

Given, the depth 24 inches; required, the sides to hold 6,56 bushels.

Then, 6,56 multiplied by 2150,4 equal to 14107,624; which, divided by 8, gives 1764, the square root of which is 42 inches; which is the length of the sides of the hopper wanted.

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## CHAPTER VI.

### ARTICLE 78.

#### OF THE DIFFERENT KINDS OF GEARS, AND FORMS OF COGS.

IN order to conceive a just idea of the most suitable form or shape of cogs in cog-wheels, we must consider that they describe, with respect to the pitch circles, a figure called an Epicycloid.

And when one wheel works in cogs set in a straight line, such as the carriage of a saw-mill, the cogs or rounds, moving out and in, form a curve called a Cycloid.

To describe this figure, let us suppose the large circle in Plate V, fig. 37, to move on the straight line from O to A; then the point O, in its periphery, will describe the arch ODA, which is called a Cycloid; and by the way in which the curve joins the line, we may conceive what should be the form of the point of the cog.

Again, suppose the small circle to run round the large one; then the point o, in the small circle, will describe the arch O b C, called an Epicycloid; by which we may conceive what should be the form of the point of the cogs. But, in common practice, we generally let the cogs extend but a short distance past the pitch circle; so that their precise form is not so important.

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### ARTICLE 79.

#### OF SPUR GEARS.

The principle of spur gears, is that of two cylinders rolling on each other, with their shafts or axes truly pa-

parallel. Here the touching parts move with equal velocity, and have, therefore, but little friction; but to prevent these cylinders from slipping, we are obliged to indent, or to set cogs in, them.

It appears to me that, in this kind of gear, the pitch of the driving wheel should be a little larger than that of the leading wheel, for the following reasons:—

1. If there is to be any slipping, it will be much easier for the driver to slip a little past the leader, than for the cogs to have to force the leader a little before the driver; which would be very hard on them.

2. If the cogs should bend any, by the stress of the work, as they assuredly do, this will cause those that are coming into gear to touch too soon, and rub hard at entering.

3. It is much better for cogs to rub hard as they are going out of gear, than as they are coming in; because then they work with the grain of the wood; whereas, at entering they work against it, and would wear much faster.

The advantage of this kind of gear is, that we can make the cogs as wide as we please, so that their bearing may be so large that they will not cut, but only polish each other, and wear smooth; therefore, they will last a long time.

Their disadvantages are,

1st. That if the wheels be of different sizes, and the pitch circles are not made to meet exactly, they will not run smoothly. And,

2dly. We cannot, conveniently, change the direction of the shafts.

Fig. 38, Plate V. shows two spur wheels working into each other; the dotted lines show the pitch circles, which must always meet exactly. The ends of the cogs are made circular, as is commonly done; but, if they were made true epicycloids, adapted to the size of the wheels, they would work with less friction, and, consequently, be much better.

Fig. 39, is a spur and face wheel, or wallower, whose pitch circles should always meet exactly.

The rule for describing the sides of the cogs, so as nearly to approach the figure of an epicycloid, is as follows; namely: Describe a circle a little inside of the pitch circle, for the point of your compasses to be set in, so as to describe the sides of the cogs, (as the four cogs at A, Plate V. fig. 38—39,) as near as you can to the curve of the epicycloid that is formed by the little wheel moving round the great one; the greater the difference between the great and small wheels, the greater distance must this circle be within the pitch circle: in doing this properly, much will depend upon the judgment of the workman.\*

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## ARTICLE 80.

### OF FACE GEARS.

The principle of face gears, is that of two cylinders rolling with the side of one on the end of the other, their axes being at right angles. Here, the greater the

\* The following is Mr. Charles Taylor's rule for ascertaining the true cycloidal or epicycloidal form for the point of cogs:—

Make a segment of the pitch circle of each wheel, which gear into each other; fasten one to a plain surface, and roll the other round it as shown, Plate V. fig. 37, and, with a point in the moveable segment, describe the epicycloid  $o b c$ ; set off at the end  $o$  one-fourth part of the pitch for the length of the cog outside of the pitch circle. Then fix the compasses at such an opening, that with one leg thereof, in a certain point, (to be found by repeated trials,) the other leg will trace the epicycloid from the pitch circle to the end of the cog: preserve the set of the compasses, and through the point where the fixed leg stood, sweep a circle from the centre of the wheel, in which set one point of the compasses to describe the point of all the cogs of that wheel whose segment was made fast to the plane.

If the wheels be bevel gear, this rule may be used to find the true form of both the outer and inner ends of the cogs, especially if the cogs be long, as the epicycloid is different in different circles. In making cast-iron wheels, it is absolutely necessary to attend to forming the cogs to the true epicycloidal figure, without which they will grind and wear rapidly.

The same rule serves for ascertaining the cycloidal form of a right line of cogs, such as those of a saw-mill carriage, &c., or of cogs set inside of a circle or hollow cone. Where a wheel works within a wheel, the cogs require a very different shape.

bearing, and the less the diameter of the wheels, the greater will be the friction; because the touching parts move with different velocities—therefore, the friction will be great.

The advantages of this kind of gear are,

1st. Their cogs stand parallel to each other; therefore, moving them a little out of or in gear, does not alter the pitch of the bearing parts of the cogs, and they will run smoother than spur gears, when their centres are out of place.

2dly. They serve for changing the direction of the shafts.

Their disadvantages are,

1st. The smallness of the bearing, so that they wear out very fast.\*

2dly. Their great friction and rubbing of parts.

The cogs for small wheels are generally round, and put in with round shanks. Great care should be taken in boring the holes for the cogs, with a machine, to direct the auger straight, that the distance of the cogs may be equal, without dressing. And all the holes of all the small wheels in a mill should be bored with one auger, and made of one pitch; then the miller may keep by him a quantity of cogs ready turned to a gauge, to suit the auger; and, when any fail, he can put in new ones, without much loss of time.

Fig. 40, Plate V. represents a face cog-wheel working into a trundle; showing the necessity of having the corners of the sides of the cogs sniped, or worked, off in a cycloidal form, to give liberty for the rounds to enter between the cogs, and pass out again freely. To describe the sides of the cogs of the right shape to meet the rounds when they get fairly into gear, as at c, there must be a circle described on the ends of the cogs, a little outside of the pitch circle, for the point of the compasses to be set in, to scribe the ends of the cogs; for, if the point be set in the pitch circle, it will leave the inner

\* If the bearing of the cogs be small, and the stress so great that they cut one another, they will wear exceedingly fast; but if it be so large, and the stress so light, that they only polish one another, they will last very long.

