Grinding Action and Surface of Rolls

Summary of the Results of Investigations, by R. W. DEDRICK, Instructor, Mill Engineering State College, Pa.

The speed of rolls varies according to size. The smaller are run considerably faster than the larger. Some buildings merely give one speed for rolls of certain diameters, as say, 450 revolutions per minute for a 9-inch roll, 550 revolutions per minute for a 7-inch rool and again 600 revolutions per minute for a 7-inch roll, these being considered as the maximum speed permissible for these sized rolls. According to most catalogues the speeds of rolls are given thus: 10-inch and 9-inch rolls, 450 to 500 revolutions per minute for fast roll; 7-inch roll, 550 to 600 revolutions per minute for fast roll; 6-inch roll, 600 to 650 revolutions per minute for fast roll.

While rolls might be run at greater speed than here given, it is considered by various authorities in milling that beyond these maximum speeds it is not advisable to go. Since it is one of the prime objectives in modern milling to grind cool, that is, to so grind as to keep the temperature down to a certain limit in order not to increase or engender undue heat by excessive frictional contact of the surface of rolls with the stock being reduced. The travel of the rim surface ought not to very much exceed 1,000 feet per minute.

Under the above speed, a roll would travel if used as a wheel, nearly 11.5 miles of ground in one hour.

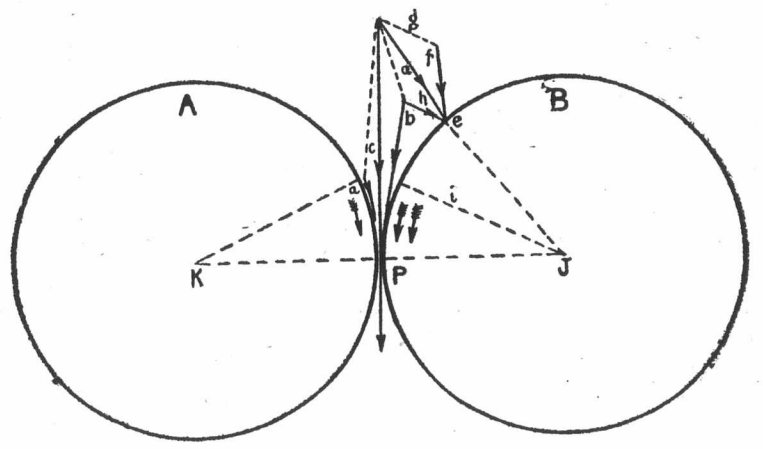

Fig. 1

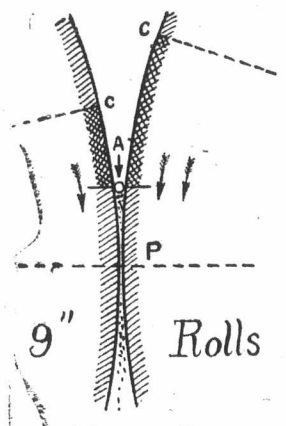

Fig. 2

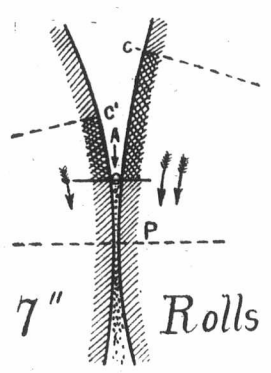

Fig. 3

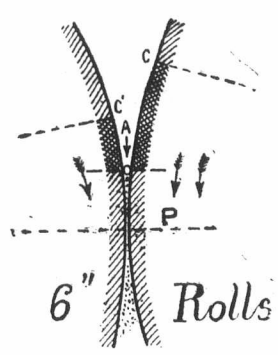

Fig. 4

The following table gives the diameter of rolls. Circumference and the speed of fast rolls given, so as to give the equivalent travel, or rim surface per minute, for each size roll:

Diameter, inches.	Circumference, inches.	Speed fast roll.	Rim travel, feet per minute.
10	31.416	406	1,062
9	28.274	450	1,062
7	21.991	580	1,062
6	18.880	676	1,062

If the 9-inch roll be taken as a standard or base, then in order to give each size roll the same rim or peripheral speed, it would be necessary to run the rolls at the above speeds or at the same ratio. At a very high rate of speed the rolls become very warm, even rot, especially with smooth rolls, by reason of the friction of roll against the stock. Heat causes the rolls to expand. The higher speed has its effect on the journal boxes also, increasing the danger of very warm or hot boxes. A roller bearing may not become so warm or hot as to become noticeable, yet may cause an expansion of the journals and even though very slight may be sufficient particularly when the rolls are set up very close and the grinding delicate as on some very fine middlings stock.

High speeds can be only attained at the expense of increased power. The higher the speed of rolls, shafting, etc., the more power consumed. It means more energy, and this again more heat. Now since the rolls become hot, this heat is communicated to or is given off to the stock passing between the rolls, and is detrimental to stock. Excessive heating in grinding has a tendency to change the characteristics of the gluten, also to iron out or to flake the material.

One of the reasons for running the rolls far above the proper speed is to increase the capacity of rolls and the mill as a whole. It would be far better to increase the surface, eitherb y using rolls larger in diameter or rolls with greater lengths, or using scratch rolls on the better class of middlings reductions, or again, middlings or scroll mills as auxiliaries. Some imagine that rolls of small diameters can be made to equal in duty and capacity rolls of larger diameters by increasing the speed of the small rolls, so as to give the same peripheral speed or rim surface per minute, arguing that as the same amount of surface is presented the grinding or crushing is as effective as that of the larger rolls. While the speeding up of the smaller rolls does to some extent render the difference as to capacity less wide than it would be otherwise, they will not equal the larger rolls in effectiveness as to capacity less wide than it would be otherwise, they will not equal the larger rolls in effectiveness of grinding and are therefore less efficient.

The reader is referred to the accompanying sketch showing "roll surface" (Figs. 2, 3, 4), where the difference of roll surface of 9-inch, 7-inch and 6-inch rolls is graphically displayed. The opening above the point P is wider or greater for small rolls than for larger and a particle of a given size will drop farther down towards P with rolls of small diameters than with rolls of larger diameters. Further, the force to crush can be utilized only and exerted by cylindrical bodies (working together) from or rather between the point of seizure A and the minimum distance at centre P. The smaller rolls have less weight, force or leverage and stability, and this with the shorter contact of working distance between the points A and P necessitates closer setting and a correspondingly greater pressure to accomplish a certain quantity of work in a given time as compared to rolls of larger diameters.

The 9-inch roll has 25 per cent more contact or grinding surface engaged in the actual grinding of stock between the rolls from the point of seizure at A to the centre at P than the 7-inch roll and 30 per cent more than a 6-inch roll, while the 7-inch roll has 8 per cent more than the 6 per cent roll.

The table below gives the square inch surface of rolls of same length, but of different diameters and the approximate weight of one roll, including the journals:

Diameter and length in inches.	Surface, square inches.	Weight in pounds.
10x20	628.82	505
9x20	565.48	405
7x20	439.82	185
6x20	377.00	185

The journals of rolls must be proportional to the diameters and lengths of the rolls or grinding cylinders, in order to bear the weight and be free from any tendency to give or spring under heavy pressure in grinding and to withstand sudden and severe shocks.

It is necessary to increase diameters of rolls when a certain length has been attained in order to avoid giving or springing, and to maintain a state of stableness under all conditions of grinding.

Below is given a table of lengths for the different diameters as found in various catalogues:

Diameters, inches.	Length in inches.
10	30, 26, 42
9	14, 18, 20, 24, 30, 36
7	14, 16, 18, 20, 24
6	12, 14, 16, 18, 20

It would be preferable to put the limit somewhat under the extreme length given above; they would do better work. Greatest length for 10-inch roll, 36 inches; for 9-inch roll, 30 inches; 7-inch roll, 20 inches, and for 6-inch roll, 16 inches.

British Flour Purchases

In connection with the appointment by the Allied Governments of a purchasing agent in New York to look after the Allies' purchase of flour in Canada and the United States, our contemporary, "Milling," of Liverpool, in the issue of Feb. 19 raises some objections. Advocating that, "it is certain that our Government should not purchase foreign flour," "Milling," says, in part:

"If the Government state that the whole of the flour purchases which have been made by the International Joint Committee are on behalf of our Allies, France and Italy, then, of course, no one, neither we nor anyone else, has any right to complain; these notes are designed not so much to complain of a mistake which may not have been made, as to utter warning so that the effects of any such buying may be clearly realized. Even so, it may be well to point out the reasons why the importation of flour is to be discouraged and the importation of wheat, as far as possible, to be encouraged. The reason may be summarized in a sentence. The importation of flour increases the price of offals and so of meat, prevents money from being made in this country; importation of wheat allows of a reserve being formed, provides work for the British manufacturer, and produces profits on the capital invested in British industry, decreases transport difficulties, lessens the amount of freight space required to provide for our breadstuffs.

"From some points of view we are not at all convinced that at a time like this, when the whole circumstances of trade are artificial, that it would not be to the advantage of the country to prohibit entirely the importation of flour from any overseas countries, except such as are part of the British Empire. In fact, this would mean Canada and Australia, and, practically speaking, Canada only. The great objection to this course is that it would deal a very serious blow to the great importing houses and the distributing houses which deal in foreign flour. This circumstance is clearly a very important one. Nothing is going to be gained, from the country's point of view, if the prohibition of the import of an unnecessary article means the killing of home trade, or if the money lost by such dislocation of the home trade is greater than the money saved by the prohibition of the importing of the articles. In the case of the foreign flour industry, prohibition of the imports of United States flour would undoubtedly bring about a serious situation, and consequently though the matter seems to us to be one of those possibilities which should be considered, we are not prepared, without further consideration, to advocate it. On the other hand, it is certain that our Government should not purchase foreign flour. If flour must be bought from overseas, then it should be bought from Canada. The better way, however, is to purchase flour from English millers, who would thus be compelled to buy an extra quantity of wheat corresponding to the amount needed."