Dimensions of this wheel, 8 arms 18 feet long, 3 by 9 inches; 16 shrouds 7 feet 9 inches long, 2½ by 7 or 8 inches; 56 buckets; and shaft 24 inches diameter.

Fig. 4 represents the penstock and trunk, &c., the water being let on the wheel by drawing the gate G.

Fig. 1 and 2, Plate XVI., represents a low overshot, 12 feet diameter, which should be in width equal to the diameter of the stone. Its parts and dimensions are, 6 arms 12 feet long, 3½ by 9 inches; 12 shrouds 6½ feet long, 2½ by 8 inches; shaft 22 inches diameter, and 30 buckets.

Fig. 3 represents a very high overshot 30 feet diameter, which should be 3½ inches wide for every foot of the diameter of the stone. Its parts and dimensions are, 6 main arms, 30 feet long, 3¼ inches thick, 10 inches wide at the shaft, and 6 at the end; 12 short arms 14 feet long, of equal dimensions; which are framed into the main arms near the shaft, as in the figure, for if they were all put through the shaft, they would make it too weak. The shaft should be 27 inches diameter, the whole being very heavy and bearing a great load. Such high wheels require but little water.

CHAPTER XX.

ARTICLE 125.

OF THE MOTION OF OVERSHOT WHEELS.

After trying many experiments, I concluded that the circumference of overshot wheels geared to mill-stones, grinding to the best advantage, should move 550 feet in a minute; and that of the stones 1375 feet in the same time; that is, while the wheel moves 12, the stone moves 30 inches, or in the proportion of 2 to 5.

Then, to find how often the wheel we propose to make, will revolve in a minute, take the following steps: 1st, Find the circumference of the wheel by multiplying the diameter by 22, and dividing by 7, thus:

Suppose the diameter to be 16 feet, then, 16 multiplied by 22, produces 352; which, divided by 7, gives 50 2-7 for the circumference.

```
   16
   22
   --
   32
  32
  ---
7)352
  ---
  50 2-7
```

By which we divide 550, the distance the wheel moves in a minute, and it gives 11, for the revolutions of the wheel per minute, casting off the fraction 2-7, it being small.

```
5|0)55|0
    --
    11 times.
```

To find the revolutions of the stone per minute, 4 feet 6 inches (or 54 inches) diameter, multiply 54 inches by 22, and divide by 7, and it gives 169 5-7 (say 170) inches, the circumference of the stone.

```
    54
    22
    --
   108
  108
  ----
7)1188
  ----
   169 5-7
```

By which divide 1375 feet, or 16500 inches, the distance of the skirt of the stone should move in a minute, and it gives 97; the revolutions of a stone per minute, 4½ feet diameter.

```
       1375
         12
       ----
17|0)1650(0|97
     153
     ---
      120
      119
      ---
        1
```

To find how often the stone revolves for once of the water-wheel, divide 97, the revolutions of the stone, by 11, the revolutions of the wheel, and it gives 8 9-11, (say 9 times.)

```
11)97
   --
   8 9-11
```

ARTICLE 126.

OF GEARING.

If the mill were to be single geared, 99 cogs and 11 rounds would give the stone the right motion, but the cog-wheel would then be too large, and the trundle too small; it must, therefore, be double geared.

Suppose we choose 66 cogs in the big cog-wheel and 48 in the little one, and 25 rounds in the wallower, and 15 in the trundle.

Then, to find the revolutions of the stone for one of the water-wheel, multiply the cog-wheels together, and the wallower and trundle together, and divide one product by the other, and it will give the answer, $8\frac{168}{375}$, not quite $8\frac{1}{2}$ revolutions, instead of 9.

```
      25
      15
     125
      25
     375

      66
      48
     528
    264
375)3168(8 168-375
    3000
     168
```

We must, therefore, devise another proportion—Considering which of the wheels we had best alter, and wishing not to alter the big cog-wheel or trundle, we put one round less in the wallower, and two cogs more in the little cog-wheel, and multiplying and dividing as before, we find the stone will turn $9\frac{1}{6}$ times for once of the water-wheel, which is as near as we can get. The mill now stands thus, a 16 feet overshot wheel, that will revolve 11 times in a minute, geared to a stone $4\frac{1}{2}$ feet in diameter; the big cog-wheel 66 cogs, $4\frac{1}{2}$ inches from centre to centre of the cogs; (which we call the pitch of the gear) little cog-wheel 50 cogs, $4\frac{1}{4}$ pitch; wallower 24 rounds, $4\frac{1}{2}$ pitch; and trundle 15 rounds, $4\frac{1}{4}$ inches pitch.

ARTICLE 127.

RULES FOR FINDING THE DIAMETER OF THE PITCH CIRCLES.

To find the diameter of the pitch circle, that the cogs stand in, multiply the number of cogs by the pitch, which gives the circumference; this, multiplied by 7, and divided by 22, gives the diameter in inches; which, divided by 12, reduces it to feet and inches, thus:

```
      66
      4½
     264
      33
     297
       7
22)2079(94½ in.
   198
    99
    88
    11
```

For the cog-wheel of 66 cogs, and $4\frac{1}{2}$ inches pitch, we find 7 feet $10\frac{1}{2}$ inches to be the diameter of the pitch circle; to which I add 8 inches, for the outside of the cogs, which makes 8 feet $6\frac{1}{2}$ inches, the diameter from out to out.

By the same rules, I find the diameters of the pitch circles of the other wheels to be as follows; namely :—

	feet.	inches.	
Little cog-wheel 50 cogs, $4\frac{1}{4}$ inches pitch,	5	$7\frac{1}{2}\ \frac{10}{22}$	pitch cir.
I add, for the outside of the circle,		$7\frac{1}{2}$	
Total diameter from out to out,	6	3	
Wallower 24 rounds, $4\frac{1}{2}$ inches pitch,	2	$11\frac{3}{4}\ \frac{4}{22}$	do.
Add, for outsides,	0	$3\frac{1}{2}\ \frac{18}{22}$	
Total diameter from the outsides,	3	3	
Trundle head 15 rounds, $4\frac{1}{4}$ inches pitch,	1	$8\frac{1}{4}\ \frac{3}{22}$	do.
Add, for outsides,	0	$2\frac{1}{2}\ \frac{19}{22}$	
Total diameter for the outsides,	1	11	

Thus, we have completed the calculations for one mill, with a 16 feet overshot water-wheel, and stones $4\frac{1}{2}$ feet diameter. By the same rules we may calculate for wheels of all sizes from 12 to 30 feet, and stones from 4 to 6 feet diameter, and may form tables that will be of great use even to master workmen, in despatching of business, in laying out work for their apprentices and other hands, getting out timber, &c.; but more especially to those who are not sufficiently skilled in arithmetic to make the calculations. I have from long experience been sensible of the need of such tables, and have therefore unfore undertaken the task of preparing them.

ARTICLE 128.

MILL-WRIGHTS' TABLES,

Calculated to suit overshot water-wheels with suitable heads above them, of all sizes, from 12 to 30 feet diameter, the velocity of their circumferences being about 550 feet per minute, showing the number of cogs and rounds in all the wheels, double gear, to give the circumference of the stone a velocity of 1375 feet per minute, also the diameter of their pitch circles, the diameter of the outsides, and revolutions of the water-wheel, and stones, per minute.

For particulars, see what is written over the head of each table. Table I. is to suit a 4 feet stone, Table II. a 4½, Table III. a 5 feet, and Table IV. a 5½ feet stone.

N. B. If the stones should be an inch or two larger or less than those above described, make use of the table that comes nearest to it, and likewise for the water-wheels. For farther particulars see "Draughting Mills."

Use of the following Tables.

Having levelled your mill-seat, and found the total fall, after making due allowances for the fall in the races, and below the wheel, suppose there be 21 feet 9 inches, and the mill-stones be 4 feet in diameter, then look in Table I, (which is for 4 feet stones,) column 2, for the fall that is nearest yours, and you find it in the 7th example; and against it in column 8, is 3 feet, the head proper to be above the wheel; in column 4 is 18 feet, for the diameter of the wheel, &c., for all the proportions of the gears to make a steady moving mill; the stones to revolve 106 times in a minute.*

* The following tables are calculated to give the stones the revolution per minute mentioned in them, as near as any suitable number of cogs and rounds would permit, which motion I find is 8 or 10 revolutions per minute slower than proposed by Evans, in his table;—his motion may do best in cases where there is plenty of power, and steady work on one kind of grain; but, in country mills, where they are continually changing from one kind to another, and often starting and stopping, I presume a slow motion will work most regularly. His table being calculated for only one size of mill-stones, and mine for four, any one choosing his motion, may look for the width of the water-wheel, number of cogs, and rounds and size of the wheels to suit them, in the next example following, keeping to my table in other respects, and you will have his motion nearly.