51-289.K 26 EXAMINE 58

Dec. 10, 1946. S. E. A. THOMTE 2,412,435

METHOD OF GRINDING

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Fig. 1.

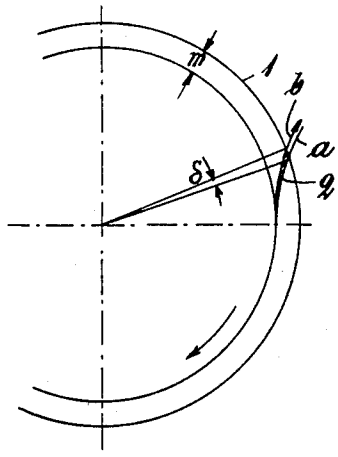


Fig. 2.

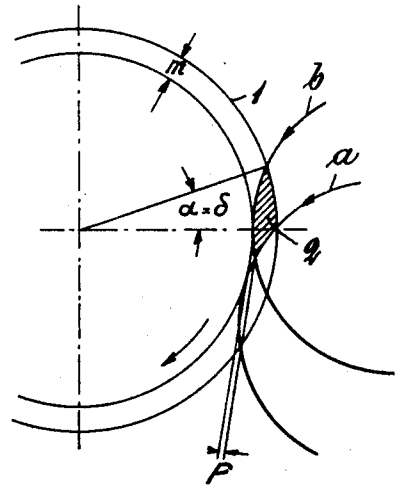


Fig. 3.

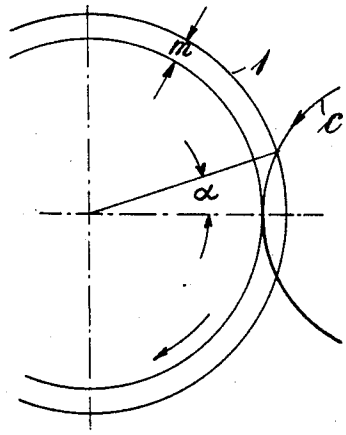
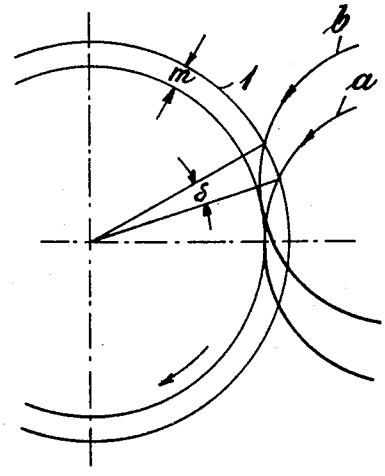


Fig. 4



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METHOD OF GRINDING

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5 Claims. (Cl. 51—281)

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The present invention relates to a method of grinding a rotating work piece with a rotating grinding wheel having a curved working surface. The principal object of the invention is to reduce the useless frictional work in grinding. The features characteristic to the invention consist substantially therein that the grinding wheel and the work piece are made to move in the same direction at the place of contact and that the relation between the peripheral velocity of the work piece and that of the grinding wheel is selected substantially greater than 1:15, and suitably greater than 1:7.5.

The method according to the invention is more closely explained below with reference to the accompanying drawing.

Figs. 1–4 disclose diagrams relating to the application of the invention to circular grinding as set forth below.

In hitherto occurring circular grinding the peripheral velocity of the work-piece 1 (Fig. 1) is at the most 2 m./sec., while the peripheral velocity of the grinding wheel (not shown) is as high as possible, usually about 30 m./sec. The grinding wheel and the work piece are then moving in opposite directions at the place of contact. When grinding under such conditions a grinding chip 2 is obtained that has the shape of an elongated comma, the cut beginning at the narrowest end of the chip *a* and *b* designate two cuts made by two successive grains of the cutting surface of the grinding wheel, when the latter rotates in the opposite direction to the work piece.

Of this grinding chip only the very last portion has any thickness worth mentioning (amounting only to a small fraction of the extent of feed *m* of the grinding wheel). During the very greatest part of the arc of contact between the grinding wheel and the work piece substantially only useless friction arises causing a powerful heating.

To reduce this useless frictional work it is suggested according to the invention, first, to let the work piece and the grinding wheel move in the same direction at the place of contact, and second, to select the relation between the peripheral velocity of the work piece and that of the grinding wheel substantially greater than hitherto so that the peripheral velocities are brought nearer to each other. It has been found that in this way the useless frictional work may be practically eliminated, whereby the output per horse power hour is considerably increased.

The case is illustrated diagrammatically in Fig. 2. The grinding wheel not shown is here supposed to have a peripheral velocity being much

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closer to the peripheral velocity of the work piece 1 than in Fig. 1 and turned in the same direction as the latter. *a* and *b* designate the curves described by two grains of the circumference of the grinding wheels in relation to the work piece 1, said two grains being supposed to immediately follow one another.

It will then be found that the grinding cut 2 limited by said two curves will obtain a considerable thickness along practically its entire length, which means that each grinding grain acts cutting along the entire arc of contact and that useless frictional work is substantially eliminated.

As a practical example of the advantages provided by the invention it may be mentioned that when grinding hardened material the output per horse power hour could be increased 14 times by selecting, instead of the usual relation 1:15 between the peripheral velocities of the work-piece and the grinding wheel, the relation 1:1.25. No heat could then be observed in spite of not using any water cooling.

A further explanation with particular reference to Figs. 3 and 4 will now be given of the factors influencing the shape of the grinding chips. In Fig. 3, *c* designates the curve described by one grain of the grinding wheel while grinding the work piece 1, *m* being the feed of the grinding wheel. α designates half of the angle of the arc between the two points where said grain cuts the circumference of the unground work piece, figured from the centre of the latter (Fig. 3).

In Fig. 4, *a* and *b* designate the similar cutting curves made by two grains of the grinding wheel immediately following one another. δ designates the angle of the arc between the two points where said two grains first cut the circumference of the work piece, figured from the centre of the latter.

When comparing Figs. 1 and 2, it is obvious that by increasing δ in relation to α, one obtains an increased grinding output (larger grinding chips), until $\delta=2\alpha$, when the chips have their maximum size. At the same time however, the smoothness of the surface is made worse so that at the latter limit the point of material *p* left on the work piece between two succeeding grain curves *a* and *b* (Fig. 2) will have the same height as the depth of the grinding feed *m*. The surface will therefore be coarser the more the value $\delta=2\alpha$ is approached.

A suitable chip shape is obtained when $\delta=\alpha$, which case is illustrated in Fig. 2. The output will then be great, and the smoothness of the surface at the same time good. The smaller δ is chosen, for example by taking a more fine-

grained grinding wheel, the smoother the surface will become, but at the same time the output is reduced.

By reducing α, which is done by nearing the peripheral velocities of the work piece and the grinding wheel to one another, the grinding chip is made shorter, and the useless frictional work is reduced. The frictional work becomes smaller, the greater said relation between the peripheral velocities is selected; that is by increasing said relation from 1:7.5 over the quotients 1:6, 1:5, 1:4, 1:3, and 1:2 to 1:1, the frictional work is gradually reduced to nought, i. e. the grain will then no more cut but only be pressed into the work piece. The upper limit is reached when $\delta=2\alpha$.

If the relation between the peripheral velocities is selected greater than corresponds to this value, wider and wider unfinished portions will be formed on the work piece between the grinding chips cut away between the two immediately succeeding grains of the grinding wheel, until no grinding at all takes place at the value 1:1. If said relation between the peripheral velocities is selected greater than 1:1, grinding is again obtained but at first only in spots.

Although the invention has been described above only when applied to external grinding (circular grinding), it is obvious that it may be utilised with the same advantages also in internal grinding. It may then prove necessary to flush away by a powerful air current such grinding chips that will tend to stick to the working surface due to the centrifugal force.

Having now particularly described the nature of my invention and the manner of its operation what I claim is:

1. A method of grinding a rotating work piece with a rotating grinding wheel having an arcuate grinding surface which comprises moving the work piece and the grinding wheel in the same direction at the place of contact, maintaining the peripheral velocity of the work piece in relation to the velocity of the grinding wheel greater than 1:15, and maintaining less than 2:1 relation between an angle (δ) of an arc extending between two points where two immediately succeeding grains of the grinding wheel cut the circumference of the work piece and half of an angle (2α) of the arc extending between the two points where a single grain curve cuts the same circumference.

2. A method of grinding a rotating work piece with a rotating grinding wheel having a curved grinding surface which comprises rotating the work piece and the grinding wheel in the same direction at the place of contact, maintaining the peripheral velocity of the work piece in relation to the velocity of the grinding wheel greater than 1:7.5, and maintaining less than 2:1 relation between an angle (δ) of an arc extending between two points where two immediately succeeding grains of the grinding wheel cut the circumference of the work piece and half of an angle (2α) of the arc extending between the two points where a single grain curve cuts the same circumference.

3. A method of grinding a rotating work piece with a rotating grinding wheel having a curved grinding surface which comprises turning the work piece and the grinding wheel in the same direction at the place of contact, maintaining the peripheral velocity of the work piece in relation to the peripheral velocity of the grinding wheel greater than 1:3, and maintaining less than 2:1 relation between an angle (δ) of an arc extending between the two points where two immediately succeeding grains of the grinding wheel cut the circumference of the work piece and half of an angle (2α) of the arc extending between two points where a single grain curve cuts the same circumference.

4. A method of grinding a rotating work piece with a rotating grinding wheel having a curved grinding surface which comprises rotating the work piece and the grinding wheel in the same direction at the place of contact, maintaining the peripheral velocity of the work piece in relation to the peripheral velocity of the grinding wheel greater than 1:2, and maintaining less than a 2:1 relation between an angle (δ) of an arc extending between two points where two immediately succeeding grains of the grinding wheel cut the circumference of the work piece and half of an angle (2α) of an arc extending between the two points where a single grain curve cuts the same circumference.

5. A method of grinding a rotating work piece with a rotating grinding wheel having a curved grinding surface which comprises, moving the work piece and the grinding wheel in the same direction at the place of contact with the peripheral velocity of the work piece greater than that of the grinding wheel, and maintaining less than a 2:1 relation between an angle (δ) of an arc extending between two points where two immediately succeeding grains of the grinding wheel cut the circular circumference of the work piece and half of an angle (2α) of an arc extending between the two points where a single grain curve cuts the same circumference.

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