Oct. 30, 1934. P. DAVEY 1,979,146

GRINDING WHEEL SPINDLE

Filed May 3, 1932

Fig. 1.

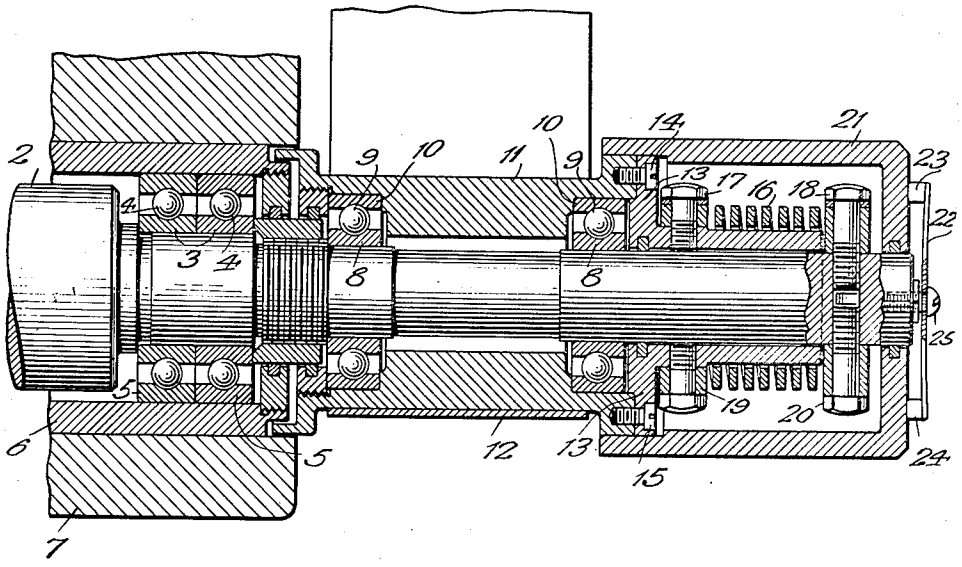
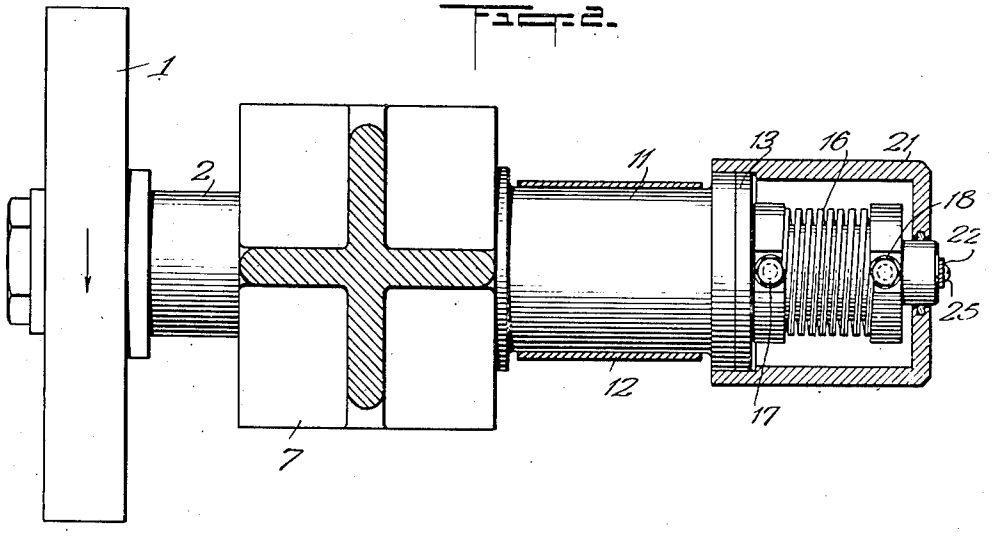


Fig. 2.



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GRINDING WHEEL SPINDLE

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3 Claims. (Cl. 51—166)

This invention relates to grinding machines, more especially to machines for precision grinding of metallic bodies, and more particularly to the grinding wheel spindle thereof.

It is well understood that many parts of modern machinery, especially relatively moving parts, are finished by a grinding operation which is designed to bring the part to the precise form and dimensions desired. Machines for performing this grinding, are truly machines of the utmost precision, and they produce an article of substantially the perfection desired within the fixed tolerance limits.

It has been found, however, that such precision grinding machines, especially those used for producing the internal surface of a race, either ball or roller, at times produce such articles which, although substantially perfect, nevertheless, exhibit a multitude of extremely slight microscopic valleys and ridges called, "chatter marks", in the ground surface. The effect of these chatter marks is observable when the ground article is put into use, causing an undesired vibration of the associated parts which becomes accentuated by further use.

Many attempts have been made to obviate the production of these undesired chatter marks. When they occur in a product, some believe that further occurrence thereof may be prevented by changing the abrasive or grinding wheel, others change the wheel spindle, either substituting another spindle of exactly the same form and size or another spindle slightly different in some respect. Many theories of the cause of this difficulty have been evolved, and depending upon the particular theory believed, one or the other of the theoretical remedies is applied, but with no uniform success because, apparently, the true reason for the formation is not known.

I have made an extensive study of the problem of preventing such chatter marks, and have made numerous experiments to determine the cause thereof. My extensive study and experiments, involving the use of different grades and sizes of grinding wheels, different sizes and designs of grinding wheel spindles, and relative speeds of the work operated upon and the grinding wheel itself, have disclosed to me that, contrary to prevailing opinion, the chatter marks in question, are not always caused by an unbalance either in the grinding wheel or the spindle or its associated parts, but the formation of the chatter marks is due to what might be called substantially instantaneous changes in speed of relative rotation between the grinding wheel and the article operated upon. This relative change, I have ascertained, is usually due to a momentary slight relative twisting back and forth, of parts of the spindle carrying the grinding wheel.

Guided by my investigations and discoveries, my principal object is to produce a construction of grinding wheel spindle and associated parts which will obviate the objectionable difficulty hereinbefore mentioned.

Other objects and advantages will appear as the description of the particular physical embodiment selected to illustrate the invention progresses, and the novel features will be particularly pointed out in the appended claims.

In describing the invention in detail and the particular physical embodiment selected to illustrate the invention, reference will be had to the accompanying drawing and the several views thereon, in which like characters of reference designate like parts throughout the several views, and in which:

Figure 1 is a sectional view of a grinding spindle and its bearings; Fig. 2 is a top plan view of the device as shown by Fig. 1, with certain parts in section to more clearly show the construction and with a grinding wheel attached to the spindle of the device.

In order to illustrate and describe the principle underlying my invention and the best construction of a device embodying my invention, I have illustrated, in the drawing a simple grinding machine with my invention incorporated therein.

The fragmentary grinding machine illustrated by me in the drawing is, in parts, of conventional arrangement. A grinding wheel 1, shown in Fig. 2, is mounted on a spindle 2. This spindle is continuous from the left to the right hand end, as shown in Fig. 1. The spindle is supported by ball races 3 which in turn are supported by the balls 4, race 5 and support 6, fastened or secured in any appropriate manner to a stationary support as 7.

The spindle 2 extends to the right, as shown in Fig. 1 and supports ball races 8 which, through the balls 9 and races 10, support the pulley or driver 11 about which passes driving belt 12 from the source of power.

Ordinarily the pulley or driver 11 does not rotate independently of the spindle 2, but is fastened rigidly to the spindle 2. In applicant's construction, however, the driver or pulley is not fastened in the usual manner rigidly to the spindle. Applicant attaches a shouldered

sleeve 13 to the driver 11, as by screws as 14 and 15. This sleeve has a helical spring 16 coiled thereabout. One end of the spring is coiled about the screw 17 and fastened to the sleeve 13. The other end of the spring is coiled about the screw 18 passing into the spindle.

By the above described construction the driver 11 does not transmit its rotative force directly to the spindle 2, but only through the resilient spring member 16 by way of the sleeve 13 and screw 18 attached to the spindle. By such construction anything which causes, in effect, a more than or less than normal speed of the driver 11, that is, an acceleration or deceleration, is not transmitted directly to the spindle 2, but being transmitted to the spring 16, causes a tightening or loosening of the spring.

The tightening or loosening of the spring tends to set up an oscillation in the spring which is in the direction of the first oscillation, opposite to that in which the spring is moved by the accelerating or decelerating force. This oscillation of the spring and the energy of the acceleration or deceleration is absorbed or dissipated by a friction damper. This damper in dissipating the energy of an accelerating or decelerating force also tends to reduce the amplitude of the oscillation of the spring.

In order to prevent this oscillation as much as can conveniently be done, applicant employs a damper or brake, which in the form shown for illustration comprises a resilient spring member 22 having on each end a pad or shoe member, as 23 and 24, bearing against the thimble casing 21 which is attached to the driver 11. This spring member 22 is attached to the spindle 2 by means of the screw 25 which may be adjusted in or out so as to increase or decrease the frictional engagement between the thimble casing 21 and the pads 23 and 24. A preferred adjustment of this damper or brake is such that the oscillations of the spring 16 are reduced to a minimum without at the same time introducing so much friction between the sleeve 21 and the pads 23 as to nullify the effect of the spring 16.

Thus by absorbing the accelerating or decelerating force in the spring 16 and then dissipating the energy thereof by means of the damper 22 rapid changes in speed of the grinding wheel in relation to the work being ground is prevented and the objectionable chatter marks on the surface of the work being ground are not formed.

In order to prevent an unbalance applicant has placed a dummy screw and collar 19 on the side of the sleeve opposite 17 and has placed a dummy sleeve and collar 20 on the spindle opposite the screw 18.

In order to protect the resilient means 16 applicant covers the same with a thimble casing 21.

Although I have particularly described one particular embodiment of my invention and explained the principle and construction thereof, nevertheless, I desire to have it understood that the form selected is merely illustrative, but does not exhaust the possible physical embodiments of the idea of means underlying my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a grinding machine, in combination: a grinding wheel; a rotatable spindle upon which the wheel is rigidly mounted; fixed bearings in which the spindle is mounted; a rotatable driver for the spindle adapted to be rotated from a source of power; means interposed between the driver and the spindle adapted to transmit rotative force from the driver to the spindle and to allow some rotational movement between the driver and the spindle and means acting to prevent too rapid recovery of a former relative rotational position after departure therefrom.

2. In a grinding machine; in combination: a grinding wheel; a rotatable spindle upon which the wheel is rigidly mounted; fixed bearings in which the spindle is mounted; a rotatable driver for the spindle adapted to be rotated from a source of power; resilient means interposed between the driver and the spindle adapted to transmit rotative force from the driver to the spindle and to allow some rotational movement in either direction between the driver and the spindle at all times during the rotation of the spindle; and means acting to prevent too rapid recovery of a former relative rotational position after a departure therefrom.

3. In a grinding machine, in combination: a grinding wheel; a rotatable spindle upon which the wheel is rigidly mounted; a fixed bearing in which the spindle is mounted; a driver mounted on the spindle and rotatable thereabout; said driver having an extended sleeve enclosing a portion of the spindle attached thereto; a helical spring wrapped about the sleeve and having one end attached to the sleeve and the other end attached to the spindle.

PETER DAVEY.