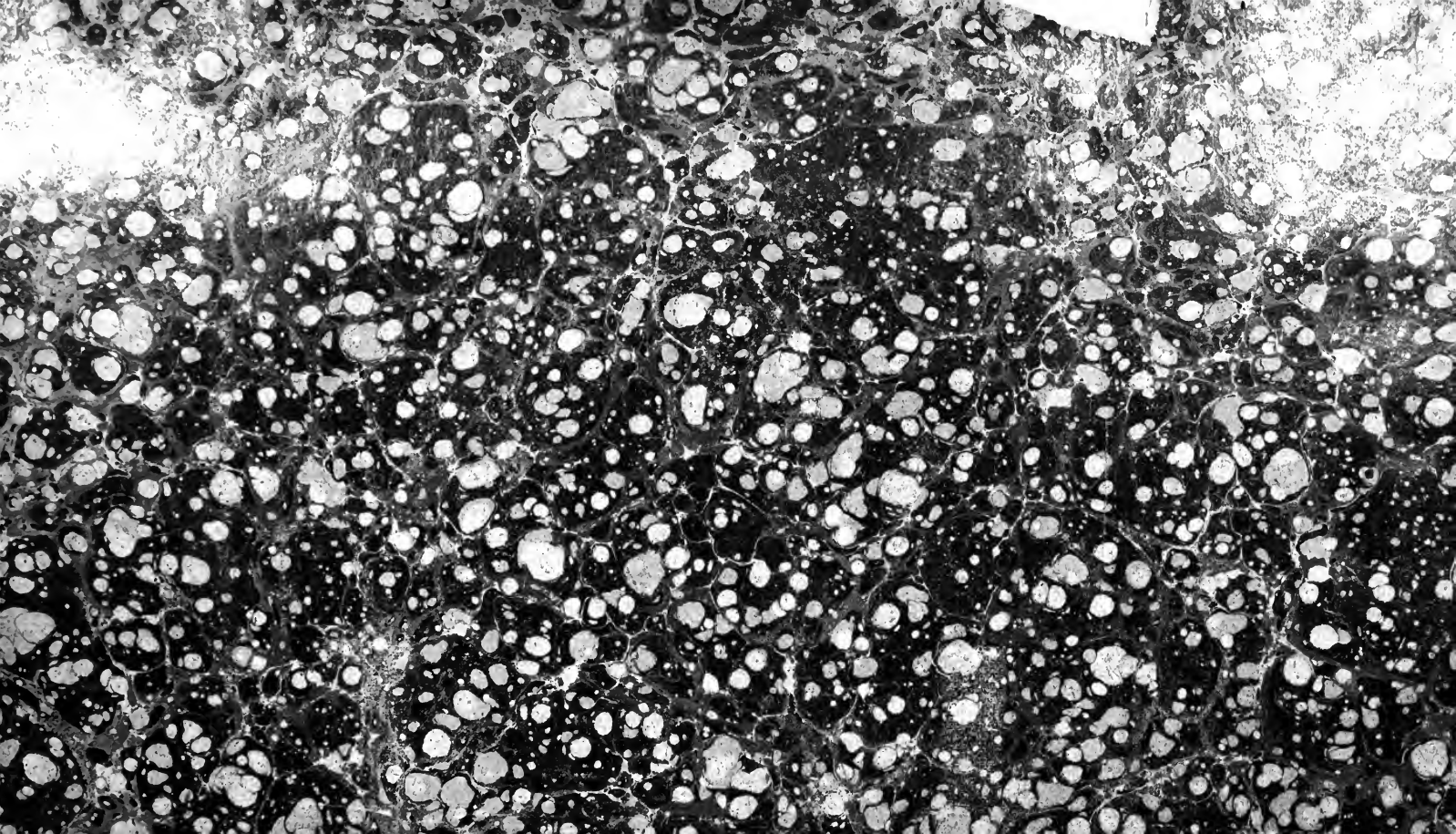
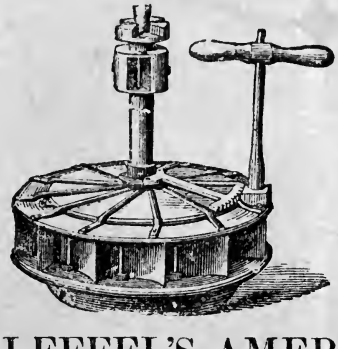
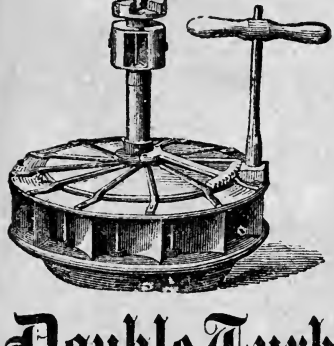


☞ PLEASE HANG UP AND PRESERVE THIS PAMPHLET.

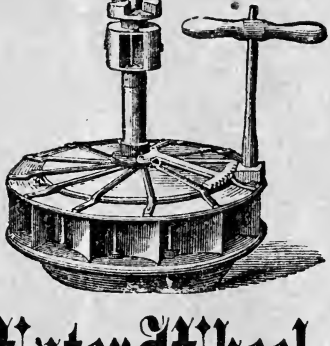
# ILLUSTRATED CATALOGUE.



## JAS. LEFFEL'S AMERICAN



These Wheels are pledged to equal in power any Overshot Wheel in existence.



# Double Turbine Water Wheel,

Manufactured by

Leffel & Myers,

AT THE

## OREGON IRON WORKS,

**PORTLAND, OREGON.**

A. G. Walling & Co., Printers, Portland.

**Please hand this to some one interested in Water Power.**

☞ **Geo. H. Jones,** General Traveling Agent for California, &c. Head
**Happ & Grant.** 310 Wash. St., Agts., for San Francisco, and Wheel Depot.

# CONTENTS.

# PREFACE.

Knowing by an experience of over four years, by the result of trials and tests without number by ourselves and by millwrights, millers, and hydraulic engineers in almost every State in the Union, that we are making a wheel giving a greater percentage of the power of the water than any other wheel made in the United States, we desire to meet the demands of the public; and instead of the incomplete and condensed circular hitherto issued by us we offer this pamphlet, giving full and complete information in regard to the power, size, number of revolutions, quantity of water used, manner of putting in, &c., &c., of our justly celebrated wheel, the "LEFFEL AMERICAN DOUBLE TURBINE WATER WHEEL," so that any millwright, with the instructions given in this pamphlet, can easily and readily put them in and adapt them to any circumstances.

We feel less hesitation in recommending our wheels and in asking the attention of all millers, mill owners, and all persons using water as a motor, to the following pages, from the fact that the parties using our wheel speak in higher terms and generally claim more for them than we do ourselves.

In this pamphlet we don't pretend to give the reasons and explain theoretically why our wheel excels so greatly any other known wheel; if we did, few would understand its theoretical advantages. We deem it sufficient to give a description of our wheel, its size, shape, and many advantages; relying entirely upon the reputation it has made for itself, and the inquiries of those interested in water power, which we hope they will make of those who *know* its great superiority by a practical experience in the use of our wheels; that is, we don't expect people to purchase our wheel on account of its *theoretical* superiority, or from our representations, but for its *actual* superiority as demonstrated by the evidence of practical business men, who have in actual use our wheels, and have tested them alongside of other wheels; and this evidence we wish you to procure for yourselves.

In the latter part of this pamphlet there are a few names of practical business men, using our wheel, selected from each State, so that any one can refer to parties in their own immediate vicinity for evidence.

If you possibly can, go and see for yourself the steady, sturdy, thorough manner that the little wheel does its work, with the small quantity of water it uses.

# HISTORICAL STATEMENT.

The unparelleled success of the "AMERICAN DOUBLE TURBINE WATER WHEEL" we deem a sufficient apology for giving here a brief history of the life and labors of him whose unceasing efforts at last produced what we can truthfully claim isthe best hydraulic motor ever invented.

The subject of Hydraulics was with Mr. Leffel a favorite one, and the construction of rude models of water wheels, and their practical application to some boyish purpose, constituted almost the sole pastime of the leisure hours of his boyhood. Like many other inventors he was left at an early age to battle alone in life; and the peculiar difficulties attending a pioneer life soon gave to his mind that practical turn which characterized him, and which so peculiarly fitted him for those searching and careful experiments which alone can obtain in the science of Hydraulics.

While yet a mere boy he undertook the erection of a saw mill, and, without the advice or assistance of any mechanic, completed it. It proved the most efficient mill in that section of the country. The manner in which he constructed the wheel, and the great care he exercised in admitting the water to it, at once gave proof of an innate knowledge of Hydraulics possessed by no other mechanic in the country, even if of greater age and experience. The complete success of the undertaking at once drew the attention of other mill owners, and, notwithstanding his youth, he was beset on all sides to re-model wheels, which were now in comparison considered as inefficient.

With the tact natural to him, he soon detected the errors in their construction, and many a manufacturer was constrained to praise that youthful skill, which, as if by magic, transformed his hitherto insufficient power into a valuable and abundant one. Continuing for a few years to labor as a millwright, he then engaged in the foundry and machine business. With the facilities offered by his new occupation he began a series of experiments in Hydraulics, which continued through a period of nearly 34 years, that for thoroughness and accuracy perhaps never were equaled in any department of the arts or sciences.

His first efforts were directed to the improvement of the re-action wheel, of which there were a great many different kinds in use at that time. Although he was able to produce better results than had hitherto been obtained from that class of wheels, he soon saw an inherent deficiency in their principle that would defy all attempts to carry them beyond a point of efficiency which was far below the standard of a thoroughly economical wheel. He then abandoned this form of wheel and directed his efforts to the improvement of the Turbine.

During the pursuit of his regular business, he constructed some of the best mills in the country, and the performance of the Overshot Wheel which he always employed, where economical use of water was desired, was so satisfactory that he was almost induced to believe it the most perfect form of wheel that could be adopted; yet however much he was pleased with its performance, there were some objections to its use; and with the true spirit of an inventor, which discards any fixed form or method to accomplish certain results, he determined if it were possible to improve the Turbine so that it would possess all the excellent qualities of the Overshot without its defects. This, then, became the great problem of his life—to construct a Turbine Wheel to at least equal or if possible to excel the Overshot, in all circumstances and conditions. Never, perhaps, did a man pursue a fixed purpose with more devotion, patience and industry. Day after day, and year after year, the study of Hydraulics and experiments connected therewith, occupied his leisure hours—and after immense labor and expense, he saw but little hope of realizing. Yet as the difficulties and discouragements increased, he became proportionately more determined in his purpose, which now became the sole aim of his life. Abandoning all other business, he devoted his time exclusively to the construction of different forms of wheels.

To convey some idea of the immense labor he performed in this department, we would say that he constructed and experimented with over one hundred different forms of water wheels. Among these were the Outward Discharge or Forneyron Wheel, the Jonval or Vertical Discharge, and Center Vent, &c. Each different class underwent in his hands numerous modifications, both in the construction of the wheel and the manner of admitting the water to it, through various forms of adjustable guides and scroll.

It must not be supposed, however, that among the great number of wheels he constructed, there were none that proved to be of much merit —on the contrary, there were many that yielded a very high percentage of the water, by the usual mode of testing them, and more than once he was led to believe, from the splendid results of experimental tests, that his long sought object was obtained. Yet, upon careful experiments with them, in practical operation, they failed to meet his expectations; although their performance would have been in the highest degree satisfactory to one of less severe discriminations.

In the course of his large experience in Hydraulics, he was perhaps the first to discover the important fact that a wheel might yield a high per cent. of power in a test trial, yet be totally unfit for the ordinary purpose of manufacturing, which among other causes is attributable to the unsteady motion, speed and variable quantity of water used,

which in practical operation are conditions unavoidable and fatal almost to every Turbine.

With the knowledge acquired by a ceaseless toil of years in this department, and the construction of almost every conceivable form of water wheel, he at last constructed the Double Turbine, which received the most thorough practical tests before it was offered to the public.

We ask not the theorist, with his fine drawn theories of impact percussion and re-action, but we appeal to the practical manufactures all over the country, who are using them, and let them decide how well he has succeeded in the great effort of his life.

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Mr. H. C. Reynolds, of Amoskeag Axe Factory, Manchester, N. H., desirous of purchasing a wheel for the Factory, and wishing to get the benefit of the experience of some responsible firm running one of our wheels, wrote to Messrs. Stimpson & Co., of Westfield, Mass., for their opinion. Below is their reply:

WESTFIELD, Mass., April 30, 1866.

Mr. H. C. REYNOLDS, Agent—Dear Sir: In giving you our opinion of the Leffel Water Wheel, perhaps we shall be so decided and positive as to create distrust in our sincerity, or, if you please, our ability to judge or give an opinion. But we know them to be the BEST wheels ever offered or used in the United States. We are acquainted with over twenty different kinds, and pronounce these to be superior in strength, durability, economy of water, and in every respect, to any wheel now in use in this conntry.

STIMPSON & CO.

**Amoskeag Manufacturing Company indorses the Leffel Wheel.**

MANCHESTER, N. H., August 7th, 1866.

Mr. WM. DUNCAN—Dear Sir: With regard to the Leffel Wheel, I would say that it is as near perfection as we could wish for. It runs very steadily, much more so than the old one. We have all the work on, and it takes only about 7-10 of the gate, and think it will drive ninety horse power with ease. I think, also, that we can defy all the leaves and anchor ice that comes along. In fact, I have perfect confidence in the economy of the wheel in every particular. We are using—to do the same work that the Boyden Turbine did—about three-fourths the water. But with both wheels in equally good condition, I think this would beat it a little.

Yours, H. C. REYNOLDS, Agent of Amoskeag Axe Co.

I have been Foreman of the Amoskeag Axe Co. for the last four years, and have had charge of their Water Wheels. I cheerfully endorse the above statement of Mr. Reynolds, and I think the Leffel Wheel to be the BEST wheel that I have any knowledge of, in every particular.

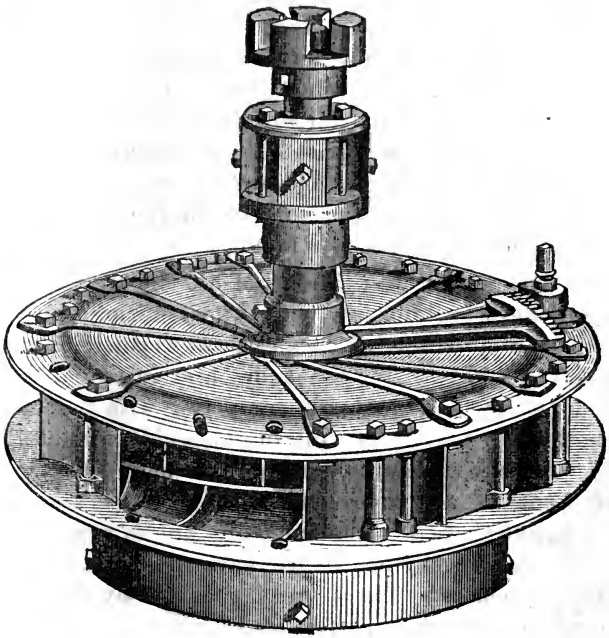
S. H. RANDLETT, Foreman.

MANCHESTER, N. H., Sept. 13, 1866.

WM. DUNCAN, Esq.—Dear Sir: The Leffel Wheel which was put into the Axe Factory continues to work in a very satisfactory manner. I have written to Messrs. Leffel & Co. to send me a 48 inch Wheel, to replace a Parker Wheel we are now using in the Bag Mill.

Yours, very truly,

E. A. STRAW,
Agent Amoskeag Manufacturing Company.



**Leffel Wheel in comparison with the Overshot.**

When the class of water wheel known as the Turbine was first introduced to the public, they were regarded with the greatest prejudice, and the repeated failures of the first rude and imperfect wheels increased the distrust—they only doing well under low heads and with a flood of water.

However, the attention of thinking men was early drawn to the fact of the imperfections of the Overshot Wheel, noted in the latter part of this article: the actual loss of head in introducing them, their unwieldy and unsteady motion, the cumbersome and expensive gearing required, (killing the power by friction,) the great expense in keeping them in repair, &c.

Having decided that the Overshot was not the most desirable wheel for the miller, they also became convinced that the Turbine, from the fact of its utilizing every inch of the head and fall, its small size, durability, steady motion, &c., was *the* wheel, if it could only be constructed so that the water, in passing through it, could communicate its entire force to the wheel; and for the last forty years hydraulic engineers, in all parts of the country, have been earnestly devoting themselves to the improvement of the Turbine wheel: and, as the result, Turbines constructed on various principles have sprung up all over the

country—some acquiring quite a reputation, and in many instances giving complete satisfaction; but they were found to fall short of the Overshot, when compared with it under a medium head of from twenty to thirty feet, (where the Overshot gives its maximum power.)

The Leffel wheel, in its first trial with an Overshot, was against one of thirty feet in diameter, in a grist mill, at Springfield, Ohio. The result was a surprise to every one, and an enigma to the old millwrights who witnessed it, thus giving a promise of the reputation it ultimately gained by its superior qualities as a motor.

If any one has the faintest idea that he is trying an experiment, when ordering our wheel, for any head between three and sixty feet, let him disabuse himself of that idea as soon as possible, because that day has *passed long since.* We can show him any number of wheels, working under every head and fall, competing with the Overshot and driving almost every variety of mill, in almost all parts of the United States; and what our wheel accomplishes in one mill it can do in another. Our wheel is no experiment to be tried, but stands a demonstrated success, and we boldly challenge any one to produce its equal. We know what we are saying, for we have the facts, and a wheel as yet unrivaled to back us. There are a great many reasons why the Overshot never can become a perfect motor, viz.:

1st—As the power of the water is its weight, many persons believe, (not having their attention called to it,) that in using the Overshot you utilize the full weight of the water. But it is a mistake, as you will readily see—*for you do not get the full benefit of your full head.* You lose a head of water equal: First, to half the head on the gate. Second, the depth of the buckets on the wheel itself. Third, the space below the wheel necessary to give clearance to the discharge.

In the use of our wheel *every inch* of head and fall is utilized.

2d—The Overshot loses considerable power by the water spilling from the buckets before it has reached the bottom.

Our wheel wastes no water—all of it passing through the wheel.

3d—One of the inherent defects of the Overshot appears when applying the power of the wheel to its work. Its slow motion requires a great amount of heavy, cumbersome gearing in getting up the required speed—which not only causes a great loss of power, arising from so much friction, but makes it expensive;

While our wheel, having a very rapid motion, (for instance, a wheel 20 inches in diameter, under a 20 feet head, giving 22½ horse power, makes 308 revolutions per minute,) requires very little gearing, and that of the simplest description—gaining the power lost by the heavy, cumbersome gearing of the Overshot, and saving the heavy expense connected therewith.

4th—The Overshot Wheel, being loaded with ice in Winter, and standing empty in Summer, and from various other causes, is seriously thrown out of balance, rendering it unfit for purposes requiring a steady, uniform power;

While our wheel (always running under water) is never frozen up or affected by the frost in any way, and is noted for its steady, uniform power.

5th—Our wheel always gives the same percentage of the power of the water, whether under a low, high, or medium head and fall; while with the Overshot the percentage varies with the head and fall.

6th—Unless made of iron, (which is very expensive,) the Overshot rots and decays in a few years, causing a considerable expense in repairs, beside the trouble and loss of time;

While the universal experience of every one using our wheel is its cheapness in running, and freedom from getting out of order.

7th—Back water either stops the Overshot entirely, or clogs it so it cannot be used to any advantage;

While our wheel is never in the slightest degree affected by back water, save in the loss of head and fall.

**The Leffel Wheel taking the place of the Overshot under 17½ feet fall.**

LAKE CITY, Minn., June 16th, 1866.

Messrs. James Leffel & Co.: From a sense of duty to you, as worthy inventors, and to the public, who have a right to the benefits of my experience, I will subjoin the following: My wheel, which came to hand in due time, we succeeded in starting the last of February in 2 feet 6 inches of backwater; this backwater, made by anchor ice, we had been running our overshot in up to the time of putting in the 20 inch wheel you sent us. We could grind only about 50 or 60 bushels of wheat per day with the overshot. With nearly the same backwater your wheel started up with 90 and 100 bushels per day. With no backwater, and under the most favorable circumstances, we could grind an average of 80 bushels of wheat per day, and run the necessary machinery. With your wheel—circumstances being always favorable, owing to uniformity, perfect simplicity, and the exceedingly small amount of machinery—with the same water, and with no more time, we can grind an average of 110 to 115 bushels of wheat per day.—Facts, which are better than opinions or conjectures, demonstrate the superiority of your wheel, as I can testify that it is at least 25 per cent. better than the overshot which I had in use; and my wheel was geared as direct as machinery of this kind could be geared, and, as compared with other mills, might be classed with the best constructed overshot wheel. It is but due your valuable wheel and its benefits to the public that I make these statements, hoping that all others buying your wheel will be as well pleased and gratified with the change as I have been. The wheel is 20 inches in diameter, and under 17½ feet fall. I will subscribe myself,

H. COLLINS.

**The Leffel Wheel gives perfect satisfaction when taking the place of the Breast Wheel under 18 feet fall.**

DALTON, Mass., Sept. 8, 1866.

Messrs. Leffel & Co.: The 40 inch "Double Turbine" that your agent, Mr. Jones, put in for me last May, gives *perfect satisfaction*. I have it under 18 feet head, and it is doing all of 70 horse power, with ¾ drawn gate. It does one-third more work than the old Breast wheel taken out, and I believe it to be decidedly more powerful than any other iron wheel in use hereabouts. Z. CRANE, JR.

**Read what an old Overshot Builder and Manufacturer thinks about the Leffel Wheel.**

NORTHAMPTON, Mass., Jan. 2, 1867.

James Leffel & Co.: With regard to the 30 inch wheel sent me in July, I can say that it does more than I anticipated. I have been running two Paper Engines, Rag Cutter, 2 Pumps, Circular Saw for sawing wood, for nine or ten years, with the water used by Delany & Watson, whose mill is 25 rods above me, and who run just the same machinery, (except their engines carry 200 lbs., while mine carry 175 lbs.) In low water, when it does not run over their dam, which is tight, I have had just enough—none to spare. Our machine wheels are just alike, and use the same amount of water. Delany & Watson use 17 feet, 4 inch diameter, 7 feet buckets.—Both wheels were in good running order as they could be: were good wheels, well geared. I put in your wheel while the water was low, and found that I had more power than before, (I lowered my pit 2 feet,) and had added another engine, same size (200 lbs.) as Delany & Watson, and can now run all three engines with the water that run but two with the Breast wheel, and they run much more steadily. By letting the rolls of the engine on the bed plate it would hold the Breast wheel so that it would not start at all. I now put down all three, and with just one-half gate they will start right off. I have built 35 Breast and Overshot wheels, and have set many iron wheels. My sympathy has always been for the Overshot and Breast; but I have *caved in on them*, and now say I would not exchange the wheel in my mill for the best Overshot or Breast, if it could be put in for nothing.

I know of no wheel that is its equal, and any person who wishes to economise in the use of water will find it to their advantage to use one of your wheels. Truly yours, C. LOUD.

**A 20 inch Wheel doing more work than a 32 feet Overshot, with the same amount of water.**

ITHACA, N. Y., Nov. 30th, 1865.

Messrs. James Leffel & Co.: About a year since, (my Overshot wheel having given out,) I was induced, through personal examination and the representations of reliable millers and millwrights, to put in your Double Turbine Wheel. My Overshot wheel was one of thirty-two feet ten inches (32 ft. 10 in.) diameter, with six feet buckets, with head and fall of thirty-five (35) feet, and was replaced by two of your twenty (20) inch wheels, under the same head and fall. I am satisfied, after a thorough trial, that

my mill does *more work* with *less water* than the Overshot; runs with a steadier and stronger motion, and makes better work than ever. One of the wheels will run three (3) run of stones, with necessary machinery, with *less water* than used with the old wheel, which is more than was expected, as I had only intended it for two run. The amount of water used with either wheel I do not know, but have certain means of judging of the comparative amounts by the gate in my dam—raising it *less now* than formerly for *same amount of work*. The wheels have never been frozen up a minute, when the overshot wheels about me have been frozen up for a week at a time. To those wanting wheels, I shall take pleasure in recommending yours as the best I know of, or can learn. Yours, truly,

H. C. WILLIAMS.

**A 17 Feet Overshot taken out and our Wheel Considered the Best he Ever Saw.**

SPRINGFIELD, Ohio, October 10th, 1865.

Messrs. James Leffel & Co.: This is to certify that I have put in my saw mill one of your wheels. The one I had before was an Overshot, in first rate order, with which I sawed 3,000 feet per day. I then tried one of the Wirtz Wheels, with which I could saw 1,500 feet. I then put in your wheel which sawed 4,000 feet of lumber in a day—each one of the wheels using the same amount of water. I have used it now over a year and a half, and consider it far beyond any other wheel in point of steadiness and convenience in running, and would heartily recommend it.

ANDREW REBERT.

**20 Feet Overshot Displaced by our 15¼ inch Wheel Driving Planers, Circular Saws, &c.**

MIDDLETOWN, Vermont, December 19th, 1865.

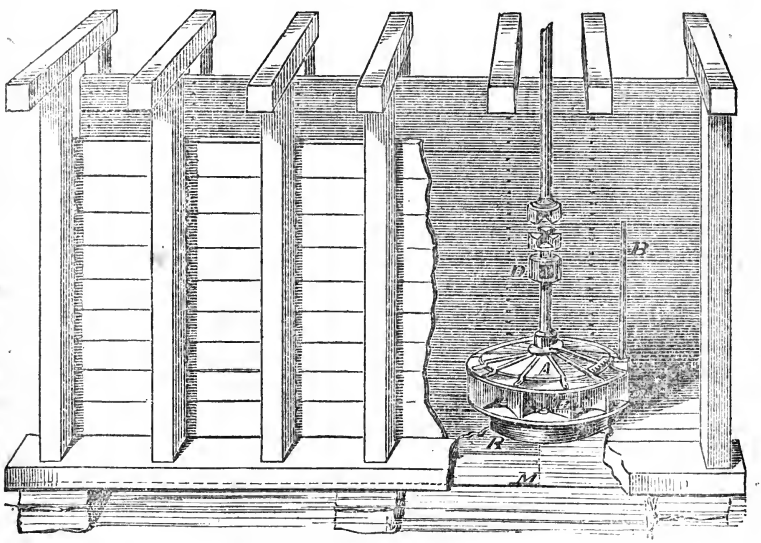
Messrs. James Leffel & Co.: Some eighteen months since we ordered one of your Double Turbine water wheels, 15¼ inches in diameter, and removed from our Horse Power Manufactory an Overshot wheel, 20 feet in diameter, and placed your wheel in its place, which occupies less than one-fiftieth of the space of the old wheel, giving us much valuable room in two stories of our factory, formerly occupied by the old wheel, which darkened and spoiled one end of the factory, which is now lighted, and the most valuable part of the building. We are now running two planers, three saws, sawing plank, two engine iron lathes, boring and drilling machines, two wood lathes, screw cutters, mortising and tenanting machines, grindstones, &c. We seldom use one-half the capacity of the wheel, whose head and fall is about 24 feet. We are millwrights by trade, and have no hesitation in saying that we consider your wheel superior to any wheel within our knowledge, and a great saving of room and expense, over the Overshot wheels now extensively used in this section, and preferable to any of the numerous Turbine wheels that have come under our observation. Finally, will say in point of power, economy of water and cheapness of running, your wheel stands at the head of the class, putting all other wheels, that are within our knowledge, entirely in the ground.

Very respectfully, A. W. GRAY & SONS.

**Decided to use the "Leffel American Double Turbine Water Wheel."**

SPRINGFIELD, Ohio, December 13th, 1865.

Messrs. James Leffel & Co.: Having lately built a new Grist Mill on a very light stream of water, I was compelled to be very particular in the kind of wheel I put in. After a most thorough investigation into the merits of different kinds of water wheels, I decided to use "The Leffel American Double Turbine Water Wheel," as the most economical in point of power I could find—and my experience has fully justified my choice. With the Leffel wheel of 15¼ inches diameter, with gate half drawn, under 30 feet head and fall, I find I can grind 13 bushels per hour and run all the necessary machinery at the same time. With gates full drawn, venting 26 inches of water, I can run one pair of 4 feet burrs and one pair of 3 feet burrs, grinding 20 bushels of wheat per hour and at the same time running smut machine, separator and the entire machinery of the mill. For steady power, convenience and durability, it far surpasses any wheel I have ever seen. I would heartily recommend it for any fall, and would say to those desiring a wheel, they need not fear the result in the event of a purchase, and as evidence to the truth of the above statement, I would refer parties to my mill, situated in Springfield, Ohio. C. THOMPSON.




**Explanation of Figure II.**

Figure II is intended to show the manner of putting the wheel in under low falls. A plain substantial flume is constructed with good heavy timbers and firm foundation. There should be sufficient space, depth and width between the bottom of flume and floor of tail race to let the water pass out from beneath the flume without obstruction. The

floor of flume should be of heavy plank, to give sufficient firmness to support the weight of water and wheel. In the floor of the flume there should be a hole cut of a size to admit the cylinder of wheel casing, which will pass through the floor of flume, the wheel thus resting upon the floor by the flange of the casing. It does not require anything to fix it to its place, as the weight of the water and wheel will hold it firmly in its position.

The flume should always be made in every case large enough so that the wheel in no place will come nearer than one half its diameter to the side of the flume. The floor of flume should come near enough to the surface of standing tail water, so that the end of the cylinder of wheel casing that projects through will dip two inches or more below the surface of the water. A pit of good depth should always be dug underneath the flume to prevent the water from reacting upon the wheel. No particular style of flume is needed. It can be constructed to suit the peculiarities of the location. The only point to be observed is to have it strong enough and of sufficient capacity to let the water to the wheel without obstruction.

In Figure II "A" is the crown plate of wheel casing: "R" is the cylinder of casing projecting below the floor: "M" the depth below end of cylinder and bottom of pit, which should be from two to three feet deep: "H" shows one of the guides of the wheel, of which there are twelve around the circumference of the wheel: "D" is the bush containing wooden followers, which can be adjusted to the upper end of wheel shaft. The coupling that connects the wheel shaft to another shaft is shown detached. "B" is the gate rod for opening and closing the gates of the wheel, which can be done with ease and accuracy.

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**What a Prominent Manufacturing Company thinks of our Wheel.**

SMITH PAPER Co., Lee, Mass., Jan. 2, 1867.

James Leffel & Co.: Yours of the 21st ult. is at hand. In reply we would say that we have used a great variety of iron wheels in our different mills, (viz.: "Jagger," "Parker," "Tyler," and "Reynolds,") but after using one of yours, purchased through your agent, E. D. Jones, Esq., were so well satisfied with its superiority over the other wheels, in durability and economy in the use of water, both with full and partially closed gates, that we ordered more of them, and have now running in our

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Columbia | Mill, | 1 | 48 | inch | wheel, | under | 14 | feet head. |
| " | " | 2 | 40 | " | " | " | 14 | " " |
| " | " | 1 | 35 | " | " | " | 14 | " " |
| " | " | 1 | 20 | " | " | " | 14 | " " |
| Housatonic | " | 1 | 48 | " | " | " | 8 | " " |
| Union | " | 1 | 48 | " | " | " | 9½ | " " |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Valley Mill, | 1 | 48 | inch wheel, | under | 8½ | feet | head. |
| " " | 2 | 56 | " " | " | 8½ | " | " |
| " " | 1 | 30 | " " | " | 8½ | " | " |

You are at liberty to make such use of this information as you may deem best. SMITH PAPER COMPANY.

**The Leffel Wheel against new Breast Wheel.**

GENESEE COUNTY MILLS, Batavia, N. Y., Dec. 29th, 1866.

Messrs. Leffel & Co.: We have a four run flour mill, with 7 feet 10 inches head. Last September we put in one of your 48 inch wheels in the place of a Breast wheel, and we can say, without hesitation, it is the best wheel out. We have tried it in low and in high water with equal success. Our miller drove three run and the machinery one day with it. Perhaps it will be well for us to explain a little. We have a mill with five run, four run 4½ feet, and one 30 inches. We have your wheel and the Breast wheel in the same flume, and we can gear the whole mill together, or run any part of the mill, with either wheel or both. So you see it is a fair test. One day, when the water did not run over the dam, we put on two run and all the water on the iron wheel, and measured the water in the tail race. Then, without altering the feed on the stone, shut the water off the iron wheel and put it on the Breast wheel, and measured the water again, and found it 1¼ inches deep by 25 feet wide less with the iron wheel than with the Breast wheel.

We have as good a Breast wheel as was ever made, but when it gets worn out it will never be repaired, as one of Leffel & Co.'s wheels will take its place. You can publish as much as you please of the above; or, if any one chooses to ask questions, or see the wheel work, they can, at any time they choose, come to the Genesee County Mills, Batavia, New York.

Yours, JAMISON & PIERSON.

**"Can't express the satisfaction it gives."**

MAZO MAERIE, Wis., Jan. 7th, 1867.

James Leffel & Co.: Yours of the 26th ult. received, and contents noted. Would say that I cannot express in writing the entire satisfaction your wheel has given me. I am no hand at writing certificates. I am perfectly satisfied your wheel is the best wheel now in use, and I very much doubt whether it ever will be surpassed in all its points. The wheel I have is a 56 inch wheel. Truly yours, W. E. ROWE.

PORTLAND, Ionia Co., Mich., Dec. 28, 1866.

Messrs. James Leffel & Co.: We have one of your 40 inch Double Turbine Water Wheels in our mill, attached to a four feet burr stone, with which we can grind 20 bushels of wheat per hour under an 8 feet head.

NEWMAN SATTERLEE & CO.
R. N. STEELE, First Miller.

**What an old Miller thiuks.**

HONEOYE, N. Y., Jan. 7th, 1867.

I have just got my mill in full operation. It astonishes all who see it,

and there have been hundreds here for that purpose. The day we started it there was quite a number in—so many that we could hardly get through them to tend the mill. We had in several grists of two bushels each, and every ten minutes we ground one. We ground all the afternoon, and we never went over eleven minutes to any of them. With our old wheel we could grind only four bushels per hour, and not always as much as that—say three bushels per hour. Finally, it does all and more than we ever expected it could do. The man who put in my last two wheels thinks there never was any wheel that would beat these. The wheels are all in full operation, earning lots of money, and I have all I can do to look after them. I took out two center discharge wheels, which were geared together, which took about 600 inches of water, and ground not over four bushels per hour, and now I have two 40 inch wheels under 6 feet head and fall, and draw about half the water they call for, and grind about three times as much.

Yours, in haste, DANIEL PHELPS.

**"Fully up to the recommendation."**

WECEDAH, Wis., Jan. 16th, 1867.

Gentlemen: We have two of your Leffel Wheels in use—one 30½ inches, and one 40 inches. Our head is 8 feet. They have been in use from one to two months. With the 30½ inch wheel we drive Power Lathe, Wood Lathe, Jigger Saw, Corn Sheller, Smut Mill and Elevators. With the 40 inch wheel we drive one set 43 inch burr stones, and one set 32 inch do., elevators and bolts. We have not yet used more than ⅝ of the water, running both stones, and grinding 8 to 10 bushels of wheat and 16 bushels of feed (corn and oats) per hour. We think the wheels fully up to the recommendation. We formerly used a Parker wheel, used 350 to 400 inches of water, and had about ⅔ the power of this 40 inch wheel, which uses only 180 inches. Yours, &c., T. WESTEN & CO.

G. W. BAILEY & CO.

**Fastest Sawing on record done by the Leffel Wheel.**

The following statement appeared in some of the newspapers in New England, one of which was sent to us. The wheel is 48 inches in diameter, running under 12 feet head. It was put in by William Duncan, our agent at Lebanon, N. H. The wheel was put in Henry Weeks' saw mill in Warren, N. H.:

"Our correspondent says: 'I started the mill about one week ago, have run it more or less every day since, but have not experimented much yet with it, as I have not had time. Have tried it enough to confirm my belief that the wheel cannot be beaten by any wheel in the world. I challenge any mill on the face of this earth to saw more lumber in the same length of time with the same facilities than can be cut in this mill, because we have the power to drive the saw up to its utmost capacity. I told the boys last Saturday noon that I wanted to try for one hour and see how much we could saw, and at twelve minutes past four I told them I was ready for the trial; and in sixty minutes we sawed, on one big circular saw, 4,517 feet of lumber. We took the trees in the pond without selecting, drew

them into the mill, cut them up into logs 12 feet long, with a drag saw, and cut up slabs 20 inches long and loaded them into the slab car, ran the lumber out of the mill on to platform ready to load on to car—the three saws and drawing in all driven by this one wheel, and all done in the sixty minutes. Beat that, and I will try once more—for I know that we can even beat that on the second trial. The logs were only 12 feet long, and some of them only six and eight feet long, and just an ordinary lot of hemlock logs. Had they been 16 feet long we would have gone over 5,000 feet in the same length of time with the same ease. We had 12 feet head and a fractional gate—say about three-fourths. The logs were sawed as follows, viz.: about one thousand feet of boards, three thousand feet of four inch plank, and the remainder in 2½ inch plank.

JONATHAN STANYON, Millwright.'"

The above statement being disputed by millwrights and sawyers, we wrote to Mr. Weeks (fearing there might be some mistake) concerning the statement, as we did not want to publish anything of which there was the slightest doubt. The following is the reply of Mr. Weeks, the owner of the mill:

WARREN, N. H., Dec. 26, 1866.

Messrs. James Leffel & Co.: Yours of the 20th is received and contents noted, and in reply would say that I made a statement and sent it to Mr. Wm. Duncan the 24th. He wanted it to send you a copy, which I presume is on the way ere this, therefore I will not send you the statement. The quantity of lumber was sawed, and the statement you have seen was made by my millwright. Had I considered at the time that the work was of so much importance, I should have had it surveyed by some one not in my employ. The planks I got to order, and they held out our measure; and there could not have been an error in the boards and 2½ inch plank. I talked with my sawman after I received your letter last evening, and he says if any man doubts the statement, and will come here in the Spring after the frost gets out of the logs, he will try another hour, and if he does not saw 5,000 feet, he will pay all expense for their time and traveling expenses. I have seen a great many mills, but I have never seen a mill so well situated for getting the logs on the carriage, and the lumber from the mill. We had several logs on the deck before starting up, or we could not have kept the saw at work. My old mill had the name of being the best mill in New Hampshire. In April last, a lumber dealer from Lowell, who had seen many of the best mills about the country, said he 'had seen many mills, but had never seen a saw mill before he saw Weeks' Mills." Now, with my new mill and your wheel, we can saw twice as fast as we could before. My old mill ran twelve years, and we had close work, on account of low water, to saw out one million. This Winter I contracted for two millions, for I know we can do double what we used to with the old wheels. To driving the same saws and "drawing-in works," I had three wheels, drawing good 800 inches water, and now we use 259 inches water, and can do twice the work, because we have more power.

Yours, very truly, HENRY W. WEEKS.

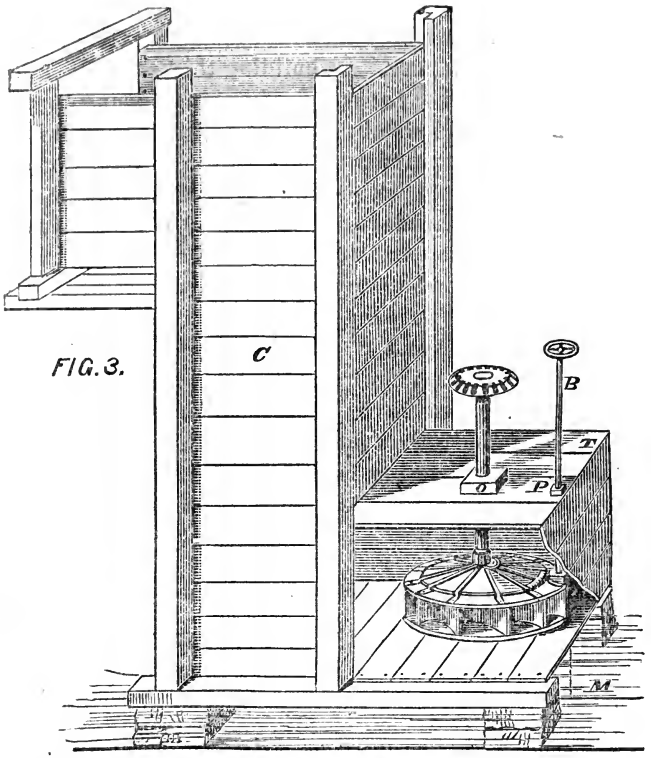



FIG. 3.

**Explanation of Figure III.**

There are some mills, particularly flouring and saw mills, that are so situated with reference to flume, that it is difficult to pass the wheel shaft above the surface of the water. This happens where the water (as it frequently is) is on a level with the second or third story of the mill, and the machinery operated on the first floor. In this case the wheel can be put in as shown in the plate. In addition to the ordinary perpendicular portion of flume or penstock there is a horizontal section of flume built in which the wheel is placed. The shaft that is attached to wheel shaft passes out of the top or deck of this section of flume, and around this shaft is placed a stuffing box to prevent leakage of water around the shaft. The power can then be taken off by bevel or spur gears as shown. The advantage of this method of putting the wheels in is that the power can be brought near to the point where the work is to be done, otherwise it would have to be brought through a long train of gears and shafting, which of course would tend much to lessen the useful effect of the wheel.

As the value of any mill depends mainly upon the power to propel it, we would say conform the machinery if possible to the wheel, and not

the wheel to the machinery, as is too frequent done. Bring the work as near the wheel as possible, and avoid too great length of shafting and complication of gearing. In building this style of flume we cannot too much impress the necessity of having strong heavy timbers and plank, which should also be fitted closely. The gate rod also passes out of the decking, around which is also a stuffing box. We also have a cast iron case fitted with stuffing box for shaft and gate stem, to be attached to pipe for heads varying from 40 to 500 feet fall.

In the plate, "O" represents the stuffing box around wheel shaft—"P" stuffing box around gate rod—"B" gate rod for opening and closing the gates—"C" perpendicular portion of flume or penstock—"M" depth of pit below end of cylinder of wheel casing—"T" top or decking of horizontal section of flume. This section of flume may be carried much further than is represented. The top or deck should always be high enough, so that the *coupling* on wheel shaft will come *under* the deck. *It is wrong to deck around the sleeve or bush of the wheel.* Remember the coupling on wheel comes below the deck, and the stuffing box goes around the portion of shaft *above* the coupling.

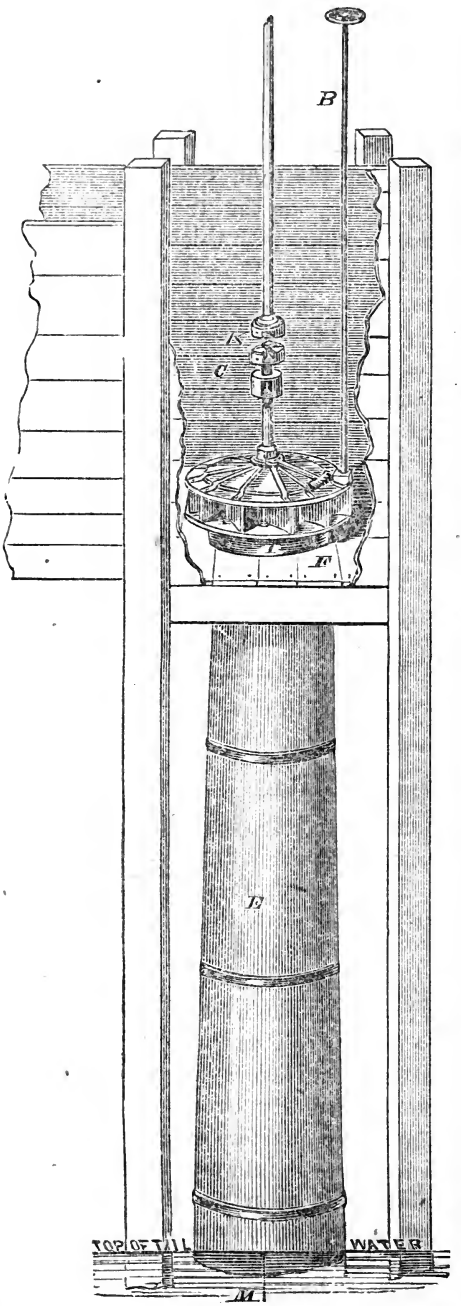
**Read what a Wheel only ten inches in diameter can do in a Flour Mill.**

WEST MILTON, Miami Co., O., Nov. 12, 1866.

Messrs. James Leffel & Co.: We have been running one of your American Double Turbine Water Wheels of only ten inches in diameter, which we set in place of two Overshot wheels, one of twenty-six feet diameter, and the other of twenty feet diameter. We now run the little ten inch wheel under fifty-six feet head and fall, and are able to do fully one-half more work with the same amount of water than we could do with the Overshot. We have never used full gates on the wheel. With one-half gates we have run two run of burrs, and ground ten bushels per hour; and we will not hesitate in saying that we can run three run of stone, and grind fifteen bushels per hour, and run all the necessary machinery at the same time; and for steady power we have never seen any wheel to equal the one we now use: in short, we think if they are put in right they will surpass any other wheel, and from the experience we have had, we think the wheel is very durable. Any person doubting this statement can come to the well known Cedar Branch Mill, situated in Miami County, Ohio, for further information. D. & J. WEIMER.

P. S.—Since I have written the above, I have tried the third run of burrs, and have ground with two-thirds gates, fifteen bushels per hour, and run all the machinery at the same time. We have run these three pairs of large burrs day after day, and have no trouble to run them strong with the gates two-thirds open. We know this may seem to others as extraordinary work for so small a wheel, and we are literally astonished ourselves at the results of the little wheel, nor could we be induced to believe that a wheel of that size would do the work stated, had we not made the trial ourselves for weeks together. D. & J. W.

## Draft Tube---Explanation of Figure IV.




In adapting wheels to very high falls, it sometimes becomes desirable, in order to avoid extreme length of shaft on wheel and also to otherwise conform it to the peculiar location of the mill, to place the wheel at a distance above tail water, and conduct the water away from the wheel by an *air-tight* tube, called a draft tube. We present on this page a cut of a wheel thus arranged.

Now, while, theoretically, a wheel will do just as much work with the same quantity of water when using a draft tube; yet practically, the difficulties of making a draft tube perfectly air tight—which must be done to avoid waste of power—are so great, that we advise the use of a draft tube of great length only in *cases where it cannot well be avoided.*

There cannot be, ordinarily, any objection to the use of a draft tube not to exceed ten feet in length, as within that limit, by good workmanship and proper material, a tube can be constructed both air-tight and durable. Yet, as inexperience in this matter might lead to mistakes which would tend to greatly diminish the power of the wheel, we would here state as a rule we would advise the wheel to be placed at the bottom of the fall.

When the draft tube exceeds ten feet in length, and particu-

larly when used for small wheels, it should be made of boiler iron, as our experience has taught us that when the tube is of great length, a wooden tube cannot be relied on as either air-tight or durable.

In constructing wooden tubes, the staves should be of any soft wood, and from two to two and a half inches thick. They should taper so as, when put together, the tube will be somewhat larger at one end, which we call the drift. The drift in the tube should be about one-quarter of an inch to the foot. The object in having the tube larger at one end is, that the iron rings may be driven tightly on the tube. The rings may be two inches wide and one quarter of an inch thick, and should be placed from twenty inches to two feet apart. When the tube is completed and made as tight as possible, then a hole should be cut through the floor "F" of flume; the end of the tube is passed through, and should project above the floor of the flume six inches, as at "I." The tube must be made of sufficient diameter inside to freely admit the cylinder of wheel casing. The flange of wheel casing will thus rest on top of the tube, which should be planed off smooth and even, thus affording a firm support for the wheel. For small wheels, there is no other support required—it will be sufficient to place the wheel in the open end of the tube, which should be securely spiked to the frame of the flume; but for wheels of large diameter, we think it is best not to trust to the tube alone for support. In this case, we would suggest that a plank of proper thickness be fitted around the tube, thus causing the wheel to rest partly on the end of draft tube and partly on the floor, thus making a more general distribution of the weight of the wheels and the column of water on the wheel.

### Explanation of Plate.

"C" represents the inside of flume: "K," the coupling by which shafting is attached to wheel shaft: "F," floor of flume which should be made of strong, heavy plank: "I," end of draft tube, which should project above the floor of the flume six inches, in the end of which the cylinder of wheel is inserted: "B," the gate rod for opening and closing the gates, which can be conducted to any convenient point in the mill, on the end of which is a hand wheel. We wish here to caution parties not to increase the leverage on this rod, as there is in the mechanical arrangement of the wheel sufficient leverage, so that the gates can be opened and closed with ease and rapidity, even under very high falls. The rod is intended to make three-quarters of a revolution to open or close the gates, and the leverage should not be increased so that the rod makes over one revolution to open or close the wheel. We wish this to be remembered when *arranging to attach the gate rod.* We would also, in this connection renew our caution to give good depth of pit below end of draft tube for free discharge of water. The end of

draft tube should dip two or three inches below surface of *standing* tail water, and there should be a distance of two or three feet from the end of the tube to bottom of pit below end of draft tube. "E" represents draft tube: "M," depth of water in pit below draft tube.

### Double Wheel.

We wish to make a few explanations in regard to the feature in our wheel we characterize as a Double Wheel—as many have been led to erroneously believe it is in its compound form similar to many other double wheels, in which the water discharged from one set of buckets is made to operate on a second set, with the idea of more effectually securing a maximum effect of the water. It is not our object to discuss or point out the obvious objections to the arrangement of that form of wheel, as it is now universally considered to be essentially wrong in principle.

But our object is here to explain the construction of our wheel sufficiently to prevent its being confounded with the class of double wheels mentioned. In our wheel there is a combination of two independent sets of buckets—one having a center and the other a vertical discharge, and each receiving independent of the other, its proper quantity of water from the same guides.

As one set of buckets is placed immediately under the other, a combination is thus effected without increasing the diameter of the wheel. By this arrangement there is admitted the greatest possible volume of water to a wheel of any given size, and at the same time securing the greatest area for escape of water: thus reducing the surface in the wheel as compared to the quantity of water used, to the smallest compass, thereby avoiding a great loss by friction, an element which serves to diminish the effective power of a wheel.

To those understanding the necessity of reducing the frictional surface in a wheel to a minimum, the value of this arrangement is apparent, and the results obtained will fully justify us in attaching to it the importance we do.

### Durability and Simplicity of the Leffel Wheel.

Our wheel, simple in its construction and being made either of iron or brass, is very durable—special attention being paid so as to secure this last quality, and although there are twelve gates they are opened and closed by an arrangement so simple as to almost preclude any liability of getting out of order.

Rival wheel builders who are obliged to admit the superior qualities of the Leffel Wheel, try to damage its reputation by the cry of "It is too complicated." "It won't last long." If that were true, it is a little singular that we have never heard a single complaint on that point,

from any one of the purchasers of the vast number of wheels already sold. We appeal to any one of our numerous patrons, scattered all over the United States.

### Small Wheels.

As the severest test a Turbine Wheel can possibly be put to, is to take the place of an Overshot Wheel under very high falls, and with an extremely limited supply of water, such as is afforded by a few springs only, it certainly can be claimed for the wheel that will succeed under those circumstances, that it is the very best wheel that can be constructed.

We therefore invite special attention to the following statements from practical Millers and Millwrights, who have had years of experience with Overshot Wheels, under high falls and small quantities of water—just the circumstances under which it has formerly been considered impossible for any Turbine to successfully compete with an Overshot, and we think it not too much to say that the Leffel Wheel is the *only wheel* that can achieve such results under such conditions. But severe as is this test, the Leffel Wheel not only has proved equal but superior in every respect to the Overshot, and it will also be observed that notwithstanding the high degree of economy demanded in the use of so small a quantity of water, *not one of the wheels are using full drawn gates. In fact some are operating with gates only one-quarter open;* thus proving, beyond a doubt, the highest degree of economy in our wheel with partial gates.

Another fact, that cannot escape attention, is the immense power produced by such small wheels. We claim this as a feature peculiar to the Leffel Wheel, and we have found by careful comparison with other wheels, that we can produce a far greater power from the same sized wheel than any other wheel in use; thus enabling us to use a much smaller wheel for any purpose than can be used by any other form of wheel.

Aside from a small wheel costing less, occupying a smaller space, lessening the cost of flume, &c., it is not necessary to mention the many other advantages of using a wheel in which the greatest possible power is condensed in a small diameter, rather than to employ much larger and cumbersome wheels of other styles which it would be necessary to employ in order to produce the same power.

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**"It runs up to the table."**

BLACK EARTH, Wis., Jan. 12, 1867.

Gentlemen: The 48 inch Leffel wheel is the best I have ever had in use. Under the 8 feet head and fall I have, it drives all my flouring bolts and machinery, with a pair of four feet stones, grinding from 14 to 16 bushels of wheat per hour. It runs up to the table better than I ever had wheels do before. Respectfully, JOHN WALL.

### A Ten Inch Wheel in a Saw Mill.

ADAMS, Mass., Jan. 4th, 1866.

Messrs. James Leffel & Co.: I have just started the little ten inch wheel under 16½ feet head, and have belted on to a 16 inch circular saw, 7 inch saw, pulley 3 inches, belt very tight. Saw runs 1,000 or more revolutions per minute. With half gate I can saw more than the majority of shop saws, and with full gate can put the saw through the hardest seasoned six inch timber, either endwise, crosswise or cornerwise. If by hard pressure I stop the saw, the wheel knows nothing of it. Its motion is onward: it requires a larger belt to test the power.

On account of its more uniform speed it is worth for my light work double the best Overshot in existence, and I believe it will do more work with the same quantity of water.

Gentlemen, I am satisfied, and more than satisfied, with your wheel. Years ago I was a millwright by trade, and I perfectly understand the percentage given by the iron wheels which are in general use in this section. Your wheel is far superior, and worthy of and must have a more general introduction. Yours truly, D. D. ALLEN.

### Our Wheel in a Woolen Factory.

CRAWFORDSVILLE, Ind., Nov. 18, 1865.

Messrs. James Leffel & Co.: We wish to add our testimony to the value of your Double Turbine Water Wheels. After an experience of some forty years, of different wheels in use, I can say, without hesitation, I have never found any to equal the Double Turbine. We have used one of your 10 inch wheels on 28 feet fall, after throwing out an Overshot, and were able to do one-fourth more work and a more steady movement, not so liable to be checked, throwing on and off bands. And we are now using one of your 17½ inch wheels, on 14½ feet head and fall, running one set of machinery—carding, spinning, weaving, fulling, and all other fixtures for manufacturing cloth, with less water than could possibly do with an Overshot wheel on same head and same amount of water. We have not added machinery enough to our 17½ inch wheel to know what it could do, but have no doubt we could double the machinery before filling the capacity of the wheel. You can make whatever you choose of the above.

Yours, truly, R. M. HILLS.

### Have a remarkably steady, true speed.

NORTHAMPTON, Mass., Jan. 1st, 1867.

Messrs. Leffel & Co.: You ask us how we like your wheels, put in our new mill last Summer. The 23 inch wheel is running under 32 feet head, and drives two rag engines 40 inch bore, 36 inch diameter of roll, (called 500 lb. engines,) rag cutter, duster, pumps, &c., with one-half gate. We have ample power for another engine same size. The 10 inch wheel runs the 54 inch machine with one-half gate. They have a remarkably steady, true speed, and we consider them superior to any wheel within our knowledge. We are now running a good Breast wheel in another mill, for which we propose to substitute one of yours next Summer.

DELANEY & WATSON.

## Explanation of Tables.

On the three following pages will be found tables showing the power, number of revolutions per minute, and also the number of cubic feet of water discharged per minute for each size of our wheels, under heads from 3 to 40 feet. The top line of figures shows the head and fall in feet. The left hand perpendicular column gives the size of wheel from $6\frac{5}{8}$ to 56 inches in diameter. In the small squares formed by the intersection of the perpendicular and horizontal columns will be found three sets of figures. The upper one indicates the number of horse power, which you will see is abbreviated at the left of the horizontal column. The middle set of figures shows the number of cubic feet of water used by the wheel per minute. This is likewise abbreviated. The lower set of figures shows the number of revolutions of the wheel per minute. We will give an example of the manner of determining by this table the power, quantity of water used, and revolutions of any sized wheel under a given fall. Suppose we wanted to find the power of a 20 inch wheel under 11 feet fall; find in the top line of figures (indicating the fall in feet) the fall required—11 feet; now follow down the perpendicular column immediately under the figure 11 until you come to the horizontal column in which the size of wheel (20 in.) is placed at the left. In the square where these two columns intersect will be found $9\frac{20}{100}$ horse power, 499 cubic feet of water per minute, 229 revolutions per minute. Again, take a 48 inch wheel under 8 feet fall. In following down the perpendicular column under figure 8 until you reach the horizontal column leading from the 48 inch wheel to the right, at the intersection will be found $32\frac{89}{100}$ horse power, 2457 cubic feet of water per minute, and 81 revolutions per minute, which will be the number of horse power, the cubic feet of water used per minute, and the revolutions per minute of a wheel 48 inches diameter under 8 feet fall. The same method will determine the power, quantity of water used per minute of any size wheel, under any fall from 3 to 40 feet. The revolutions of the wheels as laid down in this table are the number of revolutions the wheel makes *when at work*. But as there is always a loss of fall by the water drawing down in the head race, and also raising in the tail race when the wheel is running, we would here state that as a rule we would advise those who have charge of putting the wheels in, that in calculating for the speed of wheel and machinery they should always base their calculations on a fall of from 6 inches to a foot less than the measured fall when the head and fall is from 4 feet to 20 feet; and 18 inches, when the fall is over 20 feet—thus allowing for the loss of head mentioned: which will bring the speed of the wheel to suit the actual running head. On page 26 will be found a table showing the number of square inches used by the different sized wheels, together with the prices.

# THE FOLLOWING TABLE

Was calculated expressly for "LEFFEL'S AMERICAN DOUBLE TURBINE WATER WHEEL," and will apply to no other wheel. It contains the size of the different Wheels in inches of diameter; the number of horse-power; the cubic feet of water used per minute, and the number of revolutions per minute made by each sized Wheel for any head from 3 to 40 feet:

Diameter of wheel in inches. | Horse power, cubic ft., revolution per minute.

HEAD IN FEET.

| | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6⅝ | Horse P'r. | .15 | .22 | .31 | .41 | .52 | .63 | .76 | .89 | 1.02 | 1.17 | 1.31 | 1.47 | 1.63 | 1.79 |
| | Cubic Ft. | 29 | 33 | 37 | 41 | 44 | 47 | 50 | 53 | 55 | 58 | 60 | 63 | 65 | 67 |
| | Revolu'n. | 360 | 416 | 465 | 510 | 551 | 588 | 624 | 658 | 690 | 721 | 750 | 779 | 806 | 832 |
| 7⅝ | Horse P'r. | .20 | .30 | .42 | .56 | .70 | .86 | 1.02 | 1.20 | 1.38 | 1.57 | 1.77 | 1.98 | 2.20 | 2.42 |
| | Cubic Ft. | 39 | 45 | 50 | 55 | 60 | 64 | 68 | 71 | 75 | 78 | 81 | 84 | 87 | 90 |
| | Revolu'n. | 313 | 362 | 404 | 443 | 478 | 511 | 542 | 572 | 600 | 626 | 652 | 677 | 700 | 723 |
| 8¾ | Horse P'r. | .25 | .38 | .53 | .70 | .88 | 1.08 | 1.28 | 1.51 | 1.74 | 1.98 | 2.23 | 2.50 | 2.76 | 3.05 |
| | Cubic Ft. | 49 | 57 | 64 | 70 | 75 | 80 | 85 | 90 | 94 | 98 | 102 | 106 | 110 | 114 |
| | Revolu'n. | 273 | 315 | 352 | 386 | 417 | 446 | 473 | 498 | 523 | 546 | 568 | 590 | 610 | 630 |
| 10 | Horse P'r. | .33 | .52 | .72 | .95 | 1.18 | 1.46 | 1.74 | 2.04 | 2.35 | 2.65 | 3.02 | 3.38 | 3.75 | 4.13 |
| | Cubic Ft. | 67 | 77 | 86 | 94 | 102 | 109 | 115 | 122 | 128 | 133 | 139 | 144 | 149 | 154 |
| | Revolu'n. | 239 | 275 | 308 | 337 | 364 | 390 | 414 | 436 | 457 | 478 | 497 | 516 | 534 | 551 |
| 11½ | Horse P'r. | .44 | .67 | .94 | 1.24 | 1.56 | 1.90 | 2.27 | 2.66 | 3.07 | 3.50 | 3.94 | 4.41 | 4.89 | 5.38 |
| | Cubic Ft. | 87 | 100 | 112 | 123 | 133 | 142 | 150 | 159 | 166 | 174 | 181 | 188 | 194 | 201 |
| | Revolu'n. | 207 | 240 | 268 | 293 | 317 | 339 | 359 | 379 | 397 | 415 | 432 | 448 | 464 | 479 |
| 13¼ | Horse P'r. | .58 | .90 | 1.25 | 1.65 | 2.08 | 2.54 | 3.03 | 3.55 | 4.09 | 4.66 | 5.26 | 5.88 | 6.52 | 7.18 |
| | Cubic Ft. | 116 | 134 | 149 | 164 | 177 | 189 | 201 | 211 | 222 | 232 | 241 | 250 | 259 | 267 |
| | Revolu'n. | 180 | 208 | 233 | 255 | 275 | 294 | 312 | 329 | 345 | 360 | 375 | 389 | 403 | 416 |
| 15¼ | Horse P'r. | .76 | 1.17 | 1.63 | 2.14 | 2.70 | 3.30 | 3.94 | 4.61 | 5.32 | 6.06 | 6.83 | 7.64 | 8.47 | 9.33 |
| | Cubic Ft. | 151 | 174 | 194 | 213 | 230 | 246 | 261 | 275 | 288 | 301 | 313 | 325 | 337 | 348 |
| | Revolu'n. | 157 | 181 | 202 | 221 | 239 | 256 | 271 | 286 | 300 | 313 | 326 | 338 | 350 | 362 |
| 17½ | Horse P'r. | .97 | 1.53 | 2.13 | 2.80 | 3.53 | 4.31 | 5.15 | 6.03 | 6.96 | 7.93 | 8.94 | 9.99 | 11.08 | 12.20 |
| | Cubic Ft. | 197 | 227 | 254 | 278 | 301 | 321 | 341 | 359 | 377 | 393 | 410 | 425 | 440 | 455 |
| | Revolu'n. | 136 | 158 | 176 | 193 | 208 | 223 | 236 | 249 | 261 | 273 | 284 | 295 | 305 | 315 |
| 20 | Horse P'r. | 1.31 | 2.02 | 2.82 | 3.71 | 4.67 | 5.71 | 6.81 | 7.98 | 9.20 | 10.49 | 11.83 | 13.22 | 14.66 | 16.15 |
| | Cubic Ft. | 260 | 301 | 336 | 368 | 398 | 425 | 451 | 476 | 499 | 521 | 542 | 563 | 582 | 602 |
| | Revolu'n. | 119 | 138 | 154 | 169 | 182 | 195 | 207 | 218 | 229 | 239 | 249 | 258 | 267 | 276 |
| 23 | Horse P'r. | 1.75 | 2.69 | 3.76 | 4.94 | 6.23 | 7.61 | 9.08 | 10.64 | 12.28 | 13.99 | 15.77 | 17.63 | 19.55 | 21.54 |
| | Cubic Ft. | 347 | 401 | 448 | 491 | 531 | 567 | 602 | 634 | 665 | 695 | 723 | 750 | 777 | 802 |
| | Revolu'n. | 104 | 119 | 134 | 147 | 159 | 169 | 180 | 190 | 199 | 208 | 216 | 224 | 232 | 240 |
| 26½ | Horse P'r. | 2.27 | 3.50 | 4.89 | 6.43 | 8.10 | 9.90 | 11.81 | 13.83 | 15.96 | 18.18 | 20.50 | 22.92 | 25.41 | 28.00 |
| | Cubic Ft. | 451 | 521 | 583 | 638 | 690 | 737 | 782 | 824 | 864 | 903 | 940 | 975 | 1009 | 1043 |
| | Revolu'n. | 90 | 104 | 116 | 127 | 138 | 147 | 156 | 164 | 173 | 180 | 188 | 195 | 201 | 208 |
| 30½ | Horse P'r. | 3.03 | 4.67 | 6.52 | 8.57 | 10.80 | 13.20 | 15.75 | 18.44 | 21.28 | 24.24 | 27.33 | 30.56 | 33.88 | 37.33 |
| | Cubic Ft. | 602 | 695 | 777 | 851 | 920 | 983 | 1043 | 1099 | 1153 | 1204 | 1253 | 1300 | 1346 | 1390 |
| | Revolu'n. | 78 | 90 | 101 | 111 | 120 | 128 | 136 | 143 | 150 | 157 | 163 | 169 | 175 | 181 |
| 35 | Horse P'r. | 3.99 | 6.15 | 8.59 | 11.29 | 14.23 | 17.38 | 20.74 | 24.30 | 28.03 | 31.94 | 36.01 | 40.25 | 44.64 | 49.17 |
| | Cubic Ft. | 793 | 916 | 1023 | 1121 | 1211 | 1295 | 1373 | 1448 | 1518 | 1586 | 1650 | 1713 | 1773 | 1831 |
| | Revolu'n. | 68 | 79 | 88 | 96 | 104 | 111 | 118 | 125 | 131 | 136 | 142 | 148 | 153 | 158 |
| 40 | Horse P'r. | 5.25 | 8.08 | 11.28 | 14.83 | 18.79 | 22.84 | 27.26 | 31.92 | 36.83 | 41.96 | 47.31 | 52.88 | 58.64 | 64.61 |
| | Cubic Ft. | 1042 | 1203 | 1345 | 1473 | 1592 | 1701 | 1804 | 1902 | 1995 | 2083 | 2168 | 2251 | 2330 | 2406 |
| | Revolu'n. | 60 | 69 | .77 | 84 | 91 | 97 | 103 | 109 | 114 | 119 | 124 | 129 | 133 | 138 |
| 48 | Horse P'r. | 7.58 | 11.66 | 16.30 | 21.42 | 27.00 | 32.99 | 39.37 | 46.11 | 53.20 | 60.61 | 68.33 | 76.39 | 84.71 | 93.32 |
| | Cubic Ft. | 1505 | 1738 | 1942 | 2128 | 2299 | 2457 | 2607 | 2747 | 2882 | 3009 | 3132 | 3251 | 3365 | 3475 |
| | Revolu'n. | 50 | 57 | 64 | 70 | 76 | 81 | 86 | 91 | 95 | 99 | 104 | 107 | 111 | 115 |
| No1 56 | Horse P'r. | 10.40 | 15.82 | 22.12 | 29.06 | 36.63 | 44.75 | 53.40 | 62.54 | 72.17 | 82.20 | 92.67 | 103.60 | 114.92 | 126.59 |
| | Cubic Ft. | 2045 | 2345 | 2619 | 2870 | 3100 | 3315 | 3566 | 3717 | 3886 | 4060 | 4224 | 4385 | 4539 | 4687 |
| | Revolu'n. | 42 | 49 | 55 | 60 | 65 | 69 | 74 | 78 | 82 | 85 | 89 | 92 | 97 | 99 |
| No 56 | Horse P'r. | 13.10 | 19.77 | 27.65 | 36.32 | 45.78 | 55.93 | 66.75 | 78.17 | 90.21 | 102.75 | 115.83 | 129.50 | 143.65 | 158.23 |
| | Cubic Ft. | 2556 | 2931 | 3273 | 3587 | 3875 | 4143 | 4457 | 4646 | 4857 | 5075 | 5282 | 5481 | 5673 | 5858 |
| | Revolu'n. | 42 | 49 | 55 | 60 | 65 | 69 | 74 | 78 | 82 | 85 | 89 | 92 | 97 | 99 |

# THE FOLLOWING TABLE

Was calculated expressly for "LEFFEL'S AMERICAN DOUBLE TURBINE WATER WHEEL," and will apply to no other wheel. It contains the size of the different Wheels in inches of diameter; the number of horse-power; the cubic feet of water used per minute, and the number of revolutions per minute made by each sized Wheel for any head from 3 to 40 feet.

HEAD IN FEET.

| Diameter of wheel in inches. | Horse power, cubic ft., revolution per minute. | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6⅝ | Horse Power, | 1.97 | 2.14 | 2.32 | 2.51 | 2.70 | 2.89 | 3.09 | 3.30 | 3.51 | 3.72 | 3.93 | 4.15 |
| | Cubic Feet, | 69 | 71 | 73 | 75 | 77 | 78 | 80 | 82 | 84 | 85 | 87 | 88 |
| | Revolution, | 858 | 883 | 907 | 931 | 954 | 976 | 998 | 1019 | 1040 | 1061 | 1081 | 1101 |
| 7⅝ | Horse Power, | 2.65 | 2.89 | 3.14 | 3.39 | 3.64 | 3.91 | 4.18 | 4.45 | 4.73 | 5.02 | 5.31 | 5.61 |
| | Cubic Feet, | 93 | 96 | 98 | 101 | 103 | 106 | 108 | 111 | 113 | 115 | 117 | 119 |
| | Revolution, | 745 | 767 | 788 | 809 | 828 | 847 | 867 | 886 | 904 | 922 | 939 | 956 |
| 8¾ | Horse Power, | 3.34 | 3.64 | 3.95 | 4.26 | 4.59 | 4.93 | 5.26 | 5.60 | 5.96 | 6.23 | 6.69 | 7.06 |
| | Cubic Feet, | 117 | 121 | 124 | 127 | 130 | 133 | 136 | 139 | 142 | 144 | 148 | 150 |
| | Revolution, | 650 | 668 | 687 | 704 | 722 | 739 | 756 | 772 | 788 | 803 | 819 | 834 |
| 10 | Horse Power, | 4.52 | 4.93 | 5.34 | 5.77 | 6.21 | 6.65 | 7.12 | 7.58 | 8.06 | 8.55 | 9.05 | 9.55 |
| | Cubic Feet, | 159 | 163 | 168 | 172 | 176 | 180 | 184 | 188 | 192 | 196 | 200 | 203 |
| | Revolution, | 568 | 585 | 601 | 617 | 632 | 647 | 661 | 675 | 689 | 703 | 716 | 729 |
| 11½ | Horse Power, | 5.90 | 6.43 | 6.97 | 7.53 | 8.10 | 8.68 | 9.28 | 9.89 | 10.51 | 11.15 | 11.80 | 12.46 |
| | Cubic Feet, | 207 | 213 | 219 | 224 | 230 | 235 | 241 | 246 | 251 | 256 | 260 | 265 |
| | Revolution, | 494 | 508 | 522 | 536 | 549 | 562 | 574 | 587 | 599 | 611 | 622 | 634 |
| 13¼ | Horse Power, | 7.86 | 8.57 | 9.29 | 10.03 | 10.79 | 11.57 | 12.37 | 13.19 | 14.02 | 14.87 | 15.74 | 16.62 |
| | Cubic Feet, | 276 | 284 | 291 | 299 | 306 | 313 | 321 | 327 | 334 | 341 | 347 | 354 |
| | Revolution, | 429 | 441 | 454 | 465 | 447 | 488 | 499 | 510 | 520 | 530 | 540 | 550 |
| 15¼ | Horse Power, | 10.22 | 11.14 | 12.08 | 13.04 | 14.03 | 15.04 | 16.08 | 17.14 | 18.23 | 19.33 | 20.46 | 21.60 |
| | Cubic Feet, | 358 | 369 | 379 | 389 | 398 | 407 | 417 | 426 | 434 | 443 | 451 | 460 |
| | Revolution, | 373 | 384 | 594 | 404 | 414 | 424 | 433 | 433 | 452 | 461 | 470 | 478 |
| 17½ | Horse Power, | 13.37 | 14.56 | 15.79 | 17.06 | 18.35 | 19.67 | 21.03 | 22.42 | 23.84 | 25.28 | 26.75 | 28.25 |
| | Cubic Feet, | 469 | 482 | 495 | 508 | 521 | 533 | 545 | 557 | 568 | 579 | 590 | 602 |
| | Revolution, | 325 | 334 | 343 | 352 | 361 | 369 | 378 | 386 | 394 | 402 | 409 | 417 |
| 20 | Horse Power, | 17.69 | 19.28 | 20.90 | 22.58 | 24.29 | 26.04 | 27.83 | 29.67 | 31.54 | 33.46 | 35.41 | 37.39 |
| | Cubic Feet, | 620 | 638 | 656 | 673 | 689 | 705 | 721 | 737 | 752 | 767 | 781 | 796 |
| | Revolution, | 284 | 293 | 300 | 308 | 316 | 323 | 331 | 338 | 345 | 351 | 358 | 365 |
| 23 | Horse Power, | 23.59 | 25.70 | 27.87 | 30.10 | 32.38 | 34.72 | 37.12 | 39.56 | 42.05 | 44.61 | 47.21 | 49.85 |
| | Cubic Feet, | 827 | 851 | 874 | 897 | 919 | 940 | 962 | 982 | 1003 | 1022 | 1042 | 1061 |
| | Revolution, | 247 | 254 | 261 | 268 | 275 | 281 | 287 | 294 | 300 | 306 | 311 | 317 |
| 26⅓ | Horse Power, | 30.65 | 33.41 | 36.23 | 39.13 | 42.10 | 45.13 | 48.25 | 51.43 | 54.68 | 57.99 | 61.37 | 64.80 |
| | Cubic Feet, | 1075 | 1106 | 1136 | 1166 | 1194 | 1223 | 1250 | 1277 | 1303 | 1329 | 1354 | 1379 |
| | Revolution, | 214 | 221 | 227 | 233 | 238 | 224 | 249 | 255 | 260 | 265 | 270 | 275 |
| 30½ | Horse Power, | 40.89 | 44.55 | 48.31 | 52.17 | 56.13 | 60.18 | 64.33 | 68.58 | 72.91 | 77.32 | 81.82 | 86.40 |
| | Cubic Feet, | 1433 | 1475 | 1515 | 1554 | 1592 | 1630 | 1667 | 1703 | 1738 | 1772 | 1806 | 1838 |
| | Revolution, | 187 | 192 | 197 | 202 | 207 | 212 | 217 | 221 | 226 | 230 | 235 | 239 |
| 35 | Horse Power, | 53.86 | 58.68 | 63.64 | 68.73 | 73.94 | 79.27 | 84.75 | 90.34 | 96.04 | 101.84 | 107.78 | 113.82 |
| | Cubic Feet, | 1888 | 1943 | 1996 | 2048 | 2098 | 2147 | 2195 | 2243 | 2289 | 2334 | 2379 | 2422 |
| | Revolution, | 162 | 167 | 172 | 176 | 180 | 185 | 189 | 193 | 197 | 201 | 205 | 208 |
| 40 | Horse Power, | 70.76 | 77.10 | 83.61 | 90.34 | 97.14 | 104.15 | 111.33 | 118.69 | 126.19 | 133.82 | 141.62 | 149.54 |
| | Cubic Feet, | 2480 | 2552 | 2622 | 2690 | 2756 | 2821 | 2884 | 2947 | 3007 | 3067 | 3125 | 3182 |
| | Revolution, | 142 | 146 | 150 | 154 | 158 | 162 | 165 | 169 | 172 | 176 | 179 | 182 |
| 48 | Horse Power, | 102.21 | 111.37 | 120.77 | 130.43 | 140.32 | 150.44 | 160.83 | 171.44 | 182.27 | 193.30 | 204.56 | 216.00 |
| | Cubic Feet, | 3583 | 3687 | 3787 | 3885 | 3981 | 4075 | 4166 | 4256 | 4344 | 4430 | 4514 | 4597 |
| | Revolution, | 118 | 122 | 125 | 128 | 132 | 135 | 138 | 141 | 144 | 146 | 149 | 152 |
| 56 No. 1 | Horse Power, | 138.62 | 151.04 | 167.79 | 176.95 | 190.31 | 204.08 | 218.11 | 232.47 | 247.32 | 264.19 | 277.48 | 292.91 |
| | Cubic Feet, | 4833 | 4976 | 5110 | 5243 | 5371 | 5481 | 5691 | 5742 | 5860 | 5975 | 6090 | 6198 |
| | Revolution, | 101 | 104 | 107 | 110 | 112 | 116 | 118 | 121 | 123 | 126 | 128 | 130 |
| 56 No. 2 | Horse Power, | 173.27 | 188.80 | 209.73 | 221.18 | 237.88 | 255.10 | 272.63 | 290.58 | 309.15 | 330.23 | 346.85 | 366.15 |
| | Cubic Feet, | 6041 | 6220 | 6387 | 6553 | 6713 | 6851 | 7053 | 7185 | 7325 | 7468 | 7612 | 7749 |
| | Revolution, | 101 | 104 | 107 | 110 | 112 | 116 | 118 | 121 | 123 | 126 | 128 | 130 |

# THE FOLLOWING TABLE

Was calculated expressly for "LEFFEL'S AMERICAN DOUBLE TURBINE WATER WHEEL," and will apply to no other wheel. It contains the size of the different Wheels in inches of diameter; the number of horse-power; the cubic feet of water used per minute, and the number of revolutions per minute made by each sized Wheel for any head from 3 to 40 feet.

HEAD IN FEET.

Diameter of wheel in inches. | Horse power, cubic ft., revolution per minute.

| | | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6⅝ | Horse Power, | 4.38 | 4.61 | 4.84 | 5.08 | 5.32 | 5.56 | 5.81 | 6.06 | 6.31 | 6.57 | 6.84 | 7.09 |
| | Cubic Feet, | 90 | 39 | 93 | 59 | 96 | 97 | 99 | 100 | 102 | 103 | 104 | 106 |
| | Revolution, | 1120 | 1140 | 1158 | 1177 | 1195 | 1213 | 1231 | 1249 | 1266 | 1283 | 1299 | 1316 |
| 7⅝ | Horse Power, | 5.91 | 6.22 | 6.35 | 6.85 | 7.18 | 7.50 | 7.84 | 8.18 | 8.52 | 8.87 | 9.25 | 9.58 |
| | Cubic Feet, | 121 | 124 | 126 | 128 | 130 | 132 | 134 | 136 | 137 | 139 | 141 | 143 |
| | Revolution, | 973 | 990 | 1007 | 1024 | 1039 | 1054 | 1070 | 1085 | 1100 | 1115 | 1129 | 1143 |
| 8¾ | Horse Power, | 7.44 | 7.83 | 8.23 | 8.63 | 9.04 | 9.45 | 9.87 | 10.30 | 10.73 | 11.17 | 11.61 | 12.06 |
| | Cubic Feet, | 153 | 156 | 158 | 161 | 163 | 166 | 168 | 171 | 173 | 175 | 177 | 180 |
| | Revolution, | 848 | 863 | 877 | 891 | 905 | 919 | 932 | 945 | 598 | 971 | 984 | 996 |
| 10 | Horse Power, | 10.07 | 10.60 | 11.13 | 11.68 | 12.23 | 12.79 | 13.36 | 13.93 | 14.51 | 15.11 | 15.71 | 16.32 |
| | Cubic Feet, | 207 | 211 | 214 | 217 | 221 | 224 | 227 | 231 | 234 | 237 | 240 | 243 |
| | Revolution, | 742 | 755 | 767 | 780 | 792 | 804 | 816 | 827 | 838 | 850 | 861 | 872 |
| 11½ | Horse Power, | 13.14 | 13.82 | 14.52 | 15.23 | 15.95 | 16.68 | 17.42 | 18.17 | 18.93 | 19.71 | 20.49 | 21.28 |
| | Cubic Feet, | 270 | 275 | 279 | 284 | 288 | 292 | 297 | 301 | 305 | 309 | 313 | 317 |
| | Revolution, | 645 | 656 | 667 | 678 | 688 | 699 | 709 | 719 | 729 | 738 | 478 | 758 |
| 13¼ | Horse Power, | 17.51 | 18.43 | 19.36 | 20.31 | 21.26 | 22.24 | 23.23 | 24.23 | 25.24 | 26.28 | 27.32 | 28.37 |
| | Cubic Feet, | 360 | 366 | 372 | 378 | 384 | 390 | 396 | 401 | 407 | 412 | 417 | 423 |
| | Revolution, | 560 | 570 | 579 | 589 | 598 | 607 | 616 | 624 | 633 | 641 | 650 | 658 |
| 15¼ | Horse Power, | 22.77 | 23.96 | 25.17 | 26.40 | 27.64 | 28.91 | 30.20 | 31.50 | 32.82 | 34.16 | 35.51 | 36.89 |
| | Cubic Feet, | 468 | 476 | 484 | 492 | 499 | 507 | 514 | 521 | 528 | 536 | 543 | 550 |
| | Revolution, | 487 | 495 | 503 | 511 | 519 | 527 | 535 | 542 | 550 | 557 | 564 | 572 |
| 17½ | Horse Power, | 29.77 | 31.33 | 32.91 | 34.52 | 36.15 | 37.81 | 39.50 | 41.19 | 42.91 | 44.67 | 46.44 | 48.24 |
| | Cubic Feet, | 612 | 622 | 633 | 643 | 653 | 663 | 672 | 682 | 691 | 700 | 710 | 719 |
| | Revolution, | 424 | 431 | 439 | 446 | 453 | 459 | 466 | 473 | 479 | 486 | 492 | 498 |
| 20 | Horse Power, | 39.41 | 41.47 | 43.55 | 45.69 | 47.84 | 50.04 | 52.27 | 54.51 | 56.80 | 59.12 | 61.46 | 63.84 |
| | Cubic Feet, | 810 | 824 | 837 | 851 | 864 | 877 | 890 | 902 | 915 | 927 | 939 | 951 |
| | Revolution, | 371 | 378 | 384 | 390 | 396 | 402 | 408 | 414 | 419 | 425 | 430 | 436 |
| 23 | Horse Power, | 52.54 | 55.30 | 58.08 | 60.92 | 63.79 | 66.72 | 69.70 | 72.68 | 75.73 | 78.83 | 81.95 | 85.12 |
| | Cubic Feet, | 1079 | 1098 | 1117 | 1134 | 1152 | 1169 | 1186 | 1203 | 1220 | 1236 | 1252 | 1268 |
| | Revolution, | 323 | 328 | 334 | 339 | 344 | 350 | 355 | 360 | 365 | 368 | 374 | 379 |
| 26½ | Horse Power, | 68.30 | 71.89 | 75.50 | 79.19 | 82.93 | 86.76 | 90.61 | 94.49 | 98.45 | 102.47 | 106.53 | 110.66 |
| | Cubic Feet, | 1403 | 1428 | 1451 | 1475 | 1497 | 1520 | 1542 | 1564 | 1585 | 1607 | 1628 | 1648 |
| | Revolution, | 280 | 285 | 290 | 294 | 299 | 303 | 308 | 312 | 316 | 321 | 325 | 329 |
| 30½ | Horse Power, | 91.07 | 95.85 | 100.69 | 105.58 | 110.57 | 115.65 | 120.81 | 125.98 | 131.26 | 136.63 | 142.04 | 147.53 |
| | Cubic Feet, | 1871 | 1904 | 1935 | 1966 | 1996 | 2027 | 2057 | 2085 | 2114 | 2142 | 2170 | 2198 |
| | Revolution, | 243 | 248 | 252 | 256 | 260 | 264 | 268 | 271 | 275 | 279 | 282 | 286 |
| 35 | Horse Power, | 119.97 | 126.26 | 132.60 | 139.09 | 145.65 | 152.34 | 159.14 | 165.96 | 172.91 | 179.99 | 187.11 | 194.36 |
| | Cubic Feet. | 2465 | 2508 | 2549 | 2590 | 2630 | 2670 | 2709 | 2747 | 2785 | 2822 | 2859 | 2895 |
| | Revolution, | 212 | 216 | 219 | 223 | 226 | 230 | 233 | 236 | 240 | 243 | 246 | 249 |
| 40 | Horse Power, | 157.62 | 165.89 | 174.23 | 182.75 | 191.37 | 200.16 | 209.09 | 218.05 | 227.18 | 236.48 | 245.83 | 255.37 |
| | Cubic Feet, | 3238 | 3295 | 3349 | 3403 | 3455 | 3508 | 3560 | 3609 | 3658 | 3708 | 3756 | 3804 |
| | Revolution, | 186 | 189 | 292 | 195 | 198 | 201 | 204 | 207 | 210 | 212 | 215 | 218 |
| 48 | Horse Power, | 227.67 | 239.62 | 251.66 | 263.97 | 276.42 | 289.14 | 302.02 | 314.95 | 328.15 | 341.58 | 355.11 | 368.87 |
| | Cubic Feet, | 4678 | 4759 | 4837 | 4915 | 4991 | 5067 | 5142 | 5213 | 5286 | 5356 | 5425 | 5495 |
| | Revolution, | 155 | 157 | 160 | 162 | 165 | 167 | 170 | 172 | 175 | 177 | 179 | 182 |
| No. 1 56 | Horse Power, | 308.81 | 325.04 | 342.32 | 352.04 | 375.31 | 392.20 | 410.23 | 430.32 | 440.52 | 464.21 | 489.85 | 503.75 |
| | Cubic Feet, | 6310 | 6420 | 6526 | 6667 | 6838 | 6879 | 6985 | 7055 | 7161 | 7260 | 7375 | 7394 |
| | Revolution | 132 | 132 | 132 | 139 | 142 | 144 | 147 | 149 | 150 | 153 | 155 | 157 |
| No. 2 56 | Horse Power, | 386.01 | 406.30 | 427.90 | 440.05 | 469.16 | 490.25 | 512.73 | 537.90 | 550.65 | 580.26 | 612.31 | 629.68 |
| | Cubic Feet, | 7887 | 8025 | 8157 | 8330 | 8412 | 8593 | 8731 | 8818 | 8951 | 9075 | 9193 | 9230 |
| | Revolution, | 132 | 135 | 137 | 139 | 142 | 144 | 147 | 149 | 150 | 153 | 155 | 157 |

## Price List.

The first six sizes, from $6\frac{5}{8}$ inches up to $15\frac{1}{4}$ inches, are made of polished brass, and on that account the price is higher in proportion to the other sizes, as it greatly increases the cost of manufacture.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $6\frac{5}{8}$ | inch | wheel | vents | $4\frac{2}{10}$ | square inches of | water. | Price $400. |
| $7\frac{5}{8}$ | " | " | " | $6\frac{1}{2}$ | " | " | " " $400. |
| $8\frac{3}{4}$ | " | " | " | $8\frac{3}{5}$ | " | " | " " $400. |
| 10 | " | " | " | $11\frac{1}{4}$ | " | " | " " $400. |
| $11\frac{1}{2}$ | " | " | " | $14\frac{2}{3}$ | " | " | " " $475. |
| $13\frac{1}{2}$ | " | " | " | $19\frac{3}{4}$ | " | " | " " $525. |
| $15\frac{1}{4}$ | " | " | " | $26\frac{1}{6}$ | " | " | " " $600. |
| $17\frac{1}{8}$ | " | " | " | $34\frac{1}{2}$ | " | " | " " $700. |
| 20 | " | " | " | 45 | " | " | " " $850. |
| 23 | " | " | " | $59\frac{1}{2}$ | " | " | " " $1000. |
| $26\frac{1}{2}$ | " | " | " | 79 | " | " | " " $1100. |
| $30\frac{1}{2}$ | " | " | " | $104\frac{3}{5}$ | " | " | " " $1250. |
| 35 | " | " | " | $137\frac{1}{5}$ | " | " | " " $1550. |
| 40 | " | " | " | 180 | " | " | " " $1800. |
| 48 | " | " | " | $259\frac{1}{5}$ | " | " | " " $2000. |
| 56 | "No.1" | " | | $352\frac{3}{4}$ | " | " | " " $2800. |
| 56 | "No.2" | " | | 441 | " | " | " " $3000. |

## Measurement of Water.

When a man has concluded to improve a water power, the first thing he should ascertain is the amount of fall he can secure. The next and most important thing is to determine accurately the quantity of water that flows in a stream, as upon this will depend the amount of power, and consequently the amount of work the stream is capable of performing. And as the improvement of water power is necessarily attended with expense, it is therefore important to one who contemplates building a mill or factory, that he should know exactly what amount of work he can depend upon the stream performing; and for the want of an accurate knowledge, or from erroneous supposition of the quantity of water in the stream, which is too often obtained by a mere superficial examination of the stream, parties frequently construct mills and factories of a magnitude which, upon trial, they find the power of the stream wholly inadequate to carry. This being the case, it is important to get some one well versed in hydraulics to measure the capacity of the stream. As this cannot always be done, we will here give a few plain rules, by the aid of which any one can determine approximately the quantity of water in the stream:

To measure the stream, go to some place where the water runs with a brisk and uniform current, and where the stream is of a uniform

width and depth. Find how many feet the water will flow in the stream per minute by putting a float in the surface of the water. Then measure the depth and width of the stream, and multiply the area of the cross section of the stream in feet by the velocity of the water in feet per minute. This will give the number of cubic feet of water flowing in the stream per minute, or very nearly.

## Special Notice.

We frequently receive letters from our correspondents, saying that they have a certain number of "surface inches" of water in the stream or so many "cubic inches," and like statements. Now we wish to say that from this we cannot determine the quantity of water in the stream, as it affords no idea of the size of the stream. We would therefore caution persons in writing to us concerning the size of their stream to let us know how wide the stream is, how deep, and how fast the water runs in the stream; or if another wheel has been used in the stream, to let us know how many square inches of water the wheel used, and depth of water above the orifice; or take a board and cut a notch in it, and place it as a dam across the stream, and make all the water *spill* through the notch, then let us know how *wide* the notch is, and how *deep* the water pours through it. Or if there is a waste way about the dam or race, let us know how wide it is, and how deep the water pours over it. By any of these means we can calculate definitely the quantity of water in the stream, and by so doing will save much time and correspondence.

### How a Ten Inch Wheel, with ¼ gate, works against an Overshot.

NORTHAMPTON, Mass., Jan. 1st, 1867.

Leffel & Co.: Your agent, Mr. Loud, put one of your ten inch wheels into our Silk Mill in place of an Overshot. We find your wheel superior to the Overshot, both on account of the water used, economy of space, and steadiness of power, and are able to drive *one-third more machinery* than we formerly did. Our stream is small, and we use only one-fourth gate—say three square inches under nineteen feet head and fall. We consider it a perfect success.

Truly yours, J. & J. F. WARNER.

### Astonishing amount of work for a 17½ inch Wheel.

LEE, Mass., Jan. 29th, 1866.

To whom it may concern: I have lately put in operation, in one of my paper mills, a Leffel's American Double Turbine Water Wheel. This wheel is 17½ inches in diameter, set under a 44 feet head, and drives 4 rag engines and one rag duster. It has ample power to drive all that is attached to it, and I can cheerfully recommend it as being the best iron wheel that I have used, having had several different kinds.

PRENTISS C. BAIRD.

### Wheel in a Circular Saw Mill.

MECHANICSBURG, Ohio, January 17th, 1867.

Messrs. James Leffel & Co.: Your favor of the 12th instant has been at hand some days. It has been very cold ever since we put in our wheel, and we have not been able to give a full day's trial, but are satisfied that the wheel will give power enough to cut five thousand feet of oak lumber per day. Our fall is seventeen feet, our wheel 26½ inches. The only trial made was on a log sawed just after we put in the wheel. It was peeled black oak, 12 feet long, partially dry. This we cut into inch boards, squared up, making 176 feet in 19 minutes, or about 550 feet per hour. The wheel gives all the power we want, and its quick response when the gates are opened, its rapid and steady motion, are the admiration of all who see it. We intend to replace the Overshot in our Flour Mill with one of your wheels as soon as we can, for we believe we can do a great deal more work with the same water, and will never more be troubled with freezing up, however cold it may be.

I should have stated in the beginning that our saw mill is an old circular mill that has been run by steam some ten years; that the saw we now have gives no fair test of the wheel's capacity. For running circular saw mills, I think your wheels are the *ne plus ultra*. They start as quick as a steam engine, and when nearly through a log water may be shut off, and the motion will carry the saw through and gig back the log. Our mills are situated on a small stream, and we were fearful that we would not be able to run a 26 inch wheel, but the result has exceeded our highest anticipations.

I have examined the table calculated for your wheels, and I believe it to be perfectly correct as to the amount of water consumed.

Yours truly, A. STALEY & SON.

### Surprised that the Wheel requires so small a quantity of Water.

COLUMBUS, GA., Jan. 4th, 1867.

Messrs. James Leffel & Co.: After an experience of fifteen years with the "Riche Wheels," which gave an abundance of power, I was very unwilling to make a change; but having obtained one of your circulars giving a description of the "Double Turbine Water Wheel," and it having become necessary to make repairs, the position of your wheel in the flume, giving at all times ready access to the wheels, induced me to order three of the 40 inch wheels. On trial I was surprised to find that the wheels required so small a quantity of water, and to each of the wheels, with the gates half open, I am running, under a 14 feet head, two 4 feet burrs, with all the machinery attached. The power and steadiness of the wheels are wonderful, and the advantage of the position of the wheel is great.

Yours truly, R. L. MOTT, Proprietor of Palace Mills.

LOCKLAND, Ohio, April 30th, 1866.

Messrs James Leffel & Co.: Gents—Find inclosed check for the amount of your Wheel, $500. We have been running it for 30 days in place of Stout, Mills & Temple Wheel, which we run for better than one year, gearing in the same manner as the Stout, Mills & Temple Wheel, and we can say that we are doing 20 per cent. more work than we did before with the

other wheel. We are entirely satisfied with your Wheel so far, and take pleasure in recommending it to any one as the best wheel we have used, feeling confident that we can make 100 bbls. now, where, as before, we could not make more than 80 bbls. We find the wheel not near so liable to clog as the Dayton Wheel, never having found any thing to obstruct the wheel as yet. BACHELOR & PALMER.

We would call the attention of those who have any doubt of the superiority of our Wheel over the Stout Wheel to the above certificate, particularly from the fact of the two wheels having been tried under exactly the same conditions and circumstances—as all who are versed in hydraulics know that, unless the Wheels are tried under precisely the same circumstances, there can be no satisfactory results obtained. In the mills above mentioned, the Dayton Wheel, (through the exertions of the proprietors,) was put in the best possible condition: such as we were, in fact, well pleased with, as our Wheel was put in exactly the same place, and geared in the same manner and running the same machinery. The Stout Wheel was 42 inches in diameter, venting, according to their tables, 156 inches of water. Our Wheel, which took the place of the above Wheel, is only 35 inches in diameter and venting only 137 inches of water. It will be observed that the Leffel Wheel is doing one-fourth more work than the Dayton Wheel.

JAMES LEFFEL & CO.

KNIGHTSTOWN, Indiana, November 6th, 1865.

Messrs. James Leffel & Co.: Gentlemen: About September, 1864, I purchased of Messrs. Stout, Mills & Temple, one of their Turbine Water Wheels, with the understanding that it was the best wheel in use, and a guarantee that it would grind an average of fifteen bushels per hour: and before putting it in I saw Mr. Leffel, who told me if I would put in one of his Double Turbine Water Wheels, and it did not beat the Stout Wheel ten per cent. he would give me the wheel for nothing. I took the wheel under those conditions. In using the same amount of water under a six foot head, I find I can grind at the very least one bushel more per hour with the Springfield wheel and at the same time drive all the machinery of the mill, which I consider is one-fourth more power than Stout, Mills & Temple's Wheel gives with the same amount of water used.

I now have been using the two wheels, side by side, for the last twelve months. I grind about 11 bushels per hour with the Stout wheel, and 12 bushels per hour with the Springfield wheel, beside driving the machinery of the whole mill. From a practical experience of twelve months, I have no hesitancy in recommending the Leffel Double Turbine Water Wheel as being the best wheel of the two in point of power according to amount of water used, or the best wheel I know of; and the fact is, if I could not get another one of your wheels I would not take three times the cost of it and run the risk of getting a wheel which would be its equal.

Yours truly, J. A. CHURCH.

INDIANAPOLIS, Ind., March 1st, 1866.

Messrs. James Leffel & Co.: Gents: We have now been running the 40 inch wheel we got of you for 3 years, aud we are free to say that it does

more than we expected or you promised. Our fall is 15 feet, and the wheel gives ample power to run 3 four feet burrs strong, and all the machinery of the mill at the same time, and we can easily, and have repeatedly, ground 1,200 barrels of flour a week. We have not had the least difficulty with your wheel since we put it in. As compared with the Stout wheel, we have certainly the best means of judging, having seen them tried side by side for over two year in N. Sohl & Co.'s mills, that are situated the next door to our mill, and we are fully satisfied of the great superiority of your wheel over the Stout & Co. wheel. In fact, there is no comparison between the two wheels. In conclusion, we know your wheel to be the best we have seen or used, having used almost every kind of wheel, including the overshot. We would heartily recommend the Double Turbine to all who want a steady and economical wheel.

JAMES SKILLEN & BRO.

INDIANAPOLIS, March 18th, 1866.

James Leffel & Co.: Gents: We have now been running two of your Double Turbines over two years in our paper mills, in this city, almost constantly, night and day. With one 35 inch wheel under 15 feet fall we run three 400 lb. engines, with gates only two-thirds open, and cutter and pump at the same time; and with full gates we are confident that it would run four 400 lb. engines with cutter and pump.

The 20 inch wheel, under 15 feet fall, will run a 62 inch machine 65 feet per minute, with gates only half open. In fact, having seen a great number of your wheels in this city, used for various purposes, and in competition with others, including the Stout wheel, we think them far better than any other. We are fully and entirely satisfied with the wheels, and they perform more than we expected.

We would most heartily recommend them to others who may want wheels, as we know they will be satisfied if they will ever try them.

GAY & BRADEN,
By A. Gay, agent for the Canal Co.

INDIANAPOLIS, Indiana, November 16th, 1865.

Messrs James Leffel & Co.: Dear Sirs: Three years since, after a pretty thorough examination of the merits of a number of the most approved water wheels, we put into our Paper Mill one of your 48 inch wheels, and must say its thorough working has fully demonstrated the wisdom of the selection, and to-day we could not be induced to change it for any other within our knowledge.

Its power is ample, with 13 feet fall, water not gauged, to drive four 36 inch rag engines, rag cutter, rotary boiler, three pumps, &c.

It is not liable to freeze, is not effected by back water only in proportion as the fall is lessened, and for durability we see no evidence of its failing. We say, as an evidence of its popularity in this locality, that since ours, there have been ten others of yours put in by the Mills of this city, and but one "Stout, Mills & Temple's."

Yours, truly, J. McLENE & CO.

**increased his Power One-third.**

LEE, Mass., January 4th, 1867.

Messrs. James Leffel & Co.: In September, 1865, your agent, Mr. E. D. Jones, of this place, came to me and offered to put me in one of your 35 inch American Double Turbine Water Wheels, with the understanding that if it did not drive three Rag Engines with the same amount of water that it took to drive two engines with my 36 inch Tyler Wheel, which I was using, (and it was a new one,) I was not to pay for the wheel.

Under the above consideration I gave my consent to have your wheel put in, and also put in a third engine. I am now free to say that your wheel, with gates ⅝ drawn, is doing all your agent recommended it to do, and is now driving my three engines stronger with the same amount of water that it took to drive two engines with the Tyler Wheel with full gate. In point of steadiness as well as power, I consider it far superior to the Tyler Wheel or any other iron wheel that I ever saw. I have also put in one of your 17½ inch wheels to drive my machine, (it took the place of an Overshot Wheel,) and is doing its work nobly. For variable streams your wheel cannot be beaten by any wheel, for with gates partially closed I am satisfied it will give as good per centum of power as with full gates, and will cheerfully recommend it to any that are in want of a first class wheel.

Yours, truly, JOHN BOTTOMLY.

**Durable, Steady and Economical.**

EAU CLAIR Co., Wis., January 23d, 1867.

The 30½ inch Double Turbine Water Wheel which we purchased from you, we have been running in our mill under 12 to 13 ft. head, for about four months; I am happy to say it works to our entire satisfaction in every respect. It drives one run of 3½ ft. burrs, our separator, smutter, elevators, cooler and conveyor, and grinds 12 to 15 bushels of wheat per hour, with ⅔ gate hoisted. We don't hesitate in recommending the Leffel Double Turbine Water Wheel to be the most durable, steady running and economical wheel now in use.

Very respectfully yours,

JOHN F. STONE & SON.

**Opinion of a Practical Miller.**

LEON, WIS., January 17th, 1867.

I most cheerfully comply with your request in making a statement showing the result of my experience with the use of the Leffel Water Wheel. I will freely give you the facts. I have been using in my flouring mill one of Leffel's 40 inch wheels, drawing 180 inches of water, under 9 ft. head, since early last Spring. The first three months we could grind on an average 15 bushels wheat per hour with ⅝ of the gate open, or 20 bushels with a full gate, and run ½ chest of bolts, smutter, separator, storing elevator, and cooler. I was so well pleased with the first wheel that I have bought and put in another 35 inch wheel, drawing 137 inches water, in my mill, to run a pair of 4 feet new stock burrs. The wheel is now in fine working order, and gives entire satisfaction—grinding from 15 to 20 bushels per hour, de-

pending on what kind of wheat we are grinding. These three wheels that Mr. Mather and I are using in the paper mill are giving entire satisfaction. Judging from my own experience and knowledge of water wheels, the Leffel wheel will do at least one-third more work than any other wheel in use any where in this section of country, with the same head, and using no more water.

Yours with great respect,

WM. J. AUSTIN.

**Convinced of the Superiority of the Leffel Wheel.**

PLYMOUTH, Wis., January 21st, 1866.

After having been to considerable expense, and time spent in traveling, in order to satisfy ourselves as to the merits of the Leffel Water Wheel, represented in the north-western States by your firm, we were so far convinced of the superiority of these wheels, that we ordered three of the wheels of you in June last. We have had these wheels in operation in our flouring mills for four months, and are happy to inform you that they come up to expectations. We are using two wheels (35 inch diameter), each driving a run of stones, under a head of about 10 feet. We have, with this head, ground as high as 24 bushels winter wheat and 20 bushels spring wheat per hour. We run all the machinery of the mill, elevators, conveyors, smut machine and separators, in fact everything, except the stones, with a 26½ inch wheel, which gives us plenty of power with the gates two-thirds closed.

During the last seventeen years we have used four different descriptions of water wheels in our mills, and have no hesitation in saying that the Leffel wheel is from 15 to 20 per cent. better than either of the wheels formerly used.

HOTCHKISS & PUHLMAN.

**Saves him from buying an Engine.**

PEACHAM, VT., June 28th, 1866.

Messrs Jas. Leffel & Co.: Gentlemen: The 33 inch wheel you sent us, through Mr. Horton, has arrived, and we have got it in operation. It fully comes up to all expectation, and will save us the necessity of buying an engine.

The 26½ in. wheel you sent May 21st has not arrived yet; when it comes the pay will be forthcoming.

Very respectfully yours,

E. F. EMERSON.

**It more than meets our expectations.**

MANITOWOC, January 24th, 1867.

We, the undersigned, have in our use at our Mills in the town of Cato, one of Leffel's Double Turbine Water Wheels. To say that we are pleased with it would express but little of the satisfaction we feel. It more than meets our expectations, and does all that the manufacturers claim for it.

It gives double power; is small in size; no leakage; cannot be frozen up and will run with a very low head of water.

LYON & CO.

**Forty Inch Circular Saw driven by a Ten Inch Wheel.**

MOUNTAIN SPRING, near Portland, Oregon, July 25th, 1865.

Gentlemen: I take pleasure in making the following statement in reference to your wheel. I have been using for the last five months one of Leffel's American Double Turbine Water Wheels, of ten inches in diameter, driving a forty inch circular saw, under a twenty-nine feet head of water. With this little wheel, we have usually cut 1,600 feet of lumber per day, without rushing things; and one day we cut 2,500 feet. I am perfectly satisfied with the wheel, and believe it accomplishes more than you claim for it, and am perfectly convinced that it does not use more water than your circular represents. I therefore cordially recommend the wheel to all wanting cheap, economical and efficient power. H. KELLY.

INDIANAPOLIS, October 4, 1864.

Messrs. James Leffel & Co.: We, the undersigned, are millers in the employ of N. Sohl & Co., and have had a good opportunity to know all the facts in regard to the test of wheels claimed to have been made by Messrs. Stout, Mills & Temple, as one or both of us were present when the wheels were started, and during all the time since, and we know that no measurement of the amount of water used by either wheel has been taken, and from what we have seen of the working of the two wheels, consider the Leffel Double Turbine to be decidedly the best wheel—as under the low head your wheel, with gates one-half drawn, uses no more water than the Stout wheel with full gates, to do the same amount of work, and is not so liable to be clogged up.

ALFRED J. SOHL,
Junior partner of N. Sohl & Co., and Head Miller.
JOHN SMITH, Miller.

E. Smith & Son, of Dayton, Ohio, are using one of our Wheels in their Mills on the Canal, seven miles above Dayton, by the side of one of Stout & Co.'s wheels, and give our wheel the most decided preference as the best and most economical, and authorize us to refer any parties to them for a corroboration of their statements. Below is the opinion of their Millers:

Messrs James Leffel & Co.: We are running your wheel right along, and have no trouble with it. The Stout & Co. wheel clogs up frequently, and we have to stop and clear it out. I think we can do twice the work with your wheel that we can with the Stout & Co. wheel, using the same water. I can safely say that your wheel will grind ten bushel with the water it takes to grind six bushels on their wheel.

FREDERICK BENJAMIN.

This is to certify that I have been in the employ of E. Smith & Son, in their Mills near Dayton, for eight months after the Leffel Double Turbine Wheel was put in there, and that I heartily concur with the above statement of the comparative merits of the two wheels. Also, that during this time Stout, Mills & Co. made a change in their wheels and gearing to enable them to compete with the Leffel Wheel, but without success.

D. GUTSHALL.

## The Construction and Finish of our Wheel.

We make the manufacture of our wheel a specialty—our works, and particularly our machinery, being specially designed for that purpose, and all other work done being merely incidental to it. Most of the Turbine wheel manufacturers carry on a large machinery business—the manufacture of water wheels being merely an incident in their business, to which is is utterly impossible for them to pay the attention necessary to the construction and finish of water wheels, and their adaptation as a hydraulic motor.

We pay special attention to the construction and finish of our wheel. The guides or gates, buckets, &c., are ground smooth. Every part of the wheel and casing over which the water flows is turned to a smooth surface, so that the water flows through the wheel with as little friction as possible; and all wheels under fifteen inches are made of brass, polished to a smooth, even surface. Our wheels are put together in the most accurate and substantial manner, by thorough machinists, and not thrown together as a great many cheap and worthless wheels are. It has been our constant endeavor to make a first class wheel in point of finish and workmanship. Our patterns were built by James Leffel, the patentee, who, knowing how much damage is sometimes done by the little inaccuracies and want of correct proportions in a wheel, devoted a great deal of time and attention to their perfect accuracy; and in order to secure this beyond a doubt, he personally superintended the purchase of the machinery for the works, and its adaptation to the wheel, and drilled the machinists so that they should build a wheel according to his idea of what a wheel should be. Thomas Leffel, a brother of the inventor, who has always been associated with him in his business, devotes his whole time and attention in our works, toward carrying out the ideas of his brother in regard to the construction of the wheel.

## Percentage.

The ordinary method of determining the ratio of useful effect produced by a wheel from a certain quantity of water is by means of a friction brake, or by raising weights where the quantity of water and the hight through which it falls—or, in other words, the amount of head and fall employed—is carefully compared with the amount of resistance overcome. Thus, what is called the percentage of power is accurately obtained. Now, while in a scientific sense to ascertain the percentage of a wheel is of some value, and to which formerly much mportance was attached, it has become a well established fact, from the many careful tests made by individuals and corporations, that the co-efficient of useful effect thus determined cannot be held as a measure of the efficiency of a wheel, or taken as any assurance that the same

comparative results will be obtained, when applied to the various purposes of manufacture. Before this fact was fully established, it was a matter of much astonishment, not only to manufacturers, but to the builders of wheels themselves, to find a great disparity existing between the results obtained in an experimental test and the results produced when practically applied to propel machinery. So great has been this difference that many wheels which, from the high per cent. obtained by test trials, gave flattering promise of a successful and economical wheel, when required to overcome the ever-changing resistance of machinery, have totally failed to meet the requirements of an economical wheel.—So frequently have these failures occurred, that it forms one of the great obstacles in the way of introducing a really valuable and successful wheel; and it is an ordinary thing for shrewd and careful manufacturers to say, "We know beautiful results can be obtained before test committees, but what will your wheel do in my mill?"

The repeated failures of wheels whose value has been determined alone by their percentage, has thus caused manufacturers (and justly too) to demand more substantial proof of the practical results of a wheel, in which alone they are concerned.

The different results we have mentioned arise from several causes: 1st. In an experimental, the conditions are all favorable; the wheel being held to a calculated speed, at which the discharge of water is least, and the work performed the greatest, while any fluctuations above or below are attended with a serious reduction of power, and frequently an increased discharge of water, and then again the quantity of water used is constant and such as will give the best results. It will be seen at a glance, that these conditions are exactly the opposite of what a wheel in practical operation will be placed under, as every manufacturer knows a fluctuating motion and the use of a variable quantity of water is unavoidable.

Now, while we have obtained the very highest ratio of useful effect, we wish to be understood we do not base our claims on this alone, but it is from the evidence furnished by hundreds of wheels operating under high and low falls, and for every purpose, and under all conditions, that for steady running under a variable motion and with a variable quantity of water, without perceptible decrease in economical results, we triumphantly claim to have no equal.

### Step or Pivot.

Our wheel is so arranged mechanically that the head and fall of water produces no weight whatever upon the step or pivot—the action of the water tending rather to lift the wheel, thus preventing to a great degree the wearing down of the step and also the waste of power from friction, We have wheels running now that were put in when the wheel was

first invented—running on the same steps as when first put in. If in the course of years the step should wear down, it is only a matter of a half hour to take the bridgetree out and put in a new step.

### Mill Gearing.

As one of the advantages which the rapid motion of our wheel, (arising from its small size and diminished friction,) gives over other wheels is in the use of light gearing; and as the power of our wheel, and especially the smaller sizes, has sometimes been much diminished by the heavy, clumsy gearing of the overshot being used, we have at great expense made a set of patterns of mill gearing, light and with well shaped cogs, especially adapted to the rapid motion of our wheel; and we ask the purchaser of our wheel, to let us furnish, if possible, those pieces by which the main power is taken from the wheel.

### The Leffel Wheel.

Among the vast amount of evidence we have of the superiority of the Double Turbine, we cannot refrain from calling attention to the continual reference made by other wheel builders, to the "Leffel Wheel," either for the purpose of elevating their own by detracting from the merits of ours, or as a standard of comparison, all of which shows an ill disguised fear and virtual indirect acknowledgement of the superior merits of the Leffel Wheel.

It has now become an ordinary practice among wheel builders, in enumerating the points of excellence in their wheel, to particularly impress the fact "That their wheel is at least equal in point of economy to the Leffel Wheel."

In fact, the Double Turbine has almost superceded the Overshot as a standard by which to determine the comparative merits of wheels, and it is thought by other wheel builders to be quite as significant now to say that their wheel equals the *Leffel Wheel*, as it was formerly to say that it equaled the overshot.

Now, while we know all such claims to be unfounded, we cannot but thank them for thus affording additional proof of the truth of the claim we make of having the best wheel in the world.

### 66 Inch Wheel.

We are getting up patterns for a 66 inch wheel, which will issue about 700 square inches of water. Parties needing wheels of that power will please write us and we will furnish the desired information.

### Wheels Leave the Works Complete.

Our wheels are completely finished before leaving the works, so that parties in putting the wheel in have nothing to do but cut a hole in floor of flume the size of the cylinder of wheel, and set it in, coupling

the upper shaft to the wheel shaft by coupling furnished with the wheel free of cost.

**Parties ordering Wheels, will please observe the following:**

State which way you want your wheel to run, with the sun or against the sun; or right hand wheel or left hand wheel, as we make them to run either way, according to order—and write your shipping directions in a clear manner.

Parties wishing any further information concerning the wheel, not contained in this pamphlet, or have any peculiar location to which they wish to adapt the wheel, will please write us, and we will take great pleasure in answering any letters.

In writing to us we wish parties to state plainly their post office address, and particularly to name the State, as we receive letters almost daily in which the name of the State is omitted, and which necessarily receive no answer.

## Special Notice.

James Leffel's American Double Turbine Wheel is manufactured at five different places in the United States. The shop from which this circular is sent, is located at Portland, Oregon, and is not connected with any other.

A. Myers, a son-in-law of the inventor, having bought the exclusive right, under the patent, to the Pacific Coast, comprising the States of Oregon, California and Nevada, and the Territories of Idaho and Arizona and part of Montana, and having operated under the firm name of Leffel & Myers, is now manufacturing the wheel at the Oregon Iron Works, Portland, Oregon; from whom, or his authorized agents, all the wheels used, in this territory, must be secured.

## Warranty.

Our wheels are warranted to work to entire satisfaction, when they are put up in perfect accordance with our instructions in this pamphlet; when speeded under the head, according to the number of revolutions designated in the tables; and using the quantity of water described. When thus put up, if they do not perform to the entire satisfaction of the purchaser, they may be returned within six months, we paying the freight, and money refunded. *Any variation from our directions vitiates the guarantee in every particular.* This clause is inserted in order to secure correct principles in putting up the wheel. There are many Millwrights on this coast who think they know everything about wheels, and know nothing at all, and will use their own stupid ideas. Thus we are compelled to secure the reputation of our wheel from their vicious designs.

## Infringements.

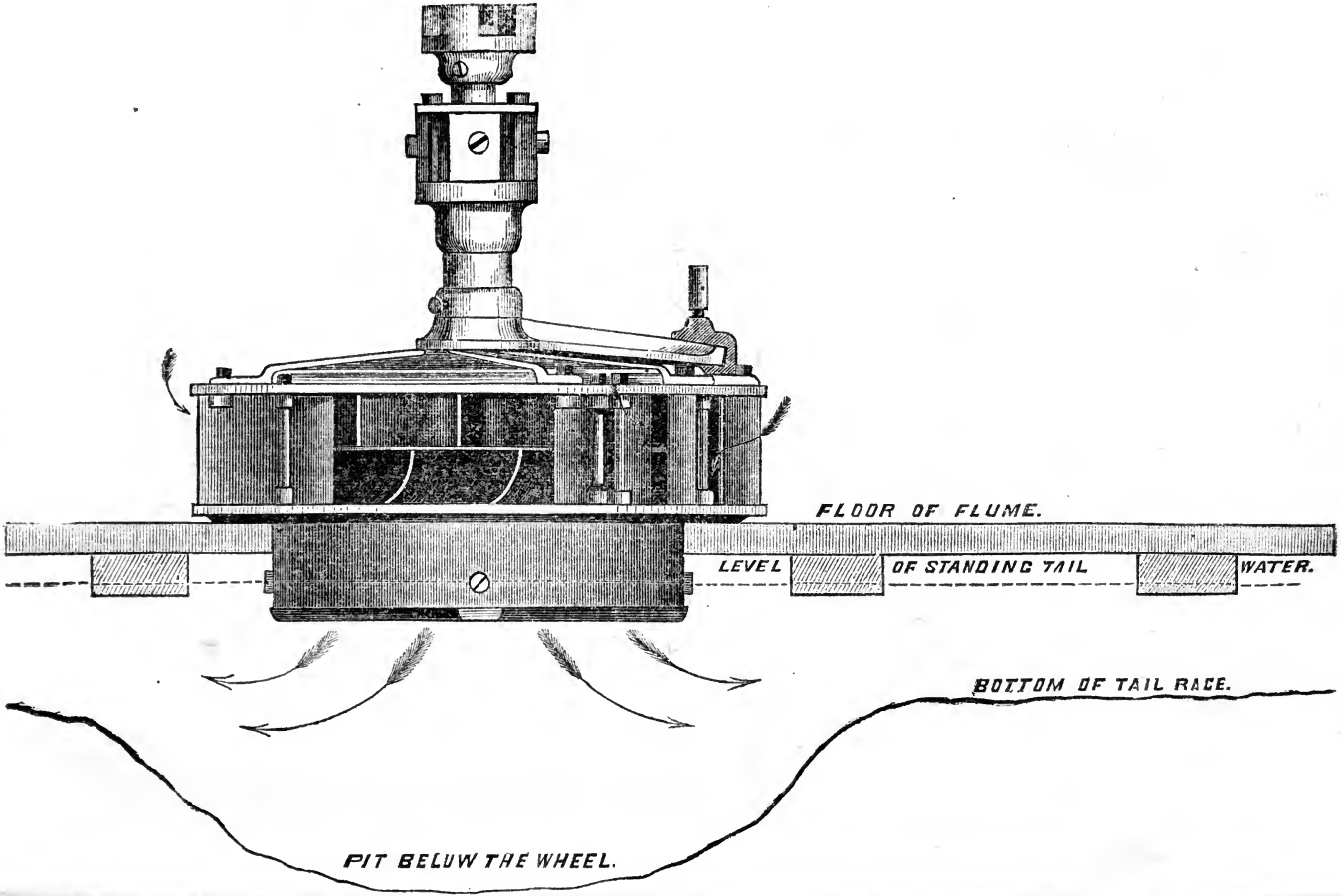
JAMES LEFFEL, of Springfield, Ohio, is the original inventor and patentee of James Leffel's American Double Turbine Water Wheel, and he has secured and protected his invention by letters patent dated January 14, 1862. and which patent was surrendered and re-issued October 11, 1864, more fully protecting his patent by eleven distinct claims, fully covering and protecting every part of his invention.

This celebrated wheel has become so widely known, and its superior merits approved, that parties are modeling after it, and in many cases infringing on the patent. To all such we hereby notify and declare that said patent will be protected from all infringements; and we hereby caution any one buying a wheel infringing in the least on the American Double Turbine, that they will be proceeded against and damages collected from them.

JAMES LEFFEL & CO.

## Directions for putting in the Wheel.

The following cut shows the manner of placing the wheel in the flume or penstock. Through the heavy planking of the floor of the flume there is a hole cut of sufficient size to let the cylinder of wheel casing pass through, the flange of wheel casing resting upon and sustained by the floor, as shown. But that which is of the greatest importance, and which we particularly desire those who have the care of putting wheels in to carefully observe, is the depth of pit below the end of cylinder of casing. This pit should not be less than 2 feet deep, and from that to 3 feet deep, according to size of wheel. It will be observed that in the cut the pit is shown as being excavated below the ordinary level or bottom of the tail race. This plan will answer in a majority of cases; but where the earth is liable to wash away, which would affect the foundation of the flume, a box or curb 2 or 3 feet deep, and of sufficient diameter, can be placed below the end of cylinder of wheel casing. The object in having this pit below the wheel is to secure a free discharge of water from the wheel; and unless it is so arranged, it will *certainly seriously affect* the operation of the wheel. There should also be sufficient space under the flume to let the water pass out freely. The next point to be observed is, that the end of the cylinder, or end of draft tube, if one is used, should dip from 2 to 3 inches below the surface of the water in the tail race when standing, as shown by the dotted line in the cut. The flume should also be of sufficient size to admit the water to the wheel without obstruction, and the side of the flume should in no place come nearer than one foot to the wheel casing, and from 20 inches to 2 feet for large wheels.


FLOOR OF FLUME.
LEVEL OF STANDING TAIL WATER.
BOTTOM OF TAIL RACE.
PIT BELOW THE WHEEL.

The following Table of Dimensions will be of service to those preparing to put in Wheel, before it arrives.

| Size of Wheel. | Diameter of Cylinder passing thro' floor of flume. | Length of Cylinder passing thro' floor of flume. | Length of Shaft from flange resting on floor of flume to center of coupling. | Diameter of bore in upper half of coupling. | Diameter of entire Casing. | Weight of Wheel, complete. |
|---|---|---|---|---|---|---|
| 56 in. wh. No. 1 | 5 feet $\frac{1}{2}$ in. | $12\frac{1}{2}$ inches. | 5 feet 7 in. | $5\frac{7}{8}$ inches. | 6 feet $8\frac{1}{2}$ in. | 7178 pounds. |
| 56 " " " 2 | 5 " $\frac{1}{2}$ " | $12\frac{1}{2}$ " | 5 " 8 " | $5\frac{7}{8}$ " | 6 " $8\frac{1}{2}$ " | 7264 " |
| 48 " " | 4 " $2\frac{1}{4}$ " | 11 " | 4 " $9\frac{1}{4}$ " | $5\frac{3}{8}$ " | 5 " 7 " | 4676 " |
| 40 " " | 3 " $6\frac{1}{4}$ " | $9\frac{1}{8}$ " | 3 " $10\frac{1}{4}$ " | $4\frac{1}{2}$ " | 4 " $8\frac{1}{2}$ " | 3214 " |
| 35 " " | 3 " $1\frac{1}{4}$ " | $7\frac{5}{8}$ " | 3 " $8\frac{3}{8}$ " | $4\frac{1}{2}$ " | 4 " 2 " | 2378 " |
| $30\frac{1}{2}$ " " | 2 " $8\frac{1}{4}$ " | 7 " | 3 " $2\frac{1}{2}$ " | $3\frac{1}{2}$ " | 3 " $7\frac{1}{2}$ " | 1500 " |
| $26\frac{1}{2}$ " " | 2 " $4\frac{1}{2}$ " | 7 " | 3 " $1\frac{1}{8}$ " | $3\frac{1}{2}$ " | 3 " $2\frac{1}{4}$ " | 1142 " |
| 23 " " | 2 " $1\frac{1}{4}$ " | $5\frac{1}{2}$ " | 2 " $10\frac{1}{4}$ " | $3\frac{1}{8}$ " | 2 " 9 " | 866 " |
| 20 " " | $21\frac{1}{2}$ " | $4\frac{3}{4}$ " | 2 " $3\frac{1}{4}$ " | $2\frac{1}{2}$ " | 2 " 4 " | 490 " |
| $17\frac{1}{2}$ " " | 19 " | $4\frac{5}{8}$ " | 2 " | $2\frac{1}{8}$ " | 2 " $\frac{3}{4}$ " | 300 " |
| 15 " " | $16\frac{1}{2}$ " | $3\frac{5}{8}$ " | 1 " $9\frac{3}{4}$ " | $1\frac{7}{8}$ " | 1 " 10 " | 240 " |
| 13 " " | 15 " | $3\frac{1}{4}$ " | 1 " $6\frac{1}{4}$ " | $1\frac{3}{8}$ " | 1 " $7\frac{1}{4}$ " | 160 " |
| 10 " " | $11\frac{1}{2}$ " | $2\frac{3}{4}$ " | $16\frac{1}{4}$ " | $1\frac{1}{8}$ " | 1 " $2\frac{1}{2}$ " | 93 " |

## To the Reader.

We always wish that the purchaser should judge of our wheels by seeing them at work in the mills, and hearing, from those using them, what their opinion may be. These are the sure tests, and by these we are ready to stand. As an aid in doing this we give the following list of names of some of the responsible practical business men who are using the Leffel wheel manufactured by us, their postoffice address, the size of wheel they use, their head and fall, and the character of work done. We beg of any one in want of a wheel to go and see the wheel run, and if you can't do that, to at least write and get their opinion.

### PENNSYLVANIA.

Paper mill—M. Nixon, Manayunk, 40 inch wheel displaced overshot wheel, 24 feet fall; 26 inch wheel displaced overshot, 24 feet fall; 30½ inch wheel displaced overshot, 24 feet fall.
Paper mill—Wooden Pulp Works, Manayunk, two 40 inch wheels and one 35 inch wheel, new mill, 24 feet fall.
Cotton mills—Ripka Mills, Philadelphia, 48 inch wheel displaced overshot, 24 feet fall.
Paper mill—J. L. Reigle, Reiglesville, 48 inch wheel displaced Tyler wheel, 8 feet fall.
Flour mill—P. Uhler, Uhlerville, 15 inch wheel displaced Tyler wheel, 35 feet fall.
Paper mill—S. S. Shryock, Chambersburg, 40 inch wheel displaced Stout, Mills & Temple's 10 feet fall.
Flour mill—D. Wannamacker, Jacksonville, 30½ inch wheel; also, use 36 in. Stout, Mills & Temple's, 7 feet fall.
Cotton Works—Mt. Vernon Cotton Works, Chester Co., 17½ inch wheel displaced Overshot, 17 feet fall.
Flour mill—Isaac Stover, Carversville, 20 inch wheel displaced Reynolds wheel, 22 feet fall
Paper mill—Jas. Lyle & Son, Lewisville, 17½ inch wheel displaced overshot, 24 feet fall.
Flour mill—Young & Slough, Easton, 17½ inch wheel displaced overshot, 22 feet fall; 17½ inch wheel displaced overshot, 14 feet fall.
Flour mill—L. J. Smith & Co., Reading, two 15¼ inch wheels displaced overshot, 21 fee
Flour mill—P. Uhler, Uhlerville, 40 inch wheel displaced breast wheel, 14 feet fall.
Cotton mills—A. J. Coughey, Fairview, 23 inch wheel displaced overshot, 22 feet fall.
Paper mill—I. B. Broomall, Coatesville, 23 inch wheel displaced overshot, 24 feet fall.
Flour mill—Wm. Hughes, Avondale, 20 inch wheel displaced overshot, 22 feet fall.
Paper mill—Mt. Holly Paper Co., Mt. Holly, 35, 26½ and 17½ inch wheels, new mill, 26 ft. fall.
Woolen mill—J. D Heft & Co., Philadelphia, 48 inch wheel displaced breast wheel, 9 ft. fall.
Blast Furnace—Ahl & Bros., Newville, 48 inch wheel displaced overshot, 24 feet fall; 26 inch wheel displaced overshot, 22 feet fall.
Paper mill—J. L. Reigle, Reiglesville, 56 inch wheel displaced overshot, 18 feet fall.
Agricultural Works—Thos. Burchinell, Huntingdon, 48 inch wheel, new works, 8 feet fall.
Paper mill—E. Shober, Lancaster, 35 inch wheel displaced Burnham wheel, 16 feet fall.
Paper mill—Swartz & Co., Reading, 30½ inch wheel displaced Gates wheel, 8 feet fall.
Paper mill—C. S. Garret, Philadelphia, 23 and 20 inch wheels, new mill, 32 feet fall.
Flour mill—J. W. Kochler, Easton two 40 inch wheels displaced Kalbeck wheel, 13 ft fall.
Saw mill—I. & E. Thomas, Torresdale, 30½ inch wheel displaced overshot, 18 feet fall.
Paper mill—Pierce & Holbrook, Lewisville, 20 inch wheel displaced Jonville Turbine, 14 feet fall.
Paper mill—C. Megarge, Philadelphia, 40 inch wheel displaced overshot, 18 feet fall.
Paper mills—C. Wells & Co., Philadelphia, 26½ inch wheel displaced overshot, 18 feet fall.
Woolen mill—Bishop, Kelly & White, Chestnut Hill, 48 in. wh. displaced breast wh., 9 ft. fall.
Woolen factory—J. C. Lewis, Kellyville, 30 inch wheel displaced breast wheel, 14 feet fall.
Flour mill—Amos, Davis & Co., Reiglesville, 35 inch wheel displaced overshot, 28 feet fall.
Paper mills—I. A. Lyster, Chambersburg, 35 and 40 inch wheels displaced Jonville Turbine, 9 feet fall.
Woolen mills—John Passmore, Paschalville, 40 inch wheel displaced overshot, 18 feet fall.
Woolen mill—J. D. Heft & Co., Philadelphia, 48 inch wheel displaced breast wheel, 9 ft. fall; 20 inch wheel displaced overshot, 24 feet fall.
Paper mill—C. S. Garret, Philadelphia, 40 inch wheel displaced pitch-back, 13 feet fall.

Paper mill—W. W. Harding, Philadelphia, 48 inch wheel displaced overshot, 24 feet fall; 17 inch wheel displaced overshot, 24 feet fall.

Woolen mill—Wolfenden, Shure & Co., Philadelphia, 35 inch wheel displaced overshot, 12 ft. fall.

Water works for private residence—Jay Cooke, Philadelphia, 17½ inch wheel displaced overshot, 16 feet fall.

Woolen mill—Geo. Bullock, Philadelphia, 48 inch wheel. new mill, 9 feet fall.

Saw mill—Jas. M. Wilcox & Co., Philadelphia, 20 inch wheel, new mill, 14 feet fall; 23 inch wheel displaced overshot in paper mill, 18 feet fall.

Woolen mill—Callihan & Bro., Philadelphia, 40 inch wheel, new mill, 11 feet fall.

Slate works—Young & Slough, Easton, 13½ inch wheel displaced overshot, 13 feet fall.

Paper mill—J. Tyson, Coatesville, 48 inch wheel displaced overshot, 12 feet fall.

Flour mill—Daniel Stout, Lower Bern, 40 inch wheel displaced undershot, 6 feet fall.

Paper mill—Jessup & Moore, York, 48 inch wheel displaced Jonville Turbine, 9 feet fall.

Flour mill—A. Davis & Co., Easton, two 35 inch wheels, new mill, 14 feet fall.

Agricultural works—L. Palmer, Media, 20 inch wheel displaced overshot, 22 feet fall; 20 in. wheel displaced overshot, 14 feet fall.

Woolen mill—S. Hoffman, Kellyville, 35 inch wheel displaced breast wheel, 16 feet fall.

Woolen mill—James Irving, Chester, 40 inch wheel displaced overshot, 10 feet fall.

Paper mill—A. J. Beaumont, New Hope, 20 inch wheel displaced overshot, 35 feet fall.

Woolen mill—John Passmore, Paschalville, 35 inch wheel displaced overshot, 24 feet fall.

Paper mill—D. S. Young, Coatesville, 30 inch wheel displaced overshot, 24 feet fall.

Paper mill—J. H. Lewis, Oakdale, 40 inch wheel displaced overshot, 16 feet fall.

Paper mill—H. Z. Van Reed, Reading, 35 inch wheel displaced Parker, 13 feet fall.

Woolen mill—M. Buggy, Lieperville, 40 inch wheel displaced overshot, 16 feet fall.

Paper mill—T. L. Marshal, Kennet Square, 40 inch wheel displaced overshot, 14 feet fall.

Rolling mill—Seifert, McManus & Co., Reading, 48 inch wheel displaced pitch-back, 21 ft. fall.

Paper mill—E. Shober, Lancaster, two 48 inch wheels displaced Burnham wheel, 16 feet fall.

Cotton mill—Wm. Simpson, Norristown, 56 inch wheel displaced Jonville wheel, 9 feet fall.

Flour mill—S. K. & J. Moyer, Auburn, 30½ inch wheel, 14 feet fall.

Paper mill—P. Rudolph, Lewisville, 20 inch wheel displaced overshot, 17 feet fall.

Flour mill—Myers & Irwin, Frankfort, 48 inch wheel displaced breast wheel, 10 feet fall.

Flour mill—Reese Davis, Leesport, 30½ inch wheel displaced overshot, 14 feet fall.

Flour mill—Charles H. Warner, New Hope, two 35 inch wheels displaced overshot, 14 ft. fall.

Flour mill—E. J. Ridgway, Darby, 17 inch wheel displaced overshot, 18 feet fall.

Flour mill—Ahl & Bro., Newville, 26 inch wheel displaced overshot, 22 feet fall.

Paper mill—W. Mode, Coatesville, 48 inch wheel displaced overshot, 13 feet fall.

Flour mill—D. B. Fisher, Reading, 30½ inch wheel displaced overshot, 11 feet fall.

Flour mill—Sol. Rhoades & Son, Douglasville, 40 inch wheel displaced Parker, 6 feet fall.

Powder mill—H. A. Weldy & Co., Tamaqua, 35 inch wheel, new mills, 13 feet fall.

Paper mill—Eli Morrison & Co., Hollidaysburg, 20 inch wheel, new mill, 42 feet fall.

Flour mill—Isaac Shaneman, Reading, two 15¼ inch wheels displaced overshot, 21 feet fall.

Paper mill—D. Y. & I. Wilson, Coatesville, 30½ inch wheel displaced overshot, 22 feet fall.

Paper mill—I. B. Broomall, Coatesville, 35 and 20 inch wheels, 22 feet fall.

Paper mill—A. D. Jessop, York, 48 inch wheel displaced Jonville, 9 feet fall.

Paper mill—Swartz & Co., Reading, 30½ and 56 inch wheels displaced Gates wheel, 8 feet fall.

Flour mill—J. Z. Geismeir, Reading, 30 inch wheel displaced overshot, 11 feet fall.

Paper mill—E. Shober, Lancaster, 20 inch wheel, new mill, 16 feet fall.

Woolen mill—George Bullock, Conshehocken, 56 inch wheel displaced breast wheel, 9 ft. fall.

Woolen mill—Worth & Dickey, West Chester, 15¼ inch wheel displaced overshot, 18 ft. fall.

Flour mill—C. Brinton, jr., Chaddsford, 56 No. 2 wheel, 5 feet fall.

## NEW JERSEY.

Foundry and Machine Shop—Thomas Loring, Spring Mills, 35 inch wheel displaced breast wheel, 11 feet fall.

Woolen mill—East Lake Woolen Manufacturing Co., Bridgeton, 26½ inch wheel displaced overshot, 26 feet fall.

Flour mill—McMill, Irwin & Rich, Ellwood 40 inch wheel displaced Kalbach wheel, 16 feet fall.

Flour mill—C. Stewart, Changewater, 56 inch wheel displaced Tyler wheel, 11 feet fall.

Flour mill—J. L. Reigle, Reiglesville, 30½ inch wheel displaced overshot, 20 feet fall.

Rolling mill—Pat. Metallic Co., Blackwoodtown, 30½ inch wheel displaced Kalbach wheel, 18 feet fall.

Flour mill—Finlay & Slichter, Lambertsville, 48 inch wheel displaced breast wheel, 11 ft. fall.
Flour mill—A. McMurrice, Belvidere, 30 and 35 inch wheels displaced overshot, 12 feet fall.
Flour mill—Joseph Smith & Co., Lambertsville, 26½ inch wheel displaced overshot, 22 ft. fall.
Flour mill—T. L. Shimer, Phillipsburgh, 23 inch wheel displaced overshot, 18 feet fall.
Flour mill—A. Davis & Co., Carpentersville, 15 inch wheel displaced Tyler, 35 feet fall.
Flour mill—Baird & Co., Lambertsville, 35 inch wheel displaced overshot, 16 feet fall.
Flour mill—B. Blackwell, Lambertsville, 35 inch wheel displaced overshot, 18 feet fall.
Flour mill—John Liraberg, Belvidere, 48 inch wheel displaced overshot, 10 feet fall.

## DELAWARE.

Cotton mill—J. Bancroft, Wilmington, 23 inch wheel displaced overshot, 24 feet fall.
Paper mill—Curtis & Bro., Newark, 48 inch wheel displaced overshot, 14 feet fall.

## IOWA.

Flour mill—J. Boyd, Yatton, 40 inch wheel.
Flour mill—Crockett Ribble, Coon Rapids, 26½ inch wheel, 12 feet fall.
Flour mill—F. Bupp & Co., Kellog, 40 inch wheel, 10 feet fall.
Flour mill—Wm. Seeka, Plum Hollow, 20 inch wheel, 14 feet.
Paper mill—Clark & Close, Iowa City, two 48 inch wheels, one 40 inch wheel, one 35 inch wheel, driving works under 8 feet head and fall.
Flour mill—J. M. Overman, Cedar Falls, one 56 inch and one 40 inch wheel, 7 feet fall.
J. W. Lewis, Des Moines, 20 inch wheel.
Flour mill—C. N. Smedley, Oskaloosa, three 40 inch wheels, 7 feet fall.
Flour mill—John Minert, Volney, 40 and 48 inch wheels, 6 feet fall.

## INDIANA.

Judson, Montgomery & Co., Mishawawa, 56 inch No. 2 wheel, 7 feet fall.
Paper mill—J. D. Smith, Connersville, 23 inch wheel, 20 feet fall.
Flour mill—John Church, Knightstown, 48 inch wheel, running alongside of Stout, Mills & Temple, 6 feet fall.
Woolen mill—T. Bushnell & Co., Monticello, 48 inch wheel, 5 feet fall
Paper mill—J. L. Baldwin, Logansport, 48 inch wheel, 10 feet fall.
Flour mill—Jas. F. Leonard, Bloomington, 10 inch wheel, 24 feet fall.
Flour mill—P. & J. Suman, Daleville, 48 inch wheel, grinds 24 bushels per hour, 8 feet fall.
Flour mill—N. Sohl & Co., Indianapolis, 48 inch wheel, running alongside of Stout, Mills & Temple. (We have 18 wheels running in the City of Indianapolis.)
Flour mill—F. Underhill, Indianapolis, two 35 inch wheels, grind 40 bushels per hour, 16½ feet fall.
Paper mill—Gay & Braden, Indianapolis, 35 inch wheel, drives 3 rag engines, 400 lbs. each, pumps, &c., 15½ feet fall; 20 inch wheel drives machine.
Flour mill—C. E. Geisendorf & Co., Rome, 30 inch wheel drives two run of 4½ feet burrs, and bolts, &c., grinds 15 bushels per hour. with gate ⅔ drawn; 20 inch wheel drives one run of 4 feet burrs, bolts, &c., grinds 15 bushels per hour with gate ⅔ drawn; 17 inch wheel drives one run 4½ feet burrs, 20 feet overshot taken out, head 23 feet.
Flour mill—I. M. Troutman, Thornton, 40 inch wheel drives one run of burrs, 7 feet fall.
Flour mill—McKinsy, Thornton, 35 inch wheel drives one run stones and machinery, 9 feet fall.
Flour mill—G. W. Wilson, Thornton, 48 inch wheel drives one run 4 feet burrs, bolts, &c., grinds 10 bushels per hour, 4½ feet fall.
Flour mill—H. M. La Follet, Thornton, 35 inch wheel drives two run 4 feet burrs. grinds 14 bushels per hour, overshot taken out, 9 feet fall.
Flour mill—Benjamin Crose, Thornton, 48 inch wheel drives two run burrs, bolts, &c., 8 feet head.
Flour mill—J. A. Thompson, Edenburgh, two 48 inch wheels drive four run 4 feet burrs, grind 24 bushels per hour, fall 7½ feet head; 30 inch wheel to drive machinery.
Flour mill—Smith & Taylor, Zionsville, 48 inch wheel drives two run of stone, 5 feet fall.
Flour mill—G. Ryne, Thorntown, 48 inch wheel drives one run of stone, 4½ feet head.
Flour mill—Falls mill company, Pendleton, 40 inch wheel drives two run of 4 feet burrs, overshot taken out.
Flour mill—Williamson & Edmonds, Yorktown, 48 inch wheel drives two run 4 feet burrs, bolts, &c., overshot taken out, 9 feet fall.
Flour mill—Caughron & Jennings, Indianapolis, 30 and 40 inch wheels drive three run and machinery, 10 feet fall.

Flour mill—Abraham Hoefger, Indianapolis, 26 inch wheel drives one run of corn burrs, 10 feet fall.

Flour mill—C. E. Geisendorf & Co., Indianapolis, two 40 inch wheels grind 1,500 bbls. of flour per week, 15½ feet fall; 23 inch wheel drives machinery.

Flour mill—James Skillen, Indianapolis, 40 inch wheel drives three run and grinds 1,200 bbls flour per week, 15½ feet fall.

Paper mill—McClane & Co., Indianapolis, 48 inch wheel drives four rag engines 400 lbs each, pumps, &c., 13 feet fall.

Flour mill—Eli Davis, Harvey's Station, Wayne Co., 40 inch wheel drives two run of 4 feet burrs, &c., overshot taken out, 9 feet fall.

Flour mill—A. B. Taylor, Huntsville, 40 inch wheel drives two run 4 feet burrs, &c., overshot taken out, 10 feet fall.

Flour mill—W. W. Wilson, Martinsville, two 40 inch wheels drive one run 4 feet burrs to each run, grind 25 bushels per hour, one Kindleberger wheel taken out, 7 feet fall.

## CONNECTICUT.

Grist and Plaster mill—P. C. Cummings, Canaan, 35 inch wheel drives grist and plaster mill, head and fall 8 feet; 40 inch wheel drives grist and plaster mill.

Benjamin Benedict, Canaan, 30½ inch wheel drives grist, plaster and saw mill, head and fall 12 feet.

Iron works—Clifton Mill Co., Winsted, 40 inch wheel drives bolt and wrench factory, head and fall 8 feet.

Cotton mill—E Palmer, Montville, 35 inch wheel drives cotton mill, head and fall 11 feet.

Grist and Saw mill—E. Hurt, Canaan, 35 inch wheel in grist and saw mill, head and fall 10 feet.

Saw mill—Cromwell Barnes, Burlington, 20 inch wheel in circular and upright saw mills, head and fall 20 feet.

Woolen mills—Samson, Almy & Co., Moosop, two 48 inch wheels drive large woolen mill, head and fall 21 feet, Tyler wheel taken out.

Cowles Paper Co., Unionville, 40 inch wheel drives two engines 500 lbs each, head and fall 17 feet; 15¼ inch wheel drives 56 inch paper machine, head and fall 17 feet.

Saw mill—John W Bliss, Colebrook, 17½ inch wheel drives saw mill, 30½ inch wheel drives 5 paper engines, head and fall 25 feet; 13¾ inch wheel drives paper machine, head and fall 25 feet.

Music factory—Ditson, Pond & Co., Unionville, 26½ inch wheel drives music factory, head and fall 17 feet.

Paper mill—Hammer & Forbes, Burnside, 48 inch wheel drives 3 paper engines, &c., head fall 17 feet.

Paper mill—D. & P M. Fairchilds & Co., Bridgeport, 30½ inch wheel drives Jordan and two rag engines, head and fall 20 feet.

Zinc Works—Platt & Son, Waterbury, 15¼ inch wheel, head and fall 10 feet.

Iron works—Union Bolt and Nut Company, Unionville, 35 inch wheel driving works, head and fall 17 feet.

Paper mill—Byron, Loomis & Co., Suffield, 30 and 15 inch wheels, 30 feet fall.

Saw mill—A. Wilcox, Granly, 15 inch wheel displaced overshot, 25 feet fall.

Green & Borthwick, Chaplin, 40 and 17½ inch wheels, 23 feet fall.

Winchester & Darrow, Southington, 26 inch wheel.

## NEW YORK.

We have about *thirty-five* of our wheels running in the city of Rochester. We give below a list of some of the parties using them:

Flour mill—G. W. Burbank, Rochester, 35 inch wheel grinds 30 bushels per hour, head and fall 14 feet; 30½ inch wheel, head and fall 14 feet.

Flour mill—James Conolly, Rochester, two 23 inch wheels drive two run of stones each, head and fall 24 feet.

Flour mill—Kennedy & Bostwick, Rochester, four 30½ inch wheels driving large flouring mill, head and fall 14 feet.

Machine shop—D. K. Barton & Co., Rochester, two 40 inch wheels driving the works, head and fall 24 feet.

Machine works—Ward & Bro., Rochester, 48 inch wheel driving works, head and fall 24 feet.

Flour mill—Joseph Hall, Rochester, one 30 and one 35 inch wheel driving mill.

Flour mill—Charles Hill & Son, Rochester, one 40 inch wheel.

Flour mill—J. W. Fiske, Rochester, three 40 inch wheels running large flour mill.

Axe Factory—J. & R. J. Dowd, Lee, 26½ wheel drives grindstones, &c., head and fall 15 feet.
Paper mill—R. Roberts & Co., Amherst, 23 inch wheel drives paper mill, head and fall 20 ft.
Paper mill—Cushman & Brothers, Amherst, 23 inch wheel drives paper mill, head and fall 20 feet.
Paper mill—Carson Paper Company, Dalton, 20 inch wheel drives paper mill engines, head and fall 26 feet.
Woolen mill—J. L. & G. W. Barker, Hancock, 26½ inch wheel drives woolen mill.
Cotton mill—Taylor & Olmstead Manufacturing Company, Springfield, 23 inch wheel displaced 30 inch Chapman wheel.
Paper mill—Wm. Clark & Sons, Northampton, 35 inch wheel displaced Chapman wheel.
Cotton waste—J. H. Simmons, Westfield, 20 inch wheel displaced overshot, 20 feet fall.
Circular saw mill—A. Bartholomew, West Springfield, 20 inch wheel displaced overshot, 24 feet fall.
Saw mill—Chas. Talmage, Southwick, 17 inch wheel displaced overshot, 18 feet fall.
Furniture manufactory—S. K. Pierce, South Garden, 40 inch wheel displaced Fairbanks wheel, 12 feet fall.
Whip makers—Knowles & Kellogg, Westfield, 17 inch wheel displaced breast wheel, 12 feet fall.
Manufacturer—P. Holland, Butchertown, 35 inch wheel.
Paper mill—Samuel Horton, Westfield, 40, 23 and 35 inch wheels displaced Clapp wheel, 9 feet fall.
Saw mill—Edward Gilbert, Southwick, 15 inch wheel displaced overshot, 24 feet fall.

## WISCONSIN.

Flour mill—W. J. Austin, Leon, one 40 inch wheel, one 35 inch wheel, head and fall 9 feet.
Flour mill—William Kyle, Maiden Rock, one 26½ inch wheel.
Flour mill—D. R. Sylvester, Castle Rock, one 30½ inch wheel running alongside of the Warren Wheel.
Flour mill—Henry Steinberg, Weyauwega, four 35 inch wheels, one 40 inch wheel, new mill, head and fall 11 feet.
Flour mill—S. O. Raymond, Geneva, one 26½ inch wheel, head and fall 12 feet.
Flour mill—Henry Thien, Thiensville, Milwaukee Co., two 56 inch wheels, one 40 inch wheel in place of Parker wheel, head and fall 6 feet.
Flour mill—Connit & Clack, Kekoskee, Dodge Co., one 56 inch wheel, in place of American Turbine wheel, head and fall 10 feet.
Flour mill—John Wall, Black Earth, one 48 inch wheel in place of Tuttle wheel, head and fall 8 feet.
Paper mill—Mather & Irwin, Sparta, one 56 inch No. 2 wheel, one 40 inch wheel, one 35 inch wheel, head and fall 6 feet.
Flour mill—Dillingham & Co., Gleebeulah, Sheboygan Co., one 23 inch wheel.
Flour mill—H. & S. Hoesley, New Glarus, Green Co., one 35 inch wheel.
Hills & Clark, Sheboygan Falls, one 30½ inch wheel.
Saw and Flour mills—T. Weston & Co., Wecedah, one 40 inch wheel in Saw Mill; one 30½ inch wheel in Flour Mill.
Flour mill—C.B. Cox & Co., River Falls, Pierce Co., one 48 inch wheel, grinds 18 bushel per hour, head and fall 7 feet; one 26½ inch wheel drives three run of stone, head and fall 27 feet.
Flour mill—Lyon & Co., Manitowoc, one 48 inch wheel, head and fall 8 feet.
Flour mill—C. Raymond, Evansville, one 20 inch wheel, head and fall 15 feet.
S. H. Harris, Waupun, one 48 inch wheel, in place of American Turbine, head and fall 7 ft.
Flour mill—N. S. Clapp, Hudson, 40 inch wheel.
Saw mill—A. Hall & Co., Ahnapu, 40 inch wheel.
Paper mill—Wright & Newcomb, Beloit, 35 inch wheel, 7 feet fall.
Flour mill—Phœnix Mill, Milwaukee, 56 inch No. 2 wheel, displaced Overshot, 12 feet fall.
Flour mill—W. D. Hillyer, Sparta, 30½ inch wheel, 10 feet fall.
Flour mill—W. E. Rowe, Mazo Maerie, 56 inch wheel.
Flour mill—Geo. Runkle, Tomah, one 23 inch wheel, one 26½ inch wheel, head and fall 14 feet.
Flour mill—Hotchkiss & Puhlman, Plymouth, Sheboygan Co., two 35 inch wheels, one 26½ inch wheel in place of Goodwin wheels, head and fall 8 feet.
Flour mill McClessen & Quint, Rural, Waupaca Co., one 48 inch wheel.
Flour mill—Amaden & Judd, Morkesan, two 23 inch wheels, head and fall 14 feet.
Flour mill—John Marshall, Fon du Lac, one 30½ inch wheel, head and fall 9 feet.
Flour mill—Otis & King, Trimble, Price Co., one 40 inch wheel.
Flour mill—J. L. Brewer & Co., Fox Lake, one 40 inch wheel in place of Noyes wheel, head and fall 12 feet.
Flour mill—John F. Stone, Augusta, Eau Clair Co., one 30½ inch wheel, head and fall 8 feet.
Flour mill—R. F. Jackson, Fon du Lac, 17½ inch wheel, head and fall 35 feet.
Flour mill—C. G. Boalt, Chuapee, Kewaunee Co., one 30½ inch wheel, head and fall 14 feet.

## ILLINOIS.

Flour mill—Joseph Smith, Danville, 35 inch wheel, 10 feet fall.

Flour mill—John Shott, Byron, 35 and 30 inch wheels, 10 feet fall.
Flour mill—Chas. Moore, Orangeville, 35 inch wheel, 9 feet fall.
Flour mill—S. Alderson, Council Hill Station, 15 inch wheel displaced Overshot, 22 feet fall.

## MINNESOTA.

Flour mill—N. B. Gaylord, Redwing, 10 feet head.
Flour mill—C. Grosvenor, Cannon Falls, 30¼ inch wheel, 8 feet head.
Flour mill—Brainard & Co., St. Paul, 20 inch wheel, Overshot taken out, head 28 feet.
Flour mill—H. Collins, Lake City, 20 inch wheel Overshot taken out, 17 feet head.
Flour mill—W. W. Phelps, Redwing, 15¼ inch wheel, 30 feet head.
Flour mill—S. W. Stevens, Hokah, 26½ inch wheel.
Flour mill—Clark & Hawley, Redwing, 40 inch wheel,

## OREGON.

Saw mill—John West & Co., West Port, Clatsop Co., 23 inch wheel, 24 feet head, driving 54 inch Circular Saw, with half gates cuts 1,000 feet per hour.
Planer mill—John West & Co., West Port, Clatsop Co., 15¼ inch wheel, Woodworth Planer, 10 feet fall.
Saw mill—H. Kelley, near Portland, 13¼ inch wheel, 29 feet head, driving 40 inch Circular Saw.
Flour mill—Savier & Co., Oregon City, 30½ inch wheel, 13½ feet head, grinds with two pair 40 inch burrs 150 bbls. flour, 24 hours.
Paper mill—Oregon City, 20 inch wheel 13¼ inch wheel, both with partial gates, small wheel, 13 feet head driving machine; 20 inch wheel, the Engines and all other machinery.
Flour mill—Dayton. Palmer & Brown, variable head from 3 to 21 feet, 35 inch wheel driving from 1 to 3 pair of burrs and machinery.
Flour mill—Rob't Kinney, McMinnville, 15¼ inch wheel, 36 feet fall, with partial gates drives two pair of burrs and machinery.
Woolen Factory—Salem, W. W. Mf. Co., 48 inch wheel, 17 feet fall, with partial gates, drives all machinery, manufacture 1000 yards per day.
Flour mill—Salem, W. W. Mf. Co., 26½ inch wheel, driving machinery, 30½ inch wheel, drives 2 pair 40 inch burrs, grinds 50 bushels per hour, full head, head varies from 20 feet down.
Saw mill—Springfield Mf. Co., Engine City, 40 inch wheel drives double Circular, Planer, &c., &c., 20 feet fall.
Flour and Saw mill—Haker & Olds, LaGrande, two 30½ inch wheels, 11 feet head, driving double Circular and Flour Mill, 3 pair burrs and machinery, alternately.
Flour mill—Forest Cove, Union Co., French & Co., 20 inch wheel, 34 feet head, drives 2 pair burrs and machinery.
Flour mill—Baker City, French & Co., 20 inch wheel, 30 feet head, 2 pair burrs and machinery, partial gates.
Quartz mill—Eagle Creek, Union Co., 15¼ inch wheel, 25 feet head.
Furniture Factory—Millwaukee, Snelling & Co., 20 inch wheel, 11 feet head, driving 40 inch Circular Saw, 10 inch wheel turning lathes, &c.
Woolen mill—Aurora, F. Keil & Co., 23 inch wheel, 7 feet head.

## CALIFORNIA.

Flour mill—Clear Lake, O. Simmons & Co., 30½ inch wheel, variable head, 2 pair burrs and machinery.
Flour mill—Folsome, Jacobs & Co., 60 feet head, partial gates, 3 pair 40 inch burrs and machinery.
Saw mill—New Lexington, Santa Clara Co., J. Covall, 20 inch wheel, 21 feet head, driving 54 in. circular, 500 feet per hour, partial gates
Saw mill—New Lexington, Santa Clara Co., J. Y. McMillen, 17½ inch wheel, 42 feet fall, partial gates, driving double circular, displaced a Tyler wheel and Overshot.

## WASHINGTON TERRITORY.

Saw mill—Lewis Love, Columbia Mills, 20 inch wheel, 34 feet fall, driving double circular, Woodworth planer, cut-off and lath saws.
Flour mill—Lewis Love, Columbia Mills, 13¼ inch wheel, 34 feet fall, drives one 54 inch burr and all machinery of mill, going 12 bushels per hour with partial gates.
Flour mill—Overholtzer & Jacobs, Walla Walla, 26½ inch wheel, 16 feet head, drives two pair 40 inch burrs and machinery.
Flour mill—J. C. Reynolds, Walla Walla, 26½ inch wheel, same as above.

## IDAHO TERRITORY.

Quartz mill—Rocky Bar, 30½ inch wheel, 20 stamp mill.

## MISCELLANEOUS.

Cotton mill—Metcalf & Clapp, Columbus, Georgia, 56 inch wheel.
Flour mill—Geo. Jennings, Nebraska City, Nebraska, 23 inch wheel.
Flour mill—Hurford & Bro., Omaha, Nebraska, 35 and 26 inch wheels, 6 feet fall.
Circular saw mill—Staley & Dyer, Marysville, Kansas, 56 inch wheel No. 2, 10 feet fall.
Flour mill—Wheaton, Pencost & Co., Hillsdale, Michigan, 15¼ inch wheel, 26 feet fall.
Jas. Taylor, Staunton, Delaware, 15 inch wheel, 40 feet fall.
Flour mill—J. W. Smith, Denver City, Colorado, 40 inch wheel.
Flour mill—Perry Hutcheson, Marysville, Kansas, 56 inch wheel No. 2, 6 feet fall.
H. Perrin, Marshal, Michigan, one 40 and three 30 inch wheels, 6 feet fall.
Flour mill—C. C. Foot, Wamego, Kansas, 20 inch wheel.
Flour mill—Luther Hadley, Brownsville, Nebraska, 40 inch wheel.

Flour mill—Joseph H. Pool, Rochester, two 30½ inch wheels drive two run of stone each head and fall 35 feet; one 26½ inch wheel drives two run of stone.
Flour mill—Richardson, Burbanks & Co., Rochester, 40 inch wheel drives.
Steam engine builders—D. A. Woodbury & Co., Rochester, 30½ inch wheel.
Flour mill—M. B. Ovitt, Rochester, 30½ inch wheel.
Flour mill—Mosely, Motley & Wilson, Rochester, 35 inch wheel.
Flour mill—J. B. Gordon & Bro., Cuba Depot, one 17½ inch wheel driving flour mill.
Grist mill—F. A. Sherman, Groton, one 30½ inch wheel driving grist mill, head and fall 13 feet.
Flour mill—Hiram Finch, Lockport, two 40 inch wheels running large flour mill, head and fall 50 feet.
Cement works—Rosendale Cement Works, Rondout, one 23 inch wheel driving works under 40 feet head.
Jamieson & Pierson, Batavia, one 48 inch wheel running alongside of new breast wheel.
Westover & Foster, Richmondville, 20 inch wheel.
Cotton mill—New Hartford Manufacturing Company, New Hartford, 40 inch wheel drives cotton mill, 100 looms, head and fall 20 feet.
Paper mill—D. P. Davis, Nassau, 26½ inch wheel drives 3 engines 250 lbs each, head and fall 20 feet; 13¾ inch wheel drives paper machine, head and fall 20 feet.
Paper mill—Bulkly, Denton & Co., New York City, 13¾ inch wheel drives 62 inch paper mill, head and fall 27 feet.
Paper mill—Orr & Co.; North Hoosick, 35 inch wheel drives paper engines.
Paper mill—Taggart, West & Co., Watertown, 56 inch wheel No. 2 drives four rag engines, 500 lbs., head and fall 8 feet.
Paper mill—George West & Son, Ballston, 40 inch wheel drives engine, &c.; 15 inch wheel drives machine, &c.
Saw mill—Daniel Phelps, Honeoye, 40 inch wheel drives saw mill, head and fall 6 feet; two 40 inch wheels drive flour mill, 6 feet head and fall.

## RHODE ISLAND.

Cotton mill—Wm. R. Green & Co., Hope Valley, 40 inch wheel displaced Collins wheel, 17 feet fall.
Cotton mill—Benjamin Wilbur, South Scituate, 30 inch wheel, 17 feet fall.
Manufactory—Alanson Steere, Rockland, 30 inch wheel displaced Tyler wheel.
Angel & Matteson, Prendon, 17½ inch wheel displaced 18 inch Tyler wheel, 18 feet fall.

## VERMONT.

Paper mill—David Hunter & Co., North Bennington, 30½ inch wheel drives paper machine, head and fall 8 feet.
Norman Cobb, jr., East Putney, 20 inch wheel.
Erastus F. Emerson, Peacham, 46½ inch wheel.

## NEW HAMPSHIRE.

Manufacturing Company—E. A. Strain, agent Amoskeag Manufacturing Co., Manchester, one 40 inch wheel driving Amoskeag Axe Factory, Boyden Turbine taken out; one 48 inch wheel driving cotton mill, head and fall 30 feet.
Woolen Factory—Daniel Hale, Woolen Manufacturing Company, Centre Ossipee, one 40 inch wheel driving works.
Saw mill—Henry W. Weeks, Warren, 48 inch wheel drives circular saw, head and fall 12 feet.

## OHIO.

Flour mill—Moore & Willer, Milford Center, 35 inch wheel, 10 feet fall.
Flour mill—Geo. Gerolman, Maumee City, 26½ inch wheel alongside overshot, 26 feet fall.
Flour mill—Service, Hill & Co., Urbana, 23 inch wheel displaced overshot, 20 feet fall.
Flour mill—Jas. Gordon & Co., Cincinnati, 56 inch wheel, 11 feet fall.
Flour mill—Bachelor & Palmer, Lockland, 35 inch wheel displaced 42 inch Stout, Mills & Temple, 15 feet fall.
Flour and Saw mill—B. W. Maxwell, Sidney, two 17¼ and two 15¼ inch wheels in flour mill; 26 inch wheel in circular saw mill, 21 feet fall. These wheels all displaced overshot wheels.
Flour mill—J. W. Carey, Sidney, five 17½ inch wheels, 20 feet fall.
Flour mill—D. & J. Weimer, West Milton, 10 inch wheel drives three run of stone, 56 feet fall, displaced two overshot wheels.
Circular saw mill—A. Staley & Son, Mechanicsburg, 26 inch wheel, 18 feet fall.
Flour mill—Jacoby & Stewart, Clifton, Greene Co., 26 and 15¼ inch wheels, 22 feet fall.

Flour mill—Wm. M. Marlatt, Newcomerstown, 35 inch wheel, 8 feet fall.
Flour mill—Jacob Vernon, Calais, 48 inch wheel, 7 feet fall.
Paper mill—Thos. Nixon, Dayton, 40, 30 and 13¼ inch wheels, 11 feet fall.
Lagonda Agricultural Works, Springfield, 35 inch wheel driving works.

## MARYLAND.

Paper mill—A. Priestly & Co., Elkton, 23 inch wheel displaced overshot, 22 feet fall.
Paper mill—Stonebraker & Cook, Hagerstown, 53 inch wheel No. 2 displaced Burnham wheel, 9 feet fall.
Paper mill—J. W. Stonebraker & Co, Hagerstown, 35 inch wheel displaced Burnham wheel, 9 feet fall.
Paper mill—Emmert & Son, Funkstown, 30 and 48 inch wheels displaced Burnham wheel, 9 feet fall.
Saw mill—W. H. Spratt, Elktown, two 20 inch wheels, 14 feet fall.
Paper mill—W. H. Hoffman, Paper Mills P. O., 35 inch wheel displaced Burnham, 18 ft. fall.
David Scott, Elktown, 26 inch wheel.

## MASSACHUSETTS.

Paper mills—Smith Paper Company, Lee, 48 inch wheel drives three engines, 700 lbs each, head and fall 14 feet; 35 inch wheel drives one Jordan engine, head and fall 14 feet; 20 inch wheel drives one 76 inch machine, head and fall 14 feet; 40 inch wheel drives three rag engines 700 lbs each, head and fall 14 feet; 40 inch wheel drives one Jordan engine, four cutters, two dusters, &c., head and fall 14 feet; 48 inch wheel drives one Jordan and mixing engines, head and fall 8½ feet; 48 inch wheel drives three engines 350 lbs each, head and fall 8 feet; 56 inch wheel No. 2 drives two engines 600 lbs., one engine 300 lbs., two cutters, dusters, &c., head and fall 8 feet; 56 inch wheel No. 2 drives one Jordan and one 500 lb. mixing engine, head and fall 8 feet; 30⅛ inch wheel drives one 62 inch machine, head and fall 8 feet; 48 inch wheel drives engines, &c.
Paper mill—P. C. Baird, Lee, 17½ inch wheel drives four rag engines 400 lbs. each, head and fall 43 feet; 26¼ inch wheel drives finishing works, head and fall 8 feet.
Paper mill—Z. Crane, jr., Dalton, 40 inch wheel drives four rag engines 300 lbs. each, two calenders, &c., head and fall 17 feet.
Paper mill—May & Rogers, Lee, 20 inch wheel drives three rag engines, 300 lbs each, head and fall 40 feet; 17½ inch wheel drives four engines 275 lbs each, two calenders, head and fall 40 feet; 23 inch wheel drives two paper engines 300 lbs each, and one calender, head and fall 24 feet.
Cotton mill—Adams & Clark, South Adams, 48 inch wheel drives cotton mill, head and fall 14 feet.
Cotton mill—J. D. Wheeler & Son, Milbury, 30½ inch wheel, 26 feet fall.
Caleb Bates, Kingston, two 23 inch wheels.
Cotton mill—Seely & Adams, Housatonic, two 56 inch No. 2 wheels, 7 feet fall.
P. Bryant & Son, West Chesterfield, 23 inch wheel driving circular saw mill, 37 feet fall; 17 inch wheel driving planing mill, 22 feet fall; 26 inch wheel driving mill, &c.
Nail works—S. Loring, Plymouth, 13¼ inch wheel driving works. Also, 30½ inch wheel.
Saw mill—Ira Chandler, Kingston, 17½ inch wheel, 8 feet fall.
Machine shop—D. D. Allen, South Adams, 10 inch wheel displaced overshot, 16 feet fall.
Wire Works—Cobb & Drew, Plymouth, 23 inch wheel; also uses Warren Turbine, 18 feet fall.
Cotton mill—Monument Mills, Housatonic, 56 inch wheel No. 2 drives large cotton mill, head and fall 17 feet.
Woolen factory—Blackington & Phillips, South Adams, 48 inch wheel drives seven set woolen machinery, head and fall 16 feet.
Paper mill—Delany & Watson, Northampton, 23 inch wheel drives two rag engines, head and fall 34 feet; 10 inch wheel drives paper machine, head and fall 34 feet.
Paper mill—John Bottomly, Lee, 35 inch wheel drives three rag engines 200 lbs each, head and fall 12 feet; 17½ inch wheel drives paper machine, head and fall 12 feet.
Paper mill—Wm. Blovelt & Co., 26½ inch wheel drives one 62 inch paper machine, head and fall 7 feet.
Iron works—30½ inch wheel drives trip hammers, &c., head and fall 12 feet.
Paper mill—Benton, Garfield & Co., Lee, 30½ inch wheel drives two rag engines 400 lbs each, head and fall 12 feet.
Paper mill—John Trimbles, Tyringham, 26½ inch wheel drives two paper engines, 250 lbs each, head and fall 13 feet.
Circular Saws—J. Allen & Son, West Tummington, 30½ inch wheel drives circular saws, head and fall 8 feet.

## TESTIMONIALS FROM THE PACIFIC STATES.

LEXINGTON, SANTA CLARA CO., CAL., June 29th, 1867.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

I am well pleased with the wheel; like it better than the overshot. As to its doing more work than the overshot, I am not sure that it does. As to comparing it with the Tyler wheel, I cannot do it. The Leffel Wheel is so far superior to the Tyler wheel that it admits of no comparison. I am satisfied with the wheel.

A word about Covell's Wheel. He has an edger running now, and yesterday sawed 9,500 feet, which is doing well.

Yours, truly. J. Y. McMILLIN.

P. S. If you send any one to my mill I will take pleasure in showing the merits of your wheels. J. Y. Mc.

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MOUNTAIN SPRING, EAST PORTLAND, July 25, 1867.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

You wished to know how I liked the Leffel's American Double Turbine Water Wheel. It is the best wheel now in use for convenience and economy, always doing its work with precision, and saves one-half the cost in machinery. After using it three years, I would recommend it to all wanting water wheels.

Yours, &c., H. KELLY.

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## MINERS' MEASUREMENT.

It is the custom on this coast generally, to estimate water by what is popularly known as Miners' Measurement; which, according to custom, is any opening under six inches pressure. In some camps four inches pressure is only allowed, and in others ten. The pressure varies according to the circumstances of different camps; hence there is no correct standard upon which to base calculations. The pressure varying, varies the quantity of water of a given number of inches under the different heads; hence, there is a great difference in the judgment of miners, as to what quantity of water constitutes a certain number of inches of water as it flows in a stream.

Taking these things all into consideration, no millwright or hydraulic engineer can come to any definite conclusion, from a declaration that this or that man, who proposes to construct a mill, has so many miners' inches of water. He may make his estimates for a six inch pressure, and it may be four, eight, or ten, or even twelve, not knowing the pressure, the result would vary materially.

Again, the methods for constructing the openings vary, so that the quantity of water issued under the different methods, is as various as from the different heads. Therefore, no definite calculation for mechanical purposes can be determined from miners' measurement.

The various results of miners' measurement range from 1.66 (one and sixty-six one hundredths) to 2.66 cubic feet per minute to a miner's inch, and sometimes as high as 3 cubic feet to an inch.

It will therefore be plainly seen by all, that the practice of this coast for estimating water is not practical, and ought to be abandoned.

The only definitely certain method is to compute the NUMBER OF CUBIC FEET per minute, which is accomplished by the following

*Rule*—Get the spouting velocity of the water under the head, which is $\sqrt{h} \times 8.02$, multiplied by the number of square inches of the orifice, $\times 12 \times 60$, and divided by 1728, the number of square inches in a cubic foot, where h represents the hight of fall in feet.

By this process any competent mechanic can determine what power may be reasonably expected from a given quantity of water under any given head. By this method all our tables are computed and our horse power, quantity of water and revolution determined.

### Miners' Inches and Cubic Feet Compared.

As the results and practice of miners' measurement are so various, it is desirable that we arrive at some method by which the two can be compared. From numerous experiments in measuring water in miners' ditches and wiers, we have adopted the following rule, to approximate the truth, in statements where miners inches are made use of. For instance, a man writes me that he has 34 feet fall and 250 inches of water, miners' measurement. I find on page 25, in the column under 34, opposite the 15¼ inch wheel, 507 cubic feet per minute, which water will give nearly 29, horse power. Or, another has 40 feet head and 100 inches water. I see in column 40, on the same page, and opposite the 10 inch wheel, 243 cubic feet per minute, and 16.32 horse power. Therefore, to arrive at the truth as near as possible, take the HALF OF THE CUBIC FEET UNDER THE HEAD, for the number of miners' inches, to know what horse power may be expected from a given number of miners' inches from any given head. But, as we said before, this is only approximate to the truth, and the result may be far greater, but it is safe to base the estimates on this result.

By the use of the following table, any quantity of water can be accurately estimated in cubic feet, by having the water *spill* through a notch cut in a board placed across the stream, as described on page 27. The *notch* should be equally distant from each side of the stream, and six inches or more from the bottom. You will make your estimate as follows:

The table shows the number of cubic feet of water that will pass a weir of ONE INCH IN BREADTH IN ONE MINUTE, from one-tenth of an inch to eighteen inches and 9-10ths in hight of water on the weir.

*Rule:*—Find the inches of hight in the left hand column, then in the same horizontal line under the tenths of inches will be found the cubic feet of water passing over one inch of breadth in a minute; this quantity, multiplied by the breadth of the weir, in inches, gives the total number of cubic feet per minute.

**Table for Weirs.**

| Ins. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.013 | 0.036 | 0.066 | 0.102 | 0.143 | 0.187 | 0.236 | 0.288 | 0.344 |
| 1 | 0.403 | 0.465 | 0.530 | 0.598 | 0.668 | 0.741 | 0.816 | 0.894 | 0.974 | 1.056 |
| 2 | 1.140 | 1.227 | 1.315 | 1.406 | 1.499 | 1.594 | 1.690 | 1.789 | 1.889 | 1.991 |
| 3 | 2.095 | 2.200 | 2.308 | 2.417 | 2.527 | 2.640 | 2.754 | 2.869 | 2.986 | 3.105 |
| 4 | 3.225 | 3.347 | 3.470 | 3.595 | 3.721 | 3.848 | 3.977 | 4.108 | 4.239 | 4.373 |
| 5 | 4.507 | 4.643 | 4.780 | 4.919 | 5.059 | 5.200 | 5.342 | 5.486 | 5.630 | 5.777 |
| 6 | 5.925 | 6.073 | 6.223 | 6.375 | 6.527 | 6.681 | 6.835 | 6.991 | 7.148 | 7.307 |
| 7 | 7.466 | 7.627 | 7.788 | 7.951 | 8.115 | 8.280 | 8.446 | 8.613 | 8.782 | 8.951 |
| 8 | 9.122 | 9.293 | 9.466 | 9.640 | 9.814 | 9.990 | 10.167 | 10.345 | 10.524 | 10.704 |
| 9 | 10.884 | 11.066 | 11.249 | 11.433 | 11.618 | 11.804 | 11.991 | 12.179 | 12.369 | 12.557 |
| 10 | 12.748 | 12.940 | 13.132 | 13.326 | 13.520 | 13.716 | 13.912 | 14.110 | 14.308 | 14.507 |
| 11 | 14.707 | 14.908 | 15.110 | 15.313 | 15.517 | 15.721 | 15.927 | 16.133 | 16.340 | 16.549 |
| 12 | 16.758 | 16.968 | 17.178 | 17.390 | 17.602 | 17.816 | 18.030 | 18.245 | 18.461 | 18.678 |
| 13 | 18.895 | 19.114 | 19.333 | 19.553 | 19.774 | 19.994 | 20.218 | 20.441 | 20.666 | 20.891 |
| 14 | 21.117 | 21.344 | 21.511 | 21.799 | 22.028 | 22.258 | 22.489 | 22.720 | 22.952 | 23.184 |
| 15 | 23.418 | 23.654 | 23.890 | 24.126 | 24.362 | 24.600 | 24.839 | 25.078 | 25.318 | 25.559 |
| 16 | 25.800 | 26.042 | 26.286 | 26.529 | 26.774 | 27.019 | 27.265 | 27.512 | 27.759 | 28.007 |
| 17 | 28.256 | 28.506 | 28.756 | 29.007 | 29.259 | 29.512 | 29.765 | 30.019 | 30.274 | 30.529 |
| 18 | 30.786 | 31.035 | 31.282 | 31.564 | 31.800 | 32.068 | 32.310 | 32.582 | 32.803 | 33.008 |

*Example.*—A weir is 5.4 inches deep and 40 inches wide. Number of cubic feet in a minute for one inch wide and 5.4 inches deep is $5.059 \times 40 = 202.36$ or 202¼ cubic feet per minute.

This would not be a correct method to measure water in a flume or ditch, but only as it pours through a weir, which any one, under any circumstance, can construct. By this method the quantity of water can be ascertained with the greatest certainty.

### Too Small Wheels.

Most persons are apt to select too small a wheel to do their work well. From what can be learned from the experience of others in

the within certificates, it will be seen that these wheels operate with equal satisfaction with partial as full gates—a facility which no other wheel has. Hence be sure to order a wheel of sufficient size, for a small quantity of water, even down to the third and fourth capacity of the wheel, can be applied on a larger wheel with the same results as if it were applied on a wheel whose capacity it would fill. An additional advantage is thus secured, for when the quantity of water is increased, the same wheel can use it to advantage, and work done in proportion to the amount of water used. Hence three or four times the power can be obtained from the same wheel which would use a small quantity economically. We have exchanged wheels as often as three times, for persons who have selected too small a wheel at first.

We are always willing to exchange wheels with any of our customers, upon these conditions: Customer to deliver wheel at the office or agency, pay for all necessary repairs if any are needed, and difference of price of the different size.

### New Case for High Head.

In order to adapt our wheel to very high heads and unusually small quantities of water, we have constructed a new case, to which a pipe or hose can be attached. By the use of this case, all expense of a penstock is avoided, and all leak also. When very high heads are used, a very small leak will lose a horse power of water per minute. From this fact many of the appliances heretofore used have failed. By this new case we obviate all loss from leakage, and the wheels used for very high heads being manufactured expressly for that purpose, are put up very exact, so that no perceptible amount of water will waste.

We keep no wheels on hand for high or very high heads, because every wheel for a very high head must be made for the head and quantity of water to be used. And it is not probable any two or three wheels will be demanded in a year which are desired for the same head and quantity of water.

Hence persons desiring wheels for very high heads should send their orders at least three months before they expect the wheel to be shipped.

### Hurdy-Gurdy Wheels.

Many of the quartz mills in California and Nevada, and other mining districts, are driven by what is called hurdy-gurdy wheels. They seem to give a great deal of power, but when the amount of

water and high head is considered, it is very evident that the percentage obtained from the amount of water used is very small indeed.

Although none of our high head wheels have, as yet, been substituted for these wheels, we are very well convinced that our wheel will give at least one-third more power, from the same water. The first wheel of this kind is now in use at the Old Forbes Mill, near New Lexington, Santa Clara County, California. We desire all who are any ways skeptical on this subject, to go and see for themselves, or write to Messrs. Rogers & Harrison, the present owners.

We are always ready to make calculations and estimates of water for any head or quantity of water for which we have no printed tables.

### Place of Manufacture.

We have been frequently asked, "Why do you make your wheels in Portland, Oregon?" There are several reasons. We can manufacture them here more cheaply than anywhere else on the coast. There is a greater demand for water wheels in Oregon and Washington Territory, in proportion to the population, than any other district. We have greater and better facilities for manufacturing here than we could obtain anywhere else. We make a speciality of manufacturing water wheels. Our machinery is all adapted to it, and our hands are accustomed to this kind of work. If we have any sympathy with any portion of this coast more than another, it is for Oregon, being among its first settlers. We furnish wheels for California, Nevada, Arizona and Mexico, and all ports and places purchasing from our agency in San Francisco, at the same price, delivered in San Francisco, as we do at the shop.

If the demand increases as we hope it will, we doubtless will, in time, establish a factory in San Francisco.

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PORTLAND, OGN, June 19th, 1865.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

The "Leffel's American Double Turbine" purchased of you last fall is now doing duty, and we are satisfied, from present experience, that it is doing all and even more than was expected of it. We have it doing duty on two pair of forty-eight inch burrs. With these two forty-eight inch burrs, we are grinding as much wheat, in the same time, with a three-quarter gate, as we are with the other three pair, and they are fifty-four inch burrs. The head we are using is fourteen feet. Yours, very truly,

SILVER & CO., A Comstock Miller,

WESTPORT, CLATSOP CO., OGN., Nov. 16, 1864.

MESSRS. LEFFEL & MYERS—DEAR SIRS:

We have plenty of water now, and your Double Turbine is in successful operation. We are satisfied that your wheel is fully equal, if not superior to the Overshot. With the same water that the Overshot uses, we can do more work with the Turbine than with the Overshot. I have tried many wheels which were claimed to be superior to any overshot, but yours is the first I have found. Hence we do not hesitate to recommend the American Double Turbine as the most efficient economizer of water in our knowledge.

JNO. WEST & CO.

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WESTPORT, OGN., Dec. 6th, 1865.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

We have now been using your Double Turbine Water Wheel more than one year. We cannot endorse what we have heretofore said of your Wheel in any better way than by ordering another. Will you, therefore, send us another Wheel fifteen inches in diameter to drive our plainer and small circular saw. We are not able to find any water motor so economical and useful as your "Double Turbine Water Wheel."

JOHN WEST.

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WALLA WALLA, W. T., Nov. 30th, 1865.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

We take pleasure in making the following statement in reference to the "Leffel's American Double Turbine Water Wheel," purchased of you last spring. The Wheel was first put in according to the directions of a millwright near this place. Previously our mill was driven by a Wheel made after the Upham plan. With this Wheel, with our present amount of water, we could only grind about a barrel of flour per hour, or twenty-four barrels in twenty-four hours: because we could only run by heads. After putting your Wheel in, as per the directions above, we could run one pair of burrs with the machinery constantly, and grind from fifty to sixty barrels of flour per day of twenty-four hours. But the Wheel evidently did not do full duty. Since, you have caused it to be taken out and put in properly, we now can run both burrs at the same time, with all the machinery of the mill—consisting of conveyors, elevators, cleaning apparatus, smutter, &c., &c. This work is all done with a two-third gate, or about two-thirds the quantity of water the wheel will use.

We are now making one hundred barrels of flour in twenty-four hours' run, and have sufficient water to run constantly.

We believe your Wheel accomplishes all you claim for it; and it proves itself to be one of the few patent implements which does all its most sanguine friends claim. Our former Wheel was four feet in diameter; the Wheel we are using of yours is twenty-six and a half inches in diameter. We, therefore, do not hesitate to recommend your Wheel to all wanting efficient and reliable power.

OVERHOLTZER & JACOBS.

MESSRS. LEFFEL & MYERS—DEAR SIR:

I take pleasure in making the following statements: I am situated on the north side of the Columbia river, six miles above Vancouver, where the Hudson's Bay Company run their saw-mill, where they used a twenty-two feet overshot wheel, and am told that they never could saw more than 1,500 feet, at their best—using all the water. And with one of your Double Turbine Wheels, under thirty-six feet head, and a twenty-inch wheel, I can cut six thousand feet of lumber; and with a ten-inch wheel, under the same head, and at the same time, can grind one hundred and twenty bushels of wheat—using no more water than the said Company used. Your Wheels make the most steady power that I ever used. For sawing, I consider it preferable to the overshot. The Turbine can be gauged so that there is no waste of water above keeping up the motion; therefore, I can recommend them to the public; and if properly put up, they need not fear the results.

Yours, respectfully, LEWIS LOVE,

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IDAHO CITY, Dec. 21st, 1865.

MESSRS. LEFFEL & MYERS:

I have long neglected writing to you, in relation to that Turbine Wheel which I bought of you last Fall; not that the wheel does not merit the highest recommendation—for if any wheel, or other piece of machinery, is worthy of a recommendation, it is Leffel's Double Turbine Water Wheel.

I cannot do it justice in speaking in its favor; nor will any one be likely to believe all that may be said, in justice, in its favor, until they have tested it. If I wanted another wheel, for any kind of milling—but especially to drive a Circular Saw—I would pay the price for the Turbine, in preference to having an Overshot, *or any other kind* that I have ever seen, if it was made a present to me.

I used mine about eight months, and used water out of Moore's Creek, when the miners were using the same water, before I got it, and it was so thick with sediment it would scarcely run; but I could see no difference between that and clear water, so far as the motion or power of the wheel is concerned.

I have reluctantly abandoend my water power, and substituted steam, in consequence of miners having the first right to the water, and there not being enough for them and the mill at the same time.

Yours, truly, I. P. LAMBING.

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PORTLAND, OGN., July 5th, 1867.

MESSRS. LEFFL & MYERS—DEAR SIRS:

We cheerfully add our testimony to the valne of your Double Turbine Water Wheels.

We have in use in our mills at Oradel, Union County, Oregon, two of your 30½ inch wheels—one driving the saw mill, and one driving our flouring mill. With the wheel in the saw mill we can cut with a 54 inch circular saw, 6,000 to 7,000 feet inch lumber in 10 hours, with ease, and with the wheel in the flour mill we can drive one pair 40 inch burrs and machinery, and grind 25 bushels per hour.

The head we use is ten feet. We are well satisfied with the wheels, and can assure all that they accomplish all that you claim for them. We know of no wheel equal to yours in value or economy of water.

J. B. HARKER,
D. OLDS, Jr.

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SALEM, OGN., July 25, 1867.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

Having been "bilked" time and again by water wheel men and water wheels, in our Woolen Factory and Flouring Mill in this city, we despared of ever having anything that would at once give power and economically use water. But having been frequently urged by you to try one of your Leffel's American Double Turbine Water Wheels, and you having guaranteed the wheel to perform as specified, we accepted the test.

We have now been using a 48-inch wheel in the Woolen Factory, of five setts of machinery, under a seventeen foot head of water for more than a year; also having substituted the wheels in our Flouring Mills. We are perfectly satisfied that your wheels are all you recommend them to be, and in every respect come up to your guarantee.

In our Flouring Mill we had four wheels driving five run of burrs, and machinery on which at most we could not grind over 40 bushels per hour. Now with one of your 30½-inch wheels we can on one burr, grind 50 bushels per hour, or with the same wheel on two burrs grind 60 bushels per hour, when we have a full head, and then we only use partial gates.

We are so well satisfied with your wheels that we are putting them in all our mills, and will this season put in a 26½-inch wheel for the machinery, a 20-inch wheel for the chopping burr, and a 35-inch wheel to drive the other two burrs.

We most cordially recommend the wheels to all wanting efficient and economical power.

L. F. GROVER, Agent,
DANIEL WALDO, President,
J. HOYT, Sup't Woolen Factory,
ANDREW McCALLEY, Head Miller.

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MCMINNVILLE, OGN., July 29, 1867.

MESSRS. LEFFEL & MYERS—GENTLEMEN:

Having been one of the first that purchased your Leffel's American Double Turbine Water Wheels in Oregon, I feel it but justice to you and the public that I add my testimony to its worth. I have had in use in my flour mill at this place for nearly two years a 15-inch wheel, under a head of 38 feet. For the first year I was not entirely satisfied with it, not knowing how to manage it, but after I ascertained the correct speed to run it, I am satisfied it is one of the best wheels in use, and no man can induce me to exchange it for an overshot, for it is so much easier managed, and also much cheaper, and by its high speed much geering is dispensed with, thereby making the cost of a mill and expense for repairs materially less.