinder is supplied with water by small pipes running from the hydraulic valve chest under the governor, the valve in this being operated by the raising or lowering of the governor balls, which, in turn, is moved by a belt from the water-wheel shaft, all as shown in the engraving. This is the only method by which water wheels can be regulated and yet retain the same percentage of power. It cannot be done on a round nozzle.

The governor shown is used for clear water. When muddy water only is available, we make another kind of governor that works the slide in the nozzle by means of gearing. Parties ordering governors should state what kind of water is used, so we may know which kind to send. Also, what is the extreme variation in speed that may be allowed, and what extreme variation of power is likely to occur. The price is \$175.00, boxed.

Knight's Patent Automatic Gate.

We make an automatic gate for compressors. When the air raises to 80 pounds pressure the gate will stop the water wheel, and will start it again when the air has been reduced to 75 pounds, thus economizing in use of water.

We have them at work at the following-named mines giving the very best satisfaction: Amador Gold Mine, Jackson, Cal.; Con. South Spring Hill Gold Mine, Amador City, Cal.; Wildman Gold Mine, Sutter Creek, Cal.; Hector Gold Mine, Sutter Creek; Argonaut Gold Mine, Jackson.

Prices on application.

RUNNING OVER 2000 STAMPS.

PRICE LIST

OF

KNIGHT'S WATER WHEELS.

Diameter of Wheels	2	5	10	20	30	40	60	80	100	200	300	400
	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
6 in. Motor.	\$ 25	\$ 30	\$ 40	.....	.....	With Cast Iron Casings						
12 in. Motor.	50	50	60	.....	.....	“	“	“	“	
18 in.	100	100	110	\$120	.....	“	“	“	“		
24 in. Motor.	180	180	190	200	\$210	“	“	“	“			
2 ft.	.....	.....	150	160	170	\$180	Wheels Without Casing.					
3 ft.	.....	.....	165	175	185	195	\$220	\$250	\$300	\$350	.....	.....
4½ ft.	.....	.....	.....	200	220	250	275	300	350	400	450	\$500
6 ft.	.....	.....	.....	.....	275	300	330	385	400	450	500	550
8 ft.	.....	.....	.....	.....	.....	400	420	450	500	550	600	650

The above prices include the wheel, boxes, shaft, gate, nozzle and a pulley to suit the speed required; provided, however, the pulley does not exceed two-thirds the diameter of water wheel. If larger than this is wanted, an additional charge is made.

Shafts are furnished as per cuts or drawing herein. Extra length will be charged for all over that specified.

Water Weeels made in sections for mule transportation not to exceed 300 lbs. 20 per cent above the List Price.

Water Wheels used under less head than 50 feet, 20 per cent extra on the above Price List.

Above prices include Water Wheels delivered at R. R. Station, Ione, Cal.

Table Showing Diameter, Revolutions and Head

FOR

KNIGHT'S WATER WHEELS.

Table calculated 46 per cent. of the spouting velocity of water in feet per minute.

Head in Feet	DIAMETER OF WHEELS.								Head in Feet	DIAMETER OF WHEELS.							
	6'	12'	18'	24'	3'	4½'	6'	8'		6'	12'	18'	24'	3'	4½'	6'	8'
	REVOLUTIONS PER MINUTE.									REVOLUTIONS PER MINUTE.							
10	444	222	148	111	74	49	37	28									
15	540	270	180	135	90	60	45	35	240	2178	1089	726	544	363	242	181	136
20	630	315	210	157	105	70	52	39	250	2226	1113	742	556	371	247	185	139
30	768	384	256	192	128	85	64	48	260	2268	1134	756	567	378	252	189	142
40	888	444	296	222	148	99	74	55	270	2316	1158	772	578	386	257	193	145
50	996	498	332	249	166	111	83	62	280	2358	1179	786	589	393	262	196	147
60	1086	543	362	271	181	121	90	68	290	2394	1197	798	598	399	266	199	149
70	1176	588	392	294	196	131	98	73	300	2436	1218	812	609	406	271	203	152
80	1254	627	418	313	209	139	104	78	320	2514	1257	838	628	419	279	209	157
90	1332	666	444	333	222	148	111	83	340	2592	1296	864	648	432	288	216	162
100	1404	702	468	351	234	156	117	88	360	2670	1335	890	667	445	297	222	167
110	1476	738	492	369	246	164	123	92	380	2742	1371	914	685	457	305	228	171
120	1542	771	514	385	257	171	128	96	400	2814	1407	938	703	469	313	234	176
130	1602	801	534	401	267	178	134	100	420	2886	1443	962	721	481	321	240	180
140	1662	831	554	415	277	185	138	104	440	2952	1476	984	738	492	328	246	184
150	1722	861	574	430	287	191	143	107	460	3018	1509	1006	754	503	335	251	188
160	1776	888	592	444	296	197	148	111	480	3084	1542	1028	771	514	343	257	194
170	1836	918	612	459	306	204	153	115	500	3144	1572	1048	786	524	349	262	197
180	1890	945	630	472	315	210	157	118	520	3210	1605	1070	802	535	356	267	200
190	1938	969	646	484	323	215	161	121	540	3270	1635	1090	817	545	363	272	204
200	1992	996	664	498	332	221	166	124	560	3330	1665	1110	832	555	370	277	208
210	2040	1020	680	510	340	227	170	127	580	3390	1695	1130	847	565	377	282	212
220	2088	1044	696	522	348	232	174	130	600	3450	1725	1150	862	575	383	287	215
230	2136	1068	712	534	356	237	178	133	620	3504	1752	1168	876	584	389	292	219

The above table gives the slowest speed for the Knight Wheel that will give high percentage. Three to four per cent. may be added to suit pulleys and speed of line shafting without making material difference. In sawmill machinery it would be well to speed the wheel from fifteen to twenty per cent in excess of above tables.

This, although not giving so high a percentage of power from the water used, will be found beneficial, because the saw, in going out of cut, will not increase so rapidly in speed, and the governor will have more opportunity to act.

RUNNING OVER 2000 STAMPS.

Table of Horse Powers

FOR

KNIGHT'S WATER WHEELS.

Calculated 1 inch=1½ Cubic Feet per Minute.

Discharge Per Minute.	Miners inch.	5	10	20	30	40	50	60	70
	Cubic Feet.	7½	15	30	45	60	75	90	105
Head in Feet.		H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
10		.11	.23	.46	.69	.92	1.15	1.45	1.68
15		.17	.34	.68	1.02	1.36	1.70	2.17	2.53
20		.22	.45	.90	1.35	1.80	2.15	2.90	3.39
30		.34	.68	1.36	2.04	2.72	3.40	4.34	5.07
40		.45	.91	1.82	2.73	3.64	4.55	5.80	6.76
50		.56	1.13	2.26	3.39	4.52	5.65	7.24	8.45
60		.66	1.33	2.66	3.99	5.32	6.65	8.69	10.14
70		.79	1.59	3.18	4.77	6.36	7.95	10.16	11.85
80		.91	1.82	3.64	5.46	7.28	9.10	11.59	13.52
90		1.02	2.04	4.08	6.12	8.16	10.20	13.04	15.21
100		1.13	2.27	4.54	6.81	9.08	11.35	14.49	16.90
110		1.25	2.50	5.00	7.5	10.00	12.50	15.94	18.59
120		1.36	2.73	5.46	8.19	10.92	13.65	17.39	20.29
130		1.47	2.95	5.90	8.85	11.80	14.75	18.83	21.97
140		1.59	3.18	6.36	9.54	12.72	15.90	20.29	23.67
150		1.70	3.41	6.82	10.23	13.64	17.05	21.73	25.35
160		1.82	3.64	7.28	10.92	14.56	18.20	23.18	27.05
170		1.93	3.86	7.72	11.58	15.44	19.30	24.63	28.73
180		2.04	4.09	8.18	12.27	16.36	20.45	26.08	30.42
190		2.16	4.32	8.64	12.96	17.28	21.60	27.53	32.12
200		2.27	4.54	9.08	13.62	18.16	22.70	28.97	33.80
210		2.38	4.77	9.54	14.31	19.08	23.85	30.43	35.50
220		2.50	5.00	10.00	15.00	20.00	25.00	31.87	37.18
230		2.61	5.23	10.46	15.69	20.92	26.15	33.32	38.88
240		2.72	5.45	10.90	16.35	21.80	27.25	34.77	40.58
250		2.84	5.68	11.36	17.04	22.72	28.40	36.22	42.26
260		2.95	5.91	11.82	17.73	23.64	29.55	37.67	43.95
270		3.08	6.17	12.34	18.51	24.68	30.85	39.12	45.64
280		3.18	6.36	12.72	19.08	25.44	31.80	40.57	47.33
290		3.29	6.59	13.18	19.77	26.36	32.95	42.02	49.02
300		3.41	6.82	13.64	20.46	27.28	34.10	43.46	50.71
320		3.63	7.27	14.54	21.81	29.08	36.35	46.36	54.09
340		3.86	7.73	15.46	23.19	30.92	38.65	49.26	57.47
360		4.09	8.18	16.36	24.54	32.72	40.90	52.16	60.85
380		4.32	8.64	17.28	25.92	34.56	43.20	55.06	64.23
400		4.54	9.09	18.18	27.27	36.36	45.45	57.95	67.61
420		4.77	9.55	19.10	28.65	38.20	47.75	60.85	70.99
440		5.00	10.00	20.00	30.00	40.00	50.00	63.75	74.37
460		5.22	10.45	20.90	31.35	41.80	52.25	66.65	77.76
480		5.45	10.91	21.82	32.73	43.64	54.55	69.55	81.14
500		5.68	11.36	22.72	34.08	45.44	56.80	72.44	84.52
520		5.91	11.82	23.64	35.46	47.28	59.10	75.34	87.90
540		6.16	12.33	24.66	36.99	49.32	61.65	78.24	91.28
560		6.36	12.73	25.46	38.19	50.92	63.65	81.14	94.66
580		6.59	13.18	26.36	39.54	52.72	65.90	84.04	98.04
600		6.82	13.64	27.28	40.92	54.56	68.20	86.93	101.42

Table of Horse Powers

FOR

KNIGHT'S WATER WHEELS.

Calculated 1 inch=1½ Cubic Feet per Minute.

Discharge per Minute.	Miners Inches.	80	90	100	120	140	160	180	20
	Cubic Feet.	120	135	150	180	210	240	270	300
Head in Feet.		H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H.P.
10	1.93	2.17	2.41	2.90	3.36	3.86	4.34	4.82	
15	2.90	3.26	3.62	4.34	5.06	5.80	6.52	7.24	
20	3.87	4.36	4.84	5.80	6.78	7.74	8.72	9.68	
30	5.79	6.52	7.24	8.68	10.14	11.58	13.04	14.48	
40	7.73	8.69	9.66	11.60	13.52	15.46	17.38	19.32	
50	9.66	10.86	12.07	14.48	16.90	19.32	21.72	24.14	
60	11.59	13.04	14.49	17.38	20.28	23.18	26.08	28.98	
70	13.54	15.24	16.93	20.32	23.70	27.08	30.48	33.86	
80	15.46	17.39	19.32	23.18	27.04	30.92	34.78	38.64	
90	17.38	19.56	21.73	26.08	30.42	34.76	39.12	43.46	
100	19.32	21.73	24.15	28.98	33.80	38.64	43.46	48.30	
110	21.25	23.90	26.56	30.88	37.18	42.50	47.80	53.12	
120	23.18	26.08	28.98	34.78	40.58	46.36	52.16	57.96	
130	25.11	28.25	31.39	37.66	43.94	50.22	56.50	62.78	
140	27.05	30.43	33.81	40.58	47.34	54.10	60.86	67.62	
150	28.98	32.60	36.22	43.46	50.70	57.96	65.20	72.44	
160	30.91	34.78	38.64	46.36	54.10	61.82	69.56	77.28	
170	32.84	36.94	41.05	49.26	57.46	65.68	73.88	82.10	
180	34.77	39.11	43.46	52.16	60.84	69.54	78.22	86.92	
190	36.70	41.29	45.88	55.06	64.24	73.40	82.58	91.76	
200	38.63	43.46	48.29	57.94	67.60	77.26	86.92	96.58	
210	40.57	45.64	50.71	60.86	71.00	81.14	91.28	101.42	
220	42.50	47.81	53.12	63.74	74.36	85.00	95.62	106.24	
230	44.43	49.99	55.54	66.64	77.76	88.86	99.88	111.08	
240	46.36	52.15	57.95	69.54	81.16	92.72	104.30	115.90	
250	48.30	54.33	60.37	72.44	84.52	96.60	108.66	120.74	
260	50.22	56.50	62.78	75.34	87.90	100.44	113.00	125.56	
270	52.16	58.68	65.20	78.24	91.28	104.32	117.36	130.40	
280	54.09	60.85	67.61	81.14	94.66	108.18	121.70	135.22	
290	56.02	63.03	70.03	84.04	98.04	112.04	126.06	140.06	
300	57.95	65.20	72.44	86.92	101.42	115.90	130.40	144.88	
320	61.82	69.54	77.27	92.72	108.18	123.64	139.08	154.54	
340	65.68	73.89	82.10	98.52	114.94	131.36	147.78	164.20	
360	69.54	78.24	86.93	104.32	121.70	139.08	156.48	173.86	
380	73.41	82.58	91.76	110.12	128.46	146.82	165.16	183.52	
400	77.27	86.93	96.59	115.90	135.22	154.54	173.86	193.18	
420	81.14	91.28	101.42	121.70	141.98	162.28	182.56	202.84	
440	85.00	95.62	106.25	127.50	148.74	170.00	191.24	212.50	
460	88.86	99.97	111.08	133.30	155.52	177.72	199.94	222.16	
480	92.73	104.32	115.91	139.10	162.28	185.46	208.64	231.82	
500	96.59	108.67	120.74	144.88	169.04	193.18	217.34	241.48	
520	100.46	113.01	125.57	150.68	175.80	200.92	226.02	251.14	
540	104.32	117.36	130.40	156.48	182.56	208.64	234.72	260.80	
560	108.18	121.71	135.23	162.28	189.32	216.36	243.42	270.46	
580	112.05	126.05	140.06	168.08	196.08	224.10	252.10	280.12	
600	115.91	130.40	144.89	173.86	202.84	231.82	260.80	289.78	

RUNNING OVER 2000 STAMPS.

300 KNIGHT'S WHEELS, GIVING OUT

Table of Horse Powers

FOR

KNIGHT'S WATER WHEELS.Calculated 1 Miner's inch = $1\frac{1}{2}$ Cubic Feet per Minute.

Discharge Per Minute.	Miners inch.	220	240	260	280	300	320	33	360
	Cubic Feet.	330	360	390	420	450	480	510	540
Head in Feet.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
10	5.30	5.80	6.27	6.72	7.23	7.72	8.19	8.67	
15	7.96	8.68	9.41	10.12	10.86	11.60	12.31	13.03	
20	10.65	11.60	12.58	13.56	14.52	15.48	16.46	17.42	
30	15.93	17.36	18.82	20.28	21.72	23.16	24.62	26.06	
40	21.25	23.20	25.12	27.04	28.98	30.92	32.84	34.78	
50	26.55	28.96	31.38	33.80	36.21	38.64	41.04	43.45	
60	31.88	34.76	37.67	40.56	43.47	46.36	49.27	52.16	
70	37.25	40.64	44.02	47.40	50.79	54.16	57.56	60.95	
80	42.50	46.36	50.23	54.08	57.96	61.84	65.69	69.55	
90	47.81	52.16	56.50	60.84	65.19	69.52	73.88	78.23	
100	53.13	57.96	62.79	67.60	72.45	77.28	82.11	86.94	
110	58.43	61.76	69.06	74.36	79.68	85.00	90.30	95.62	
120	63.76	69.56	75.35	81.16	86.94	92.72	98.53	104.33	
130	69.06	75.32	81.61	87.88	94.17	100.44	106.73	113.00	
140	74.38	81.16	87.91	94.68	101.43	108.20	114.95	121.72	
150	79.68	86.92	94.17	101.40	108.66	115.92	123.15	130.39	
160	85.01	92.72	100.46	108.20	115.92	123.64	131.38	139.10	
170	90.31	98.52	106.73	114.92	123.15	131.36	139.57	147.78	
180	95.61	104.32	113.00	121.68	130.38	139.08	147.77	156.46	
190	100.94	110.12	119.29	128.48	137.64	146.80	155.99	165.17	
200	106.24	115.88	125.55	135.20	144.87	154.52	164.19	173.84	
210	111.56	121.72	131.85	142.00	152.13	162.28	172.41	182.56	
220	116.86	127.48	138.11	148.72	159.36	170.00	180.61	191.23	
230	122.19	133.28	144.40	155.52	166.62	177.72	188.84	199.94	
240	127.49	139.08	150.67	162.32	173.85	185.44	197.03	208.62	
250	132.81	144.88	156.94	169.04	181.11	193.20	205.26	217.33	
260	138.12	150.68	163.23	175.80	188.34	200.88	213.45	226.01	
270	143.44	156.48	169.52	182.56	195.60	208.64	221.68	234.72	
280	148.74	162.28	175.79	189.32	202.83	216.36	229.87	243.40	
290	154.07	168.08	182.08	196.08	210.09	224.08	238.10	252.11	
300	159.37	173.84	188.34	202.84	217.32	231.80	246.30	260.78	
320	169.99	185.44	200.90	216.36	231.81	247.28	262.72	278.17	
340	180.62	197.04	213.46	229.88	246.30	262.72	279.14	295.56	
360	191.25	208.64	226.02	243.40	260.79	278.16	295.56	312.95	
380	201.87	220.24	238.58	256.92	275.28	293.64	311.98	330.34	
400	212.50	231.80	251.13	270.44	289.77	309.08	328.41	347.72	
420	223.12	243.40	263.69	283.96	304.26	324.56	344.81	365.11	
440	233.75	255.00	276.25	297.48	318.75	340.00	361.25	382.50	
460	244.38	266.60	288.81	311.04	333.24	355.44	377.67	399.89	
480	255.00	278.20	301.36	324.56	347.73	370.92	394.09	417.28	
500	265.63	289.76	313.92	338.08	362.22	386.36	410.52	434.66	
520	276.25	301.36	326.48	351.60	376.71	401.84	426.94	452.15	
540	286.88	312.96	339.04	365.12	391.20	417.28	443.36	469.44	
560	297.51	324.56	351.60	378.64	405.69	432.72	459.78	486.83	
580	308.13	336.16	364.16	392.16	420.18	448.20	476.20	504.22	
600	318.76	347.72	376.71	405.68	434.67	463.64	492.63	521.60	

90 WATER WHEELS,

Table of Horse Powers

FOR

KNIGHT'S WATER WHEELS.

Calculated 1 Miner's inch= $1\frac{1}{2}$ Cubic Feet per Minute.

Discharge per Minute.	Miners Inch.	390	420	450	480	510	540	570	600
	Cubic Feet.	585	630	675	720	765	810	855	900
Head in Feet.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
10	9.40	10.12	10.84	11.60	12.29	13.01	13.74	14.46	
15	14.12	15.20	16.29	17.36	18.46	19.55	20.63	21.72	
20	18.88	20.33	21.78	23.20	24.68	26.14	27.59	29.04	
30	28.24	30.41	32.58	34.64	36.92	39.10	41.27	43.44	
40	37.67	40.57	43.47	46.40	49.27	52.16	55.06	57.96	
50	47.07	50.69	54.31	57.92	61.58	65.18	68.80	72.42	
60	56.51	60.86	65.20	69.52	73.90	78.25	82.59	86.94	
70	66.03	71.11	76.18	81.28	86.34	91.42	96.50	101.58	
80	75.35	81.14	86.94	92.72	98.53	104.33	110.12	115.92	
90	84.75	91.27	97.78	104.32	110.82	117.34	123.86	130.38	
100	94.18	101.43	108.67	115.92	123.16	130.42	137.65	144.90	
110	103.58	111.55	119.52	123.52	135.46	143.42	151.39	159.36	
120	113.02	121.72	130.41	139.12	147.80	156.59	165.19	173.88	
130	122.42	131.84	141.25	150.64	160.09	169.51	178.92	188.34	
140	131.86	142.00	152.14	162.32	172.43	182.57	192.72	202.86	
150	141.26	152.12	162.99	173.84	184.72	195.59	206.45	217.32	
160	150.70	162.29	173.88	185.44	197.06	208.66	220.25	231.84	
170	160.09	172.41	184.72	197.04	209.35	221.67	233.98	246.30	
180	169.49	182.53	195.57	208.64	221.65	234.68	247.72	260.76	
190	178.93	192.70	206.46	220.24	233.99	247.75	261.52	275.28	
200	188.33	202.82	217.30	231.76	246.28	260.77	275.25	289.74	
210	197.77	212.98	228.19	243.44	258.62	273.83	289.05	304.26	
220	207.17	223.10	239.04	254.96	271.91	286.85	302.78	318.72	
230	216.61	233.27	249.97	266.56	283.25	299.92	316.58	333.24	
240	226.00	243.39	260.77	278.16	295.54	312.93	330.31	347.70	
250	235.44	253.55	271.66	289.76	307.89	326.00	344.11	362.22	
260	244.84	263.68	282.51	301.36	320.18	339.01	357.85	376.68	
270	254.28	273.84	293.40	312.96	332.52	352.08	371.64	391.20	
280	263.68	283.96	304.24	324.56	344.81	365.09	385.38	405.66	
290	273.12	294.13	315.13	336.16	357.15	378.16	399.17	420.18	
300	282.52	304.25	325.98	347.68	369.44	391.18	412.91	434.64	
320	301.35	324.53	347.71	370.90	394.08	417.26	440.44	463.62	
340	320.19	344.82	369.45	394.08	418.71	443.34	467.97	492.60	
360	339.03	365.11	391.18	417.28	443.34	469.42	495.50	521.58	
380	357.86	385.39	412.92	440.48	467.98	495.50	522.97	550.56	
400	376.70	405.68	434.65	463.60	492.61	521.59	550.56	579.54	
420	395.54	425.96	456.39	486.80	517.24	547.67	578.09	608.52	
440	414.37	446.25	478.12	510.00	541.87	573.75	605.62	637.50	
460	433.21	466.54	499.86	533.20	566.51	599.83	633.16	666.48	
480	452.05	486.82	521.59	556.40	591.14	625.91	660.69	695.46	
500	470.89	507.11	543.33	579.52	615.77	652.00	688.22	724.44	
520	489.72	527.39	565.06	602.72	640.41	678.08	715.75	753.42	
540	508.56	547.68	586.80	625.92	665.04	704.16	743.28	782.40	
560	527.40	567.97	598.53	649.12	689.67	730.24	770.81	811.38	
580	546.23	588.25	630.27	672.32	714.31	756.32	798.34	840.36	
600	565.07	608.54	652.00	695.45	738.94	782.41	825.87	869.34	

RUNNING OVER 2000 STAMPS.

Table of Diameters, Circumferences and Areas of Circles, and the Contents in Gallons of 231 Cu. In. at 1 Foot in Depth.

DIAM.	CIRCUM.	AREA.	GALLONS.	DIAM.	CIRCUM.	AREA.	GALLONS.
Inches.	Inches.	Inches.		Inches.	Inches.	Inches.	
1	3.1416	.7854	.04084	8	25.132	50.265	2.61378
1/8	3.5343	.9940	.05169	1/8	25.515	51.848	2.69609
1/4	3.9270	1.2271	.06380	1/4	25.918	53.456	2.77971
3/8	4.3197	1.4848	.07717	3/8	26.310	55.088	2.86458
1/2	4.7124	1.7671	.09188	1/2	26.703	56.745	2.95074
5/8	5.1051	2.0739	.10782	5/8	27.096	58.426	3.03815
3/4	5.4978	2.4052	.12506	3/4	27.489	60.132	3.12686
7/8	5.8905	2.7611	.14357	7/8	27.881	61.862	3.21682
2	6.2832	3.1416	.16333	9	28.274	63.617	3.30808
1/8	6.6759	3.5465	.18439	1/8	28.667	65.396	3.40059
1/4	7.0686	3.9760	.20675	1/4	29.059	67.200	3.49440
3/8	7.4613	4.4302	.23036	3/8	29.452	69.029	3.58951
1/2	7.8540	4.9087	.25522	1/2	29.845	70.882	3.68586
5/8	8.2467	5.4119	.28142	5/8	30.237	72.759	3.78347
3/4	8.6394	5.9395	.30883	3/4	30.630	74.662	3.88242
7/8	9.0321	6.4918	.33753	7/8	31.023	76.588	3.98258
3	9.4248	7.0686	.36754	10	31.416	78.540	4.08408
1/8	9.8175	7.6699	.39879	1/8	31.808	80.515	4.18678
1/4	10.210	8.2957	.43134	1/4	32.201	82.516	4.29083
3/8	10.602	8.9462	.46519	3/8	32.594	84.540	4.39603
1/2	10.995	9.6211	.50029	1/2	32.986	86.590	4.50268
5/8	11.388	10.320	.53664	5/8	33.379	88.664	4.61053
3/4	11.781	11.044	.57429	3/4	33.772	90.762	4.71962
7/8	12.173	11.793	.61324	7/8	34.164	92.885	4.82846
4	12.566	12.566	.65343	11	34.557	95.033	4.94172
1/8	12.959	13.364	.69493	1/8	35.950	97.205	5.05466
1/4	13.351	14.186	.73767	1/4	35.343	99.402	5.16890
3/8	13.744	15.033	.78172	3/8	35.735	101.623	5.28439
1/2	14.137	15.904	.82701	1/2	36.128	103.869	5.40119
5/8	14.529	16.800	.87360	5/8	36.521	106.839	5.51923
3/4	14.922	17.720	.92144	3/4	36.913	108.434	5.63857
7/8	15.315	18.665	.97058	7/8	37.306	110.753	5.75916
5	15.708	19.635	1.02102	12	37.699	113.097	5.8810
1/8	16.100	20.629	1.07271	1/8	38.091	115.466	6.0042
1/4	16.493	21.647	1.12564	1/4	38.484	117.859	6.1286
3/8	16.886	22.690	1.17988	3/8	38.877	120.276	6.2543
1/2	17.278	23.758	1.23542	1/2	39.270	122.718	6.3813
5/8	17.671	24.850	1.29220	5/8	39.662	125.185	6.5096
3/4	18.064	25.967	1.35128	3/4	40.055	127.676	6.6391
7/8	18.457	27.108	1.40962	7/8	40.448	130.192	6.7699
6	18.849	28.274	1.47025	13	40.840	132.732	6.9020
1/8	19.242	29.464	1.53213	1/8	41.233	135.297	7.0354
1/4	19.635	30.679	1.59531	1/4	41.626	137.886	7.1700
3/8	20.027	31.919	1.65979	3/8	42.018	140.500	7.3060
1/2	20.420	33.183	1.72532	1/2	42.411	143.139	7.4432
5/8	20.813	34.471	1.79249	5/8	42.804	145.802	7.5817
3/4	21.205	35.784	1.86077	3/4	43.197	148.489	7.7214
7/8	21.598	37.122	1.93034	7/8	43.589	151.201	7.8624
7	21.991	38.484	2.00117	14	43.982	153.938	8.0047
1/8	22.383	39.871	2.07329	1/8	44.375	156.699	8.1483
1/4	22.776	41.282	2.14666	1/4	44.767	159.485	8.2932
3/8	23.169	42.718	2.22134	3/8	45.160	162.295	8.4393
1/2	23.562	44.178	2.29726	1/2	45.553	165.130	8.5867
5/8	23.954	45.663	2.37448	5/8	45.945	167.989	8.7354
3/4	24.347	47.173	2.45299	3/4	46.338	170.873	8.8853
7/8	24.740	48.707	2.53276	7/8	46.731	173.782	9.0366

2500 HORSE POWER.

Table of Diameters, Circumferences and Areas of Circles, and the Contents in Gallons of 231 Cu. In. at 1 Foot in Depth.--Continued.

DIAM.	CIRCUM.	AREA.	GALLONS.	DIAM.	CIRCUM.	AREA.	GALLONS.
Inches.	Inches.	Inches.		Inches.	Inches.	Inches.	
15	47.124	176.715	9.1891	23	72.256	415.476	21.6047
1/8	47.516	179.672	9.3429	1/8	72.649	420.004	21.8402
1/4	47.909	182.654	9.498	1/4	73.042	424.557	22.0769
3/8	48.302	185.661	9.6543	3/8	73.434	429.135	22.3150
1/2	48.694	188.692	9.8119	1/2	73.827	433.737	22.5543
5/8	49.087	191.748	9.9708	5/8	74.220	438.363	22.7984
3/4	49.480	194.828	10.131	3/4	74.613	443.014	23.0367
7/8	49.872	197.933	10.2925	7/8	75.005	447.699	23.2803
16	50.265	201.062	10.4552	24	75.398	452.390	23.500
1/8	50.658	204.216	10.6192	1/8	75.791	457.115	23.746
1/4	51.051	207.394	10.7844	1/4	76.183	461.864	23.992
3/8	51.443	210.597	10.951	3/8	76.576	466.638	24.240
1/2	51.836	213.825	11.1189	1/2	76.969	471.436	24.490
5/8	52.229	217.077	11.288	5/8	77.361	476.259	24.740
3/4	52.621	220.353	11.458	3/4	77.754	481.106	24.992
7/8	53.014	223.654	11.630	7/8	78.147	485.978	25.245
17	53.407	226.980	11.8029	25	78.540	490.875	25.500
1/8	53.799	230.330	11.977	1/8	78.932	495.796	25.755
1/4	54.192	233.705	12.1526	1/4	79.325	500.741	26.012
3/8	54.585	237.104	12.3294	3/8	79.718	505.711	26.270
1/2	54.978	240.528	12.5074	1/2	80.110	510.706	26.530
5/8	55.370	243.977	12.6868	5/8	80.503	515.725	26.790
3/4	55.763	247.450	12.8674	3/4	80.896	520.769	27.053
7/8	56.156	250.947	13.0492	7/8	81.288	525.837	27.316
18	56.548	254.469	13.2323	26	81.681	530.930	27.580
1/8	56.941	258.016	13.4168	1/8	82.074	536.047	27.846
1/4	57.334	261.587	13.6025	1/4	82.467	541.189	28.113
3/8	57.726	265.182	13.7894	3/8	82.859	546.356	28.383
1/2	58.119	268.803	13.9777	1/2	83.252	551.547	28.651
5/8	58.512	272.447	14.1672	5/8	83.645	556.762	28.922
3/4	58.905	276.117	14.358	3/4	84.037	562.002	29.194
7/8	59.297	279.811	14.550	7/8	84.430	567.267	29.468
19	59.690	283.529	14.7435	27	84.823	572.556	29.743
1/8	60.083	287.272	14.938	1/8	85.215	577.870	30.019
1/4	60.475	291.039	15.134	1/4	85.608	583.208	30.296
3/8	60.868	294.831	15.331	3/8	86.001	588.588	30.575
1/2	61.261	298.648	15.5296	1/2	86.394	593.958	30.854
5/8	61.653	302.489	15.7294	5/8	86.786	599.370	31.135
3/4	62.046	306.355	15.9304	3/4	87.179	604.807	31.418
7/8	62.439	310.245	16.1327	7/8	87.572	610.268	31.702
20	62.832	314.160	16.3363	28	87.964	615.753	31.987
1/8	63.224	318.099	16.541	1/8	88.357	621.263	32.273
1/4	63.617	322.063	16.7472	1/4	88.750	626.798	32.560
3/8	64.010	326.051	16.9546	3/8	89.142	632.357	32.849
1/2	64.402	330.064	17.1633	1/2	89.535	637.941	33.139
5/8	64.795	334.101	17.3732	5/8	89.928	643.549	33.431
3/4	65.188	338.163	17.5844	3/4	90.321	649.182	33.723
7/8	65.580	342.250	17.797	7/8	90.713	654.839	34.017
21	65.973	346.361	18.0107	29	91.106	660.521	34.312
1/8	66.366	350.497	18.2258	1/8	91.499	666.227	34.609
1/4	66.759	354.657	18.442	1/4	91.891	671.958	34.906
3/8	67.151	358.841	18.6597	3/8	92.284	677.714	35.205
1/2	67.544	363.051	18.8786	1/2	92.677	683.494	35.506
5/8	67.937	367.284	19.0987	5/8	93.069	689.299	35.807
3/4	68.329	371.543	19.3202	3/4	93.462	695.128	36.110
7/8	68.722	375.826	19.5429	7/8	93.855	700.981	36.414
22	69.115	380.133	19.7669	30	94.248	706.860	36.720
1/8	69.507	384.465	19.9921				
1/4	69.900	388.822	20.2187				
3/8	70.293	393.203	20.4465				
1/2	70.686	397.608	20.6756				
5/8	71.078	402.038	20.9059				
3/4	71.471	406.493	21.1376				
7/8	71.864	410.972	21.3705				

RUNNING OVER 2000 STAMPS.

Measurement of Water

BY

DIFFERENT DITCH COMPANIES.

	Opening. Inches.	Pressure Board. Inches.	Mean Pressure. Inches.	Cubic Feet.
Amador Canal Co.	2	4	5	1.40
Eureka Lake and Canal Co.....	2	5	6	1.45
Park Canal and Mining Co.....	2	5	6	1.45
El Dorado Water and Deep Gravel Mining Co.....	4	4	6	1.45
Mokelumne and Campo Seco Canal and Mining Co..	4	3	5	1.40
Union Water Company, Murphys.....	4	4	6	1.45
South Yuba Canal Co.....	4	4	6	1.45
North Bloomfield	2	6	7	1.60
Milton	2	6	7	1.60
La Grange.....	2	6	7	1.60
Smartsville Ditch Co.....	4	7	9	1.78

The North Bloomfield, Milton and La Grange companies measure through a 3-inch plank, and the others use 1 and 1½-inch planks.

Parties using water from the Amador Canal Company, and the Mokelumne and Campo Seco Canal and Mining Company, will deduct 3½ per cent from the horse power tables on pages 26, 27, 28, 29; and those using the water from the Smartsville Ditch Company will add 23 per cent to the same tables.

TABLE
Showing Friction of Water in Pipes.

Loss of head in feet for each 100 feet in different sizes iron pipes, discharging given quantities of water per minute. $1\frac{1}{2}$ cubic feet=1 inch.

S. N. KNIGHT.

DISCHARGING PER MINUTE.			SIZES OF PIPES—INSIDE DIAMETER.									
Miner's Inches.	Cubic Feet.	Gallons.	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.
.44	.66	5	2.00	.05	.....	.....	.....	.....	.....	.....	.....	.....
.88	1.32	10	8.00	.24	.....	.....	.....	.....	.....	.....	.....	.....
1.32	1.98	15	18.00	.56	.....	.....	.....	.....	.....	.....	.....	.....
1.76	2.64	20	32.00	1.00	.....	.....	.....	.....	.....	.....	.....	.....
2.20	3.30	25	50.00	1.56	.20	.....	.....	.....	.....	.....	.....	.....
2.64	3.96	30	72.00	2.24	.....	.....	.....	.....	.....	.....	.....	.....
3.08	4.62	34	.....	3.05	.40	.....	.....	.....	.....	.....	.....	.....
3.52	5.28	40	.....	4.00	.52	.....	.....	.....	.....	.....	.....	.....
3.96	5.94	44	.....	5.05	.66	.....	.....	.....	.....	.....	.....	.....
4.40	6.60	48	.....	5.61	.81	.19	.....	.....	.....	.....	.....	.....
6.60	9.90	74	.....	14.05	1.84	.....	.14	.....	.....	.....	.....	.....
8.80	13.20	98	.....	25.00	3.28	.77	.....	.09	.....	.....	.....	.....
11.00	16.50	123	.....	39.05	5.14	.....	.40	.....	.....	.....	.....	.....
13.20	19.80	148	.....	56.24	7.40	1.74	.....	.22	.....	.....	.....	.....
15.40	23.10	174	.....	76.56	10.08	2.40	.78	.....	.....	.....	.....	.....
17.60	26.40	196	.....	.....	13.16	3.12	1.02	.40	.18	.....	.....	.....
22.00	33.00	247	.....	.....	20.56	4.88	1.60	.64	.....	.15	.....	.....
26.40	39.60	296	.....	.....	29.62	7.02	2.30	.92	.42	.21	.11	.....
30.80	46.20	345	.....	.....	40.32	9.56	3.13	1.25	.57	.29	.15	.09
35.20	52.80	395	.....	.....	52.62	12.49	4.09	1.64	.76	.38	.20	.12
39.60	59.40	444	.....	.....	66.33	15.81	5.18	2.08	.96	.48	.25	.15
44.00	66.00	494	.....	.....	.....	19.52	6.40	2.56	1.18	.60	.31	.18
66.00	99.00	741	.....	.....	.....	.....	14.40	5.78	2.67	1.36	.71	.42
88.00	132.00	987	.....	.....	.....	.....	25.60	10.28	4.75	2.44	1.26	.75
110.00	165.00	1234	.....	.....	.....	.....	.....	16.07	7.43	3.80	1.98	1.17
132.00	198.00	1481	.....	.....	.....	.....	.....	.....	10.70	5.48	2.85	1.68
154.00	231.00	1728	.....	.....	.....	.....	.....	.....	.....	7.47	3.88	2.29
176.00	264.00	1975	.....	.....	.....	.....	.....	.....	.....	.....	5.07	3.00
198.00	297.00	2222	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.79

RUNNING OVER 2000 STAMPS.

TABLE
Showing Friction of Water in Pipes.

Loss of head in feet for each 100 feet in different sizes iron pipes, discharging given quantities of water per minute. 1½ cubic feet=1 inch.

S. N. KNIGHT.

DISCHARGING PER MINUTE.			SIZES OF PIPES—INSIDE DIAMETER.										
Miner's Inches.	Cubic Feet.	Gallons.	11 in.	12 in.	13 in.	14 in.	15 in.	16 in.	18 in.	22 in.	26 in.	30 in.	37½ in.
66.00	99.00	740	.25	.16	.....	.....	.....	.....	.....	.....	.....	.....	.....
88.00	132.00	987	.46	.30	.19	.....	.....	.....	.....	.....	.....	.....	.....
110.00	165.00	1234	.72	.46	.31	.21	.....	.....	.....	.....	.....	.....	.....
132.00	198.00	1479	1.04	.67	.45	.30	.21	.....	.....	.....	.....	.....	.....
154.00	231.00	1728	1.42	.92	.61	.42	.30	.....	.....	.....	.....	.....	.....
176.00	264.00	1975	1.86	1.20	.80	.55	.40	.27	.....	.....	.....	.....	.....
198.00	297.00	2222	2.35	1.52	1.02	.70	.51	.....	.....	.....	.....	.....	.....
220.00	330.00	2468	2.91	1.88	1.26	.82	.63	.44	.24	.....	.....	.....	.....
264.00	396.00	2962	4.18	2.61	1.81	1.25	.88	.63	.....	.12	.....	.....	.....
308.00	462.00	3456	5.70	3.69	2.46	1.70	1.20	.87	.48	.....	.....	.....	.....
352.00	528.00	3549	.....	4.82	3.22	2.22	1.57	1.14	.63	.23	.09	.....	.....
396.00	594.00	4442	.....	.....	4.08	2.82	1.99	1.44	.80	.....	.....	.....	.....
440.00	660.00	4937	.....	.....	.....	3.48	2.46	1.78	1.09	.36	.15	.....	.....
484.00	726.00	5345	.....	.....	.....	.....	2.98	2.16	1.20	.....	.....	.....	.....
528.00	792.00	5924	.....	.....	.....	.....	3.55	2.57	1.42	.51	.22	.....	.....
572.00	858.00	6418	.....	.....	.....	.....	.....	3.01	1.67	.60	.....	.....	.....
616.00	924.00	6901	.....	.....	.....	.....	.....	3.50	1.94	.72	.30	.....	.....
704.00	1056.00	7899	.....	.....	.....	.....	.....	.....	2.53	.93	.....	.18	.....
792.00	1188.00	8784	.....	.....	.....	.....	.....	.....	3.21	1.17	.51	.....	.....
880.00	1320.00	9874	.....	.....	.....	.....	.....	.....	.....	1.45	.63	.31	.09
968.00	1452.00	10861	.....	.....	.....	.....	.....	.....	.....	1.76	.75	.....	.....
1056.00	1584.00	11848	.....	.....	.....	.....	.....	.....	.....	2.09	.90	.44	.14
1320.00	1980.00	14810	.....	.....	.....	.....	.....	.....	.....	.....	1.41	.69	.....
1760.00	2640.00	19747	.....	.....	.....	.....	.....	.....	.....	.....	2.52	1.23	.39
2640.00	3960.00	29585	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.77	.90
3520.00	5280.00	39494	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.93	1.68
4400.00	6600.00	49368	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.52

TABLE

Showing Thickness, Weight, Safe Internal Pressure, Etc.,
for Different Sizes of Sheet Iron Hydraulic Pipes.

S. N. KNIGHT.

Diameter of Pipes in Inches.	Area of Pipes in Square Inches.	Thickness of Iron by Birmingham Wire Gauge.	Pressure in Feet the Pipe will Stand.	Pressure in Pounds the Pipe will Stand.	Weight of Pipe per Lineal Foot in Pounds.	Thickness of Iron in Inches.	Price per Foot.	Diameter of Pipes in Inches.	Area of Pipes in Square Inches.	Thickness of Iron by Birmingham Wire Gauge.	Pressure in Feet the Pipe will Stand.	Pressure of Pounds the Pipe will Stand.	Weight of Pipe per Lineal Foot in Pounds.	Thickness of Iron in Inches.	Price per Foot.
5	19	20	296	129	2.27	.035	.....	15	176	10	443	193	24.04	.134	.....
5	19	18	414	180	3.29	.049	.....	18	254	16	156	68	14.93	.065	.....
5	19	16	549	239	4.35	.065	.....	18	254	14	200	87	18.75	.083	.....
6	28	20	239	104	2.77	.035	.....	18	254	12	262	114	24.37	.109	.....
6	28	18	335	145	4.03	.049	.....	18	254	11	289	125	27.06	.12	.....
6	28	16	436	193	5.33	.065	.....	18	254	10	354	154	29.91	.134	.....
7	38	18	294	128	4.60	.049	.....	22	380	16	128	56	17.88	.165	.....
7	38	16	390	170	6.08	.065	.....	22	380	14	165	72	22.25	.083	.....
7	38	14	500	218	7.64	.083	.....	22	380	12	216	95	29.18	.109	.....
7	38	12	656	286	9.90	.109	.....	22	380	11	238	104	32.41	.12	.....
8 1/2	50	16	333	145	7.06	.065	.....	22	380	10	294	128	35.88	.134	.....
8 1/2	50	14	427	186	8.87	.083	.....	22	380	8	325	142	44.48	.165	.....
8 1/2	50	12	560	244	11.52	.109	.....	26	530	14	142	62	29.83	.083	.....
9 1/2	63	16	292	127	8.04	.065	.....	26	530	12	186	81	34.00	.109	.....
9 1/2	63	14	375	163	10.10	.083	.....	26	530	11	206	89	37.75	.12	.....
9 1/2	63	12	492	214	13.16	.109	.....	26	530	10	252	110	41.80	.134	.....
9 1/2	63	11	543	235	14.60	.12	.....	26	530	8	281	122	51.75	.165	.....
11	95	16	260	113	9.03	.065	.....	30	706	12	164	71	38.82	.109	.....
11	95	14	333	145	11.34	.083	.....	30	706	11	181	78	43.07	.12	.....
11	95	12	437	190	14.67	.109	.....	30	706	10	221	96	47.18	.134	.....
11	95	11	482	235	16.43	.12	.....	30	706	8	246	107	58.97	.165	.....
13	132	16	223	97	10.50	.065	.....	30	706	7	271	118	64.97	.18	.....
13	132	14	285	124	13.19	.083	.....	37 1/2	1104	11	144	62	53.77	.12	.....
13	132	12	375	163	17.14	.109	.....	37 1/2	1104	10	177	77	59.56	.134	.....
13	132	11	413	179	19.05	.12	.....	37 1/2	1104	8	197	85	73.55	.165	.....
13	132	10	506	220	21.08	.134	.....	37 1/2	1104	7	216	94	81.01	.18	.....
15	176	16	195	85	11.98	.065	.....	37 1/2	1104	6	244	106	89.80	.203	.....
15	176	14	250	109	15.05	.083	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	176	12	328	143	19.55	.109	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	176	11	362	157	21.72	.12	.....	.....	.....	.....	.....	.....	.....	.....	.....

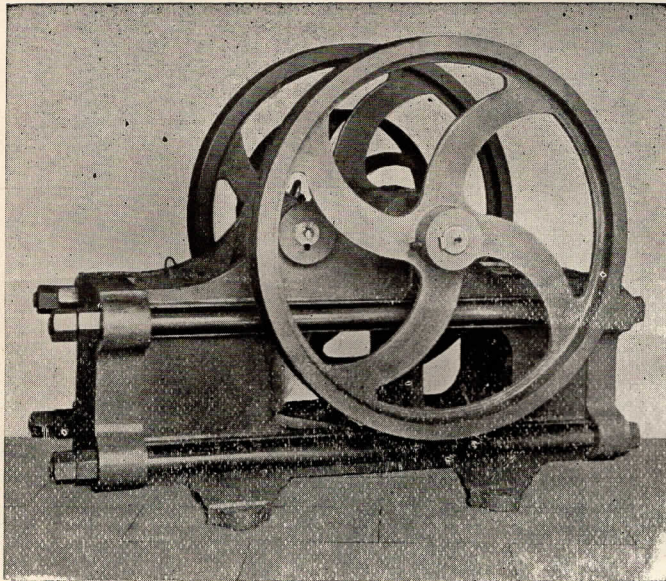
The above table is a memorandum of pipe that has been actually in use for ten years, so that it is perfectly reliable.

Large sizes of pipe, from 18-inch upwards, made of the above thicknesses, are to be buried and tamped underneath to prevent flattening when water is turned on.

Where pipe is used for hoisting works, or other work subject to shutting off suddenly, the thickness of iron to be used should be two sizes thicker for the same head, and for hoisting works an air chamber should always be used.

The weights in the above table are calculated dipped in coal tar; asphaltum would be much heavier.

Knight & Co.'s Rock-Breaker.



The above cut represents the Knight & Co. 10x12 in. Rock-Breaker. This size is used for 10 and 20-stamp mills.

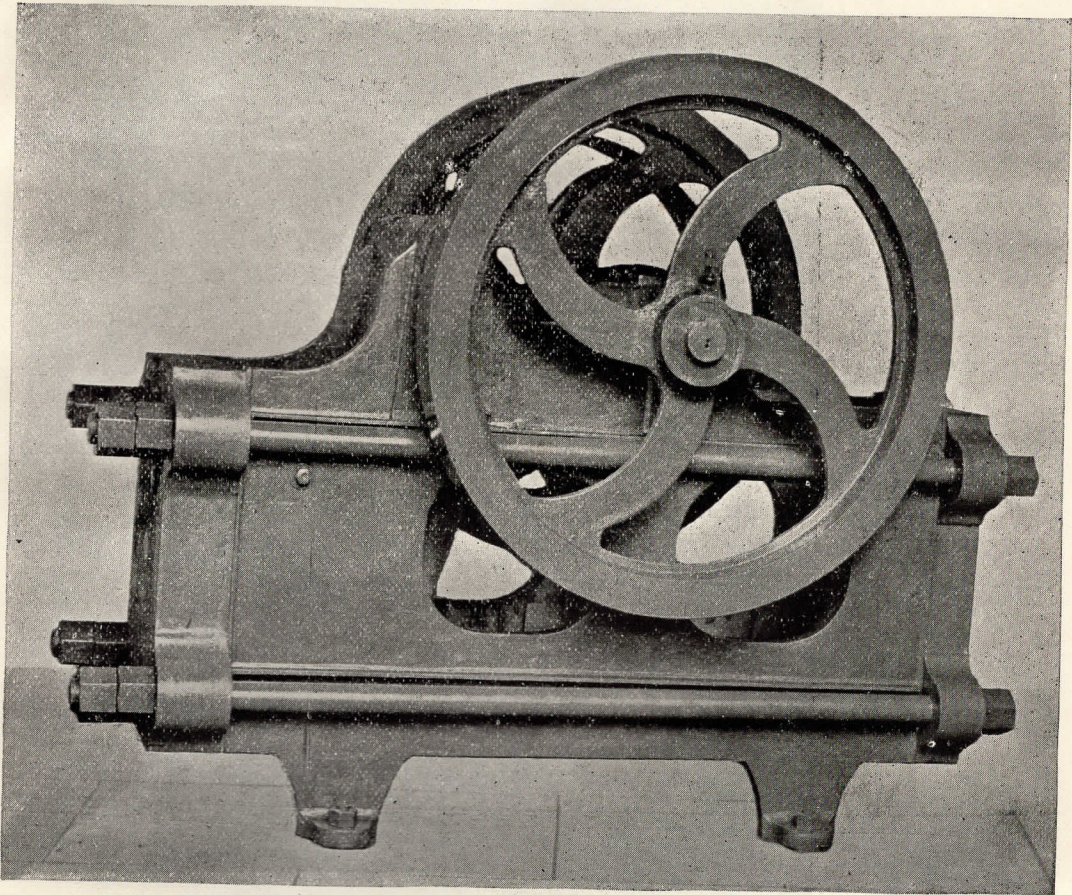
The following-named mills are using them: Hathaway mine, Newcastle, Placer county, Cal.; Reeves mine, Plymouth, Amador county, Cal.; Wildman mine, Sutter Creek, Amador county; Gover mine, Amador county; Fogus mine, Volcano, Amador county; Golden Gate mine, Sonora, Tuolumne county, Cal.

Capacity per hour, ten tons.

Speed, 250 revolutions per minute. H. P., 3 to 5; depends on material to be crushed. Weight of the machine, 7400 pounds.

Price on application.

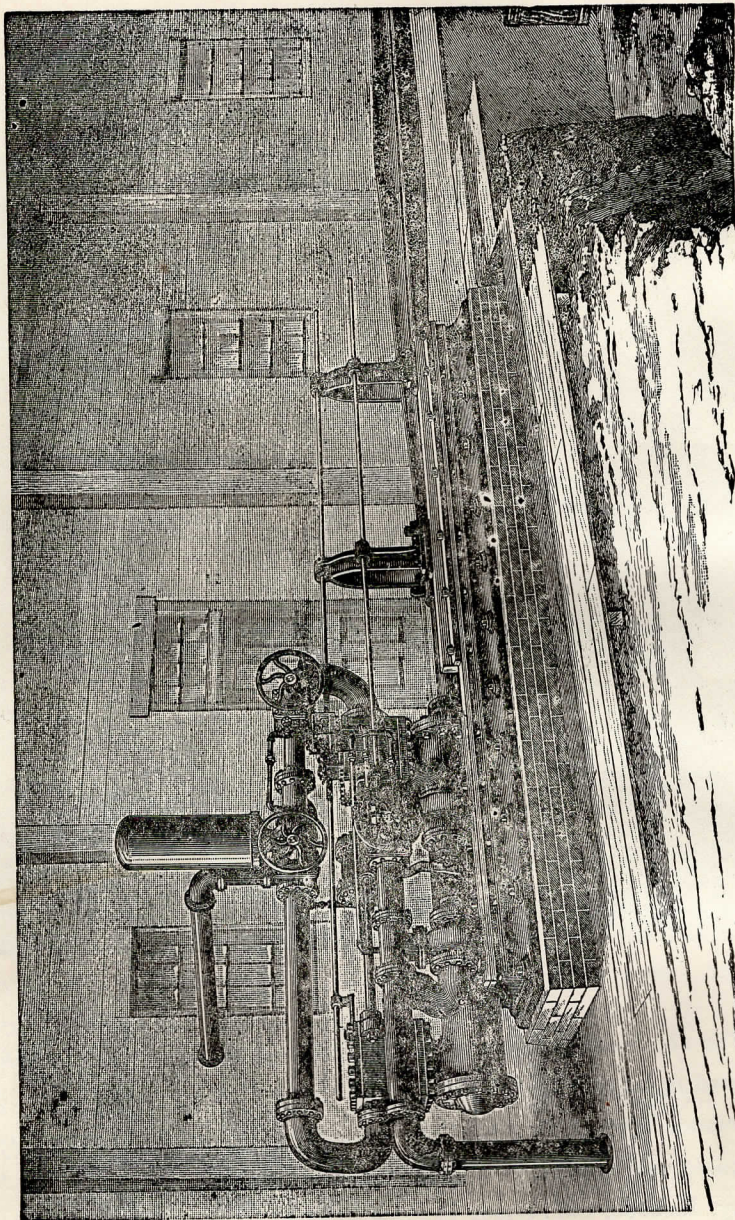
Knight & Co.'s Rock-Breaker.



The above cut represents the Knight & Co. Rock-Breaker, 12x16 inches. This size is used in large mills in California: Consolidated South Spring Hill mine, Amador City, Amador County, Cal., Cosmopolitan mine, Drytown, Amador County, Cal., Kennedy Mining and Milling Company, Jackson, Amador County, Cal., Argonaut Mining Company, Jackson, Cal., South Eureka Mining Company, Sutter Creek, Amador County, California.

Speed, from 225 to 250; H. P., 7 to 12. Capacity per hour, 20 tons. Weight, 12600 pounds.

RUNNING OVER 2000 STAMPS.

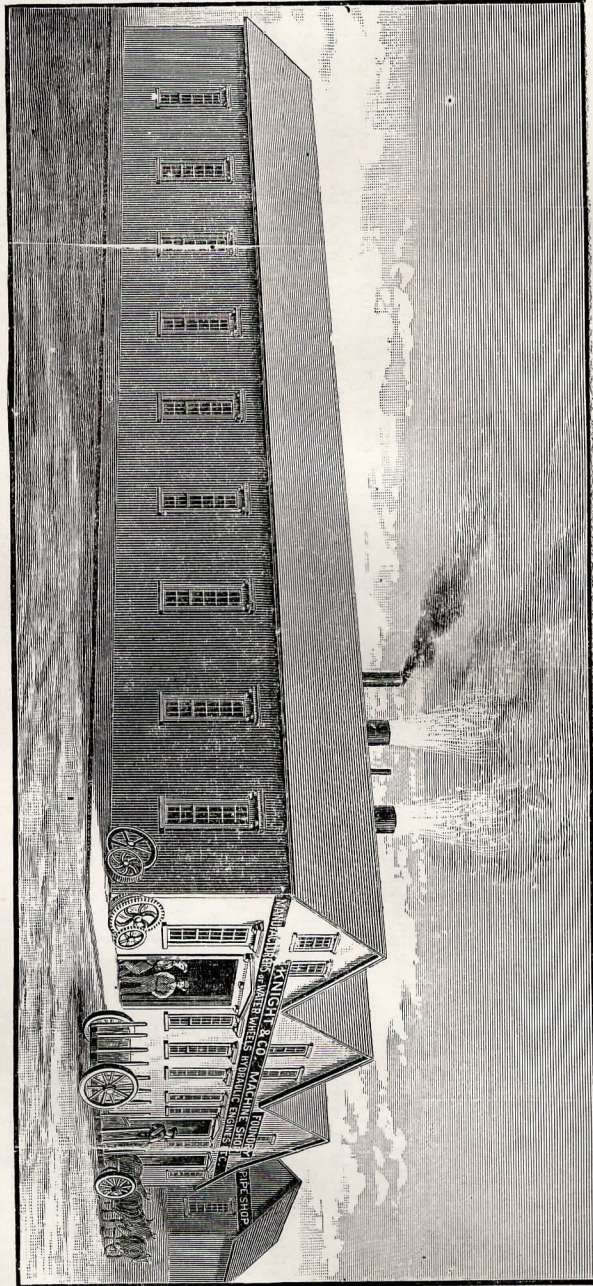


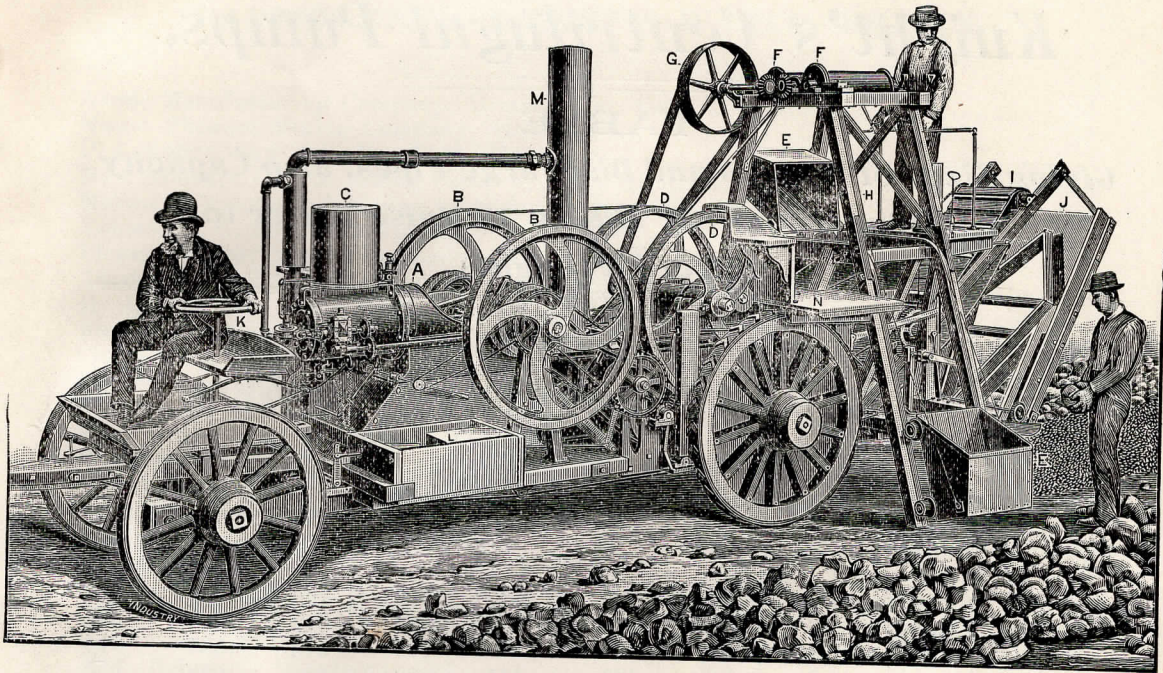
Knight's Patent Hydraulic Engine.

The above engraving represents the "KNIGHT PATENT HYDRAULIC ENGINE," an entirely new system for pumping deep mines. Heretofore where machinery was operated by water power, the Cornish pumps have been run by water wheels, through the mechanism of counter-shafts, belts, and spur gearing. This method absorbs a great proportion of the original power in the water, and while the water wheel may be of very high efficiency, the loss is such that only under very favorable circumstances will the highest class wheel give a pumping efficiency of 50 per cent. That is, if the pump is raising the water to a height equal to the head of water which is running on the wheel, it will take two cubic feet of water on the wheel to pump one cubic foot. In cases where the quantity of water used on the wheel is small, the efficiency drops as low as 25 per cent. The hydraulic pumping engine, shown above, is the first ever constructed so that it can be directly connected with the pump rod, thus avoiding the gearing. It is set on stone or brickwork and connected to the pump bob by a very strong Pitman rod. The box shown on the bob is merely for balancing the pump rod. With this engine the very highest advantage is derived from the power in the water, and shows the greatest efficiency ever attained. Messrs. Knight & Co. are ready to guarantee an efficiency of 75 per cent for the system, whenever the diameter of the cylinder is not less than 14 inches. This means that this pumping engine will run on from 25 to 40 per cent less water than the best water wheel pumping plant now in existence. The working of this machine is noiseless and there are no dead centers to stop on. It cannot be stopped on any point where it cannot start itself, the water appliances being automatic. It requires no attention, only oiling twice in 24 hours. Where parties wish to economize room in setting the engine, it can be placed on long timbers and connected directly with the pump rod. In setting in this way, a small balance bob will have to be placed in some of the lower levels to take part of the weight of the pump rod. This engine can be worked from a pressure of water from common sheet iron pipe, that runs other machines, such as quartz mills and hoisting works. Four are now in use giving entire satisfaction. Two are at the Plumas Eureka Mine, in Plumas County, Cal., one at the Wildman Mine, Sutter Creek, Cal., and one at the Marguerite Mine, at Sierra City, Cal. The supply of water at the Marguerite Mine is taken from an 18-inch sheet iron pipe, No. 12 iron, pressure 356 feet. At the Wildman Mine from an 11-inch No. 12 sheet iron pipe, pressure 460 feet. At the Plumas Eureka, from a 5-inch gas pipe at the lower end, pressure 720 feet. Both the Marguerite and Wildman run their 20-stamp mills and two hoisting works, attached to the same hydraulic pipe, which is laid with common slip joints, such as are in general use.

We manufacture another style of Hydraulic Engine, constructed like a steam pump, with the engine at one end and the pump on the other. This is designed for parties who have a large amount of water under low pressure, and desire to deliver a smaller amount at a greater height, for either power or irrigation. This is readily done by placing the engine and pump lower than the water supply, say from 20 to 150 feet, as the location may require. From the ditch, or water supply, bring down a supply pipe to furnish the engine, and from this pipe connect a supply to feed the pump. Then from the pump carry the discharge up the hill to the height required. As far as the pump is concerned, in feeding it from the water column it balances the pressure on the pump at the height of the ditch, so that there is no loss in moving the pump down the hill, excepting what friction there may be in the extra amount of pipe. This is a simple and ingenious way to furnish water as stated. Take for example a ditch 100 feet above the foot of the hill, and you desire to raise the water 200 feet higher than the ditch. With 280 inches of water in the ditch you can raise 80 inches 200 feet above it, or 40 inches 400 feet above it. This proposition is valuable to people having free water at their command, and gives them the opportunity of pumping to an elevation that furnishes opportunity of selling it for power and irrigation.

Knight & Co's Shops at Sutter Creek.





The above cut represents a Traction Engine with a Rock Breaker and Gasoline Engine to run the Rock Breaker and wagon. The purpose of the machine is to break rock after it has been delivered at each side of the road. Following is a description of our new invention for macadamizing county roads:

We have mounted a Rock Breaker and a Gasoline Engine with other appliances on a wagon built for that purpose, and to be propelled by its own power, forward or backward, as the case may require. A is a gasoline engine; BB are the balance wheels; C is the gasoline tank; DD balance wheels for rock breaker; EE cars for elevating rock delivered at roadside; FF are the two friction drums or reels for hoisting the cars with the coarse rock to be dumped into the hopper near the mouth of the breaker; G is the pulley and belt that drives the drums from end of breaker shaft; HH is the track where the cars run up to the hopper, with self dumping appliances; I is the elevator belt that conveys the broken rock from the breaker to the separator; J is the separator that classifies the broken rock into two grades, the coarsest on bottom of the road and the finest on top, and spread out to a width of eight or nine feet; the separator moves forward when the machine is standing still as rapidly as the road is filled up to the grade required; then the boy on rear platform pulls on a rope which tightens up two belts that drives the machine ahead three feet and thus the operation is repeated and the road is left behind suitable for travel; N is a platform where boy stands to feed the breaker. It will require four men to run the machine; three men to load the cars, two boys to attend to breaker and hoisting, and one man to take charge of the machine. The machine will break and spread on the road 60 to 80 tons per day of ten hours, with the cost of gasoline \$1.75 or less per day, according to the hardness of rock to be crushed.

Twenty cubic feet of boulders weigh one ton, and will macadamize 6 feet in length, 8 feet wide and $4\frac{1}{2}$ inches thick. One cubic yard of boulders will macadamize 8 feet square, $4\frac{1}{2}$ inches thick, and the cost per rod will be from 60 to 75 cents after the rock is delivered at the roadside.

We do not think so good a machine for road macadamizing purposes has ever before been put in use.

Further particulars concerning the machine can be derived by addressing Knight & Co., Sutter Creek, Cal.

RUNNING OVER 2000 STAMPS.

Knight's Centrifugal Pumps.

TABLE

Giving Sizes of Pulleys and Discharge Pipes, also Capacity and Revolutions per Minute to Raise Water to Different Heights.

NUMBER OF PUMP.	Size of Discharge Pipes.		Diameter of Pulley.	Face of Pulley.	Revolutions Per Minute Under Different Heads in Feet.							
	In.	Gallons			In.	In.	HEAD.	HEAD.	HEAD.	HEAD.	HEAD.	HEAD.
							5	10	15	20	25	30
3	3	225	8	6	585	604	630	655	700	745	790	
3½	3½	305	10	6	512	528	551	574	613	652	692	
4	4	400	10	8	455	470	490	510	545	580	615	
5	5	625	12	8	409	423	441	459	490	522	553	
6	6	900	14	10	372	384	401	417	446	474	503	
7	7	1225	16	12	315	325	339	353	377	401	426	
8	8	1600	18	14	273	282	294	306	327	348	369	

	In.	Gallons	In.	In.	HEAD.	HEAD.	HEAD.	HEAD.	HEAD.	HEAD.
					40	50	60	70	80	90	100
3	3	225	10	6	836	874	913	945	970	990
3½	3½	305	10	6	731	765	799	827	849	866
4	4	400	12	8	650	680	710	735	755	770
5	5	625	14	10	585	612	639	661	679	693
6	6	900	16	12	532	556	581	601	617	630
7	7	1225	18	14	450	471	491	509	522	533
8	8	1600	20	16	390	408	426	441	453	462

PRICE LIST Of Vertical Centrifugal Pumps.

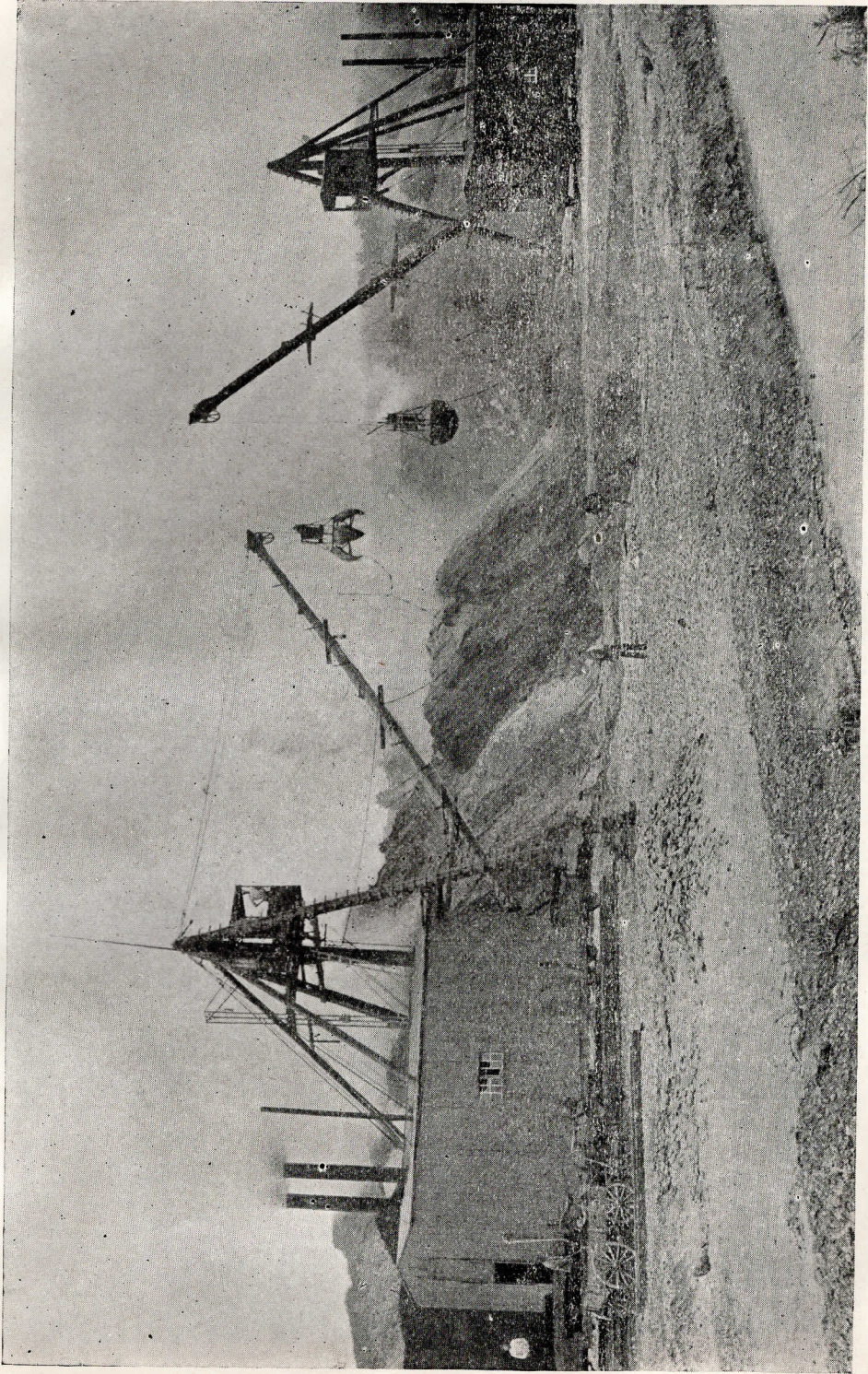
Including 8 feet of Shaft, two 28-inch diameter anti-friction Wheels, and steel face Tappett fitted to Pump shaft and Boxes.

Number of Pump	3	3½	4	5	6	7	8
Price of Pump.....	\$165	\$175	\$200	\$220	\$230	\$250	\$300

WE WILL FILL ORDERS FOR ALL SIZES OF PUMPS.

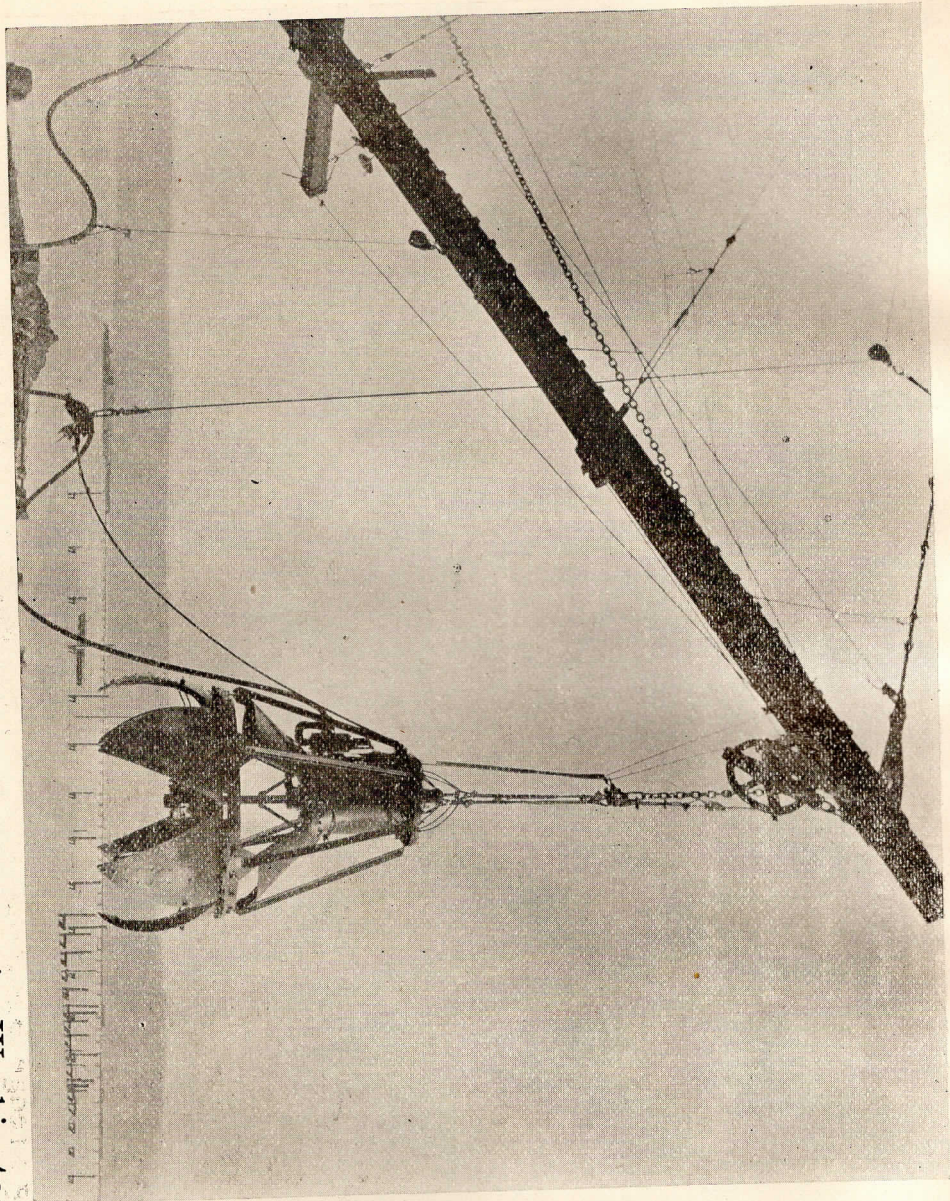
Allow 50 per cent. more power than water to be pumped on small quantities, and on large quantities 25 per cent. more power. We will guarantee 75 per cent. efficiency on 400 gallons and upwards pumped per minute.

90 WATER WHEELS,

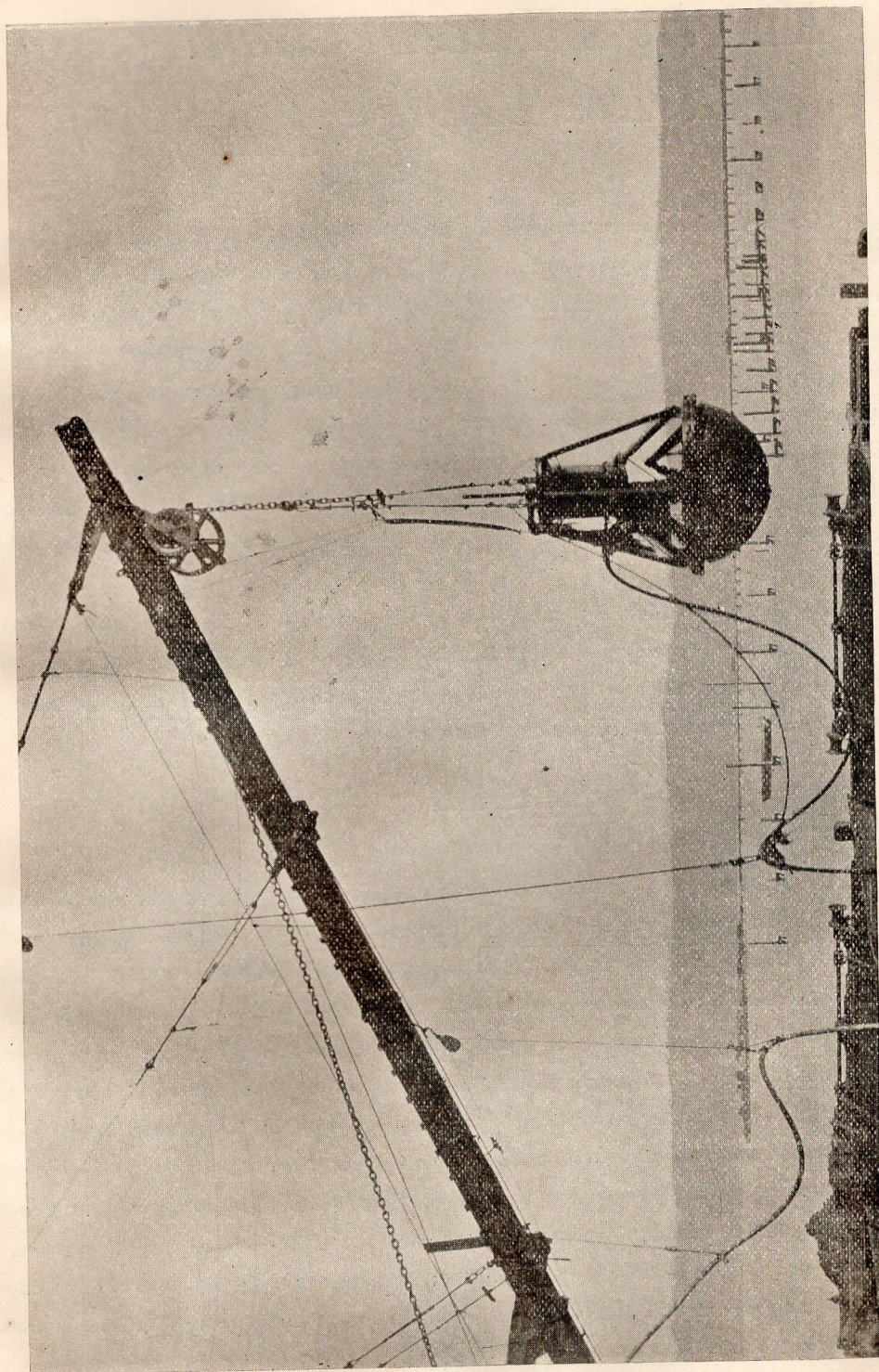


Knight's Mining Dredge Bucket at Arroyo Secco Mine, Near Ione, Cal.

RUNNING OVER 2000 STAMPS.



Working at Tacoma and Port Orchard Navy Yard, Seattle, Washington.
[SEE PAGE 46]



[SEE PAGE 46]

Working at Tacoma and Port Orchard Navy Yard, Seattle, Washington.

RUNNING OVER 2000 STAMPS.

Knight's Patent Mining and Marine Dredge Buckets.

On page 43 is shown two Mining Dredge Buckets, working on two Cranes, as they appear at the Arroyo Seco mine, near Ione, Cal. The cranes are set to open up a new pit where the waste dirt is 30 feet deep and the pay gravel from four to ten feet deep. The bucket is opened and closed by steam passing through one and one-quarter inch pipe, made in short lengths and connected by universal joints to allow the pipe to bend when the bucket raises and lowers. At a distance there are large piles of waste dirt that has been removed and the pay gravel taken out and washed in sluices.

The capacity of bucket is $1\frac{1}{2}$ cubic yards to a load, and will make a round trip in one and one half minutes on a boom 110 feet long, or will move the dirt 200 feet away.

At times it was found profitable to set the sluices in the mine and shovel the pay gravel in, and convey the water in a pipe to the sluices; then pump the water from the sump and tailrace to the surface with a Centrifugal Pump that was made for that purpose. Weight of the Bucket, 6000 pounds.

On pages 44 and 45 the same style of Bucket was used for Marine work in dredging out the harbor at Tacoma, and cutting a canal to the United States Drydock at Port Orchard, about 15 miles from Seattle, Washington. The material was of a cemented kind of gravel and sand; some parts was so hard that it had to be blasted. The Bucket was made very strong, capable of pulling out old logs that had been covered up for years and stones of large sizes that had rolled down the hill. Diameter of the cylinder, 30 inches, and a 30-inch stroke supplied with compressed air at 80 pounds pressure was used through a 2-inch hose to operate the Bucket, as the work was done under water where steam could not be used on account of condensing. The force or pulling power on the piston rod was 56,480 pounds and on each point of the blades 9,613 pounds. It can be seen at a glance that the power of penetrating is very great, and in any common material the Bucket will take up a full load. Weight of Bucket complete, 14,000 pounds.

Prices quoted on application.

PARTIES USING KNIGHT'S WATER WHEELS.

Arctic Manufacturing Company, Grizzly Flat, Cal.	1
Mount Pleasant Mining Company, Grizzly Flat, Cal.	1
P. J. Kelley, Saw Mill, Red Rock, Montana.....	1
New Almaden Quartz Mining Company, New Almaden, Cal.....	2
Melone's Consolidated Mining Company, Carson Hill, Cal.....	1
Volcano G. G. Mining Company, Volcano, Cal.....	1
Pleasant Valley Mining Company, El Dorado, Cal.....	1
Alaska Mill and Mining Company, Douglass Island, Alaska	4
H. A. W. Tabor, Jesus Maria, Chihuahua, Mexico.....	1
Russell Reduction Works, West Point, Cal.....	1
Campo Seco Copper Company, Campo Seco, Cal	2
Plymouth Consolidated Gold Mining Company, Plymouth, Cal.....	3
Monitor Mill and Mining Company, Steptoe Creek, Nevada	1
What Cheer Mining Company, Mokelumne Hill, Cal	1
Manhattan Silver Mining Company, Battle Mountain, Nevada.....	1
J. A. Elman, Saw Mill, Eagle Gulch, Cal.....	1
South Spring Hill Mining Company, Amador City, Cal.....	3
Wildman Gold Mining Company, Sutter Creek, Cal.	4
Calumet Gold Mining Company, Middle Creek, Cal.....	2
Eastern Alaska Mining Company, Douglas Island, Alaska.....	2
San Francisco Copper Company, Compo Seco, Cal	2
Rescue Mining Company, Rescue, Cal	1
M. E. Ridgway, Woodland, Cal.....	1
J. L. Gleason, Mokelumne Hill, Cal	1
Carbon Hill, (See Catalogue, Carbonado, Wash.,)	3
Columbia Milling Company, Willow Ranch, Cal.....	1
Manuel Percari's Electric Plant, Fort Jones, Cal	1
Risdon Iron and Locomotive Works.....	7
Infernal Gravel Mine, Mokelumne Hill, Cal	1
Pittsburg and California Gold Mining Company, Smartsville, Cal.....	1
Columbia Con. Gold and Silver Mining Co., Bull's Run Basin, Nevada.....	1
El Dorado Water and D. G. Mining Co., Placerville, Cal.....	2
Hector Gold Mining Company, Sutter Creek, Cal.	4
Granite Gold Mining Company, Murray, Idaho.....	1
Hunter-Espey Mining Company, Yreka, Cal	2
Clement Vacher, Kettle River, B. C.....	1
James Quinn, Electric Plant, Yreka, Cal.....	1
Amador Electric Light and Railway Company.....	1
Margarite Mining Company, Sierra City, Cal.....	3
Carbon Hill Coal Company, Carbonado, Wash.....	1
Hathaway Mine, Newcastle, Cal.....	2
Ilex Gold Mining Company, Rich Gulch, Cal.....	1
Fred Mehlmann, Sunol, Cal.....	1
Lee Mine, Rocklin, Cal.....	1
Josephine Mine, Auburn, Cal.....	1
Wm. Sharwood, Soulsbyville, Cal.....	6
Skagit Cumberland Coal Co., Skagit, Wash.....	1
Standard Iron works, San Diego.....	1
Plymouth Consolidated Gold Mining Co.	1
M. Murray, Lancha Plana, Amador, Cal.....	1
Detroit Copper Co., Hawthorne, Nevada.....	1
W. H. Armstrong, Douglas Island, Alaska.....	1
Colombo Mine, Sierra City, Cal.....	1
Pioneer Mine, Cal.....	3
R. P. & B. Clement, Oakdale,.....	1
L. M. Mann.....	1

RUNNING OVER 2000 STAMPS.

