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GEAR GRINDING MACHINE

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2 Sheets-Sheet 1

Fig. 1.

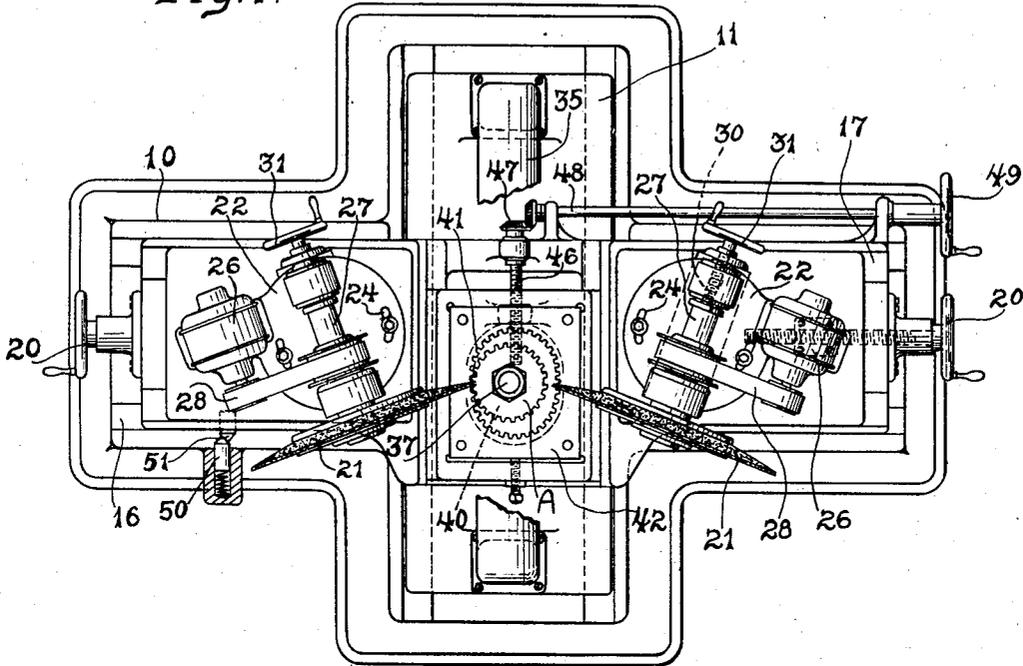
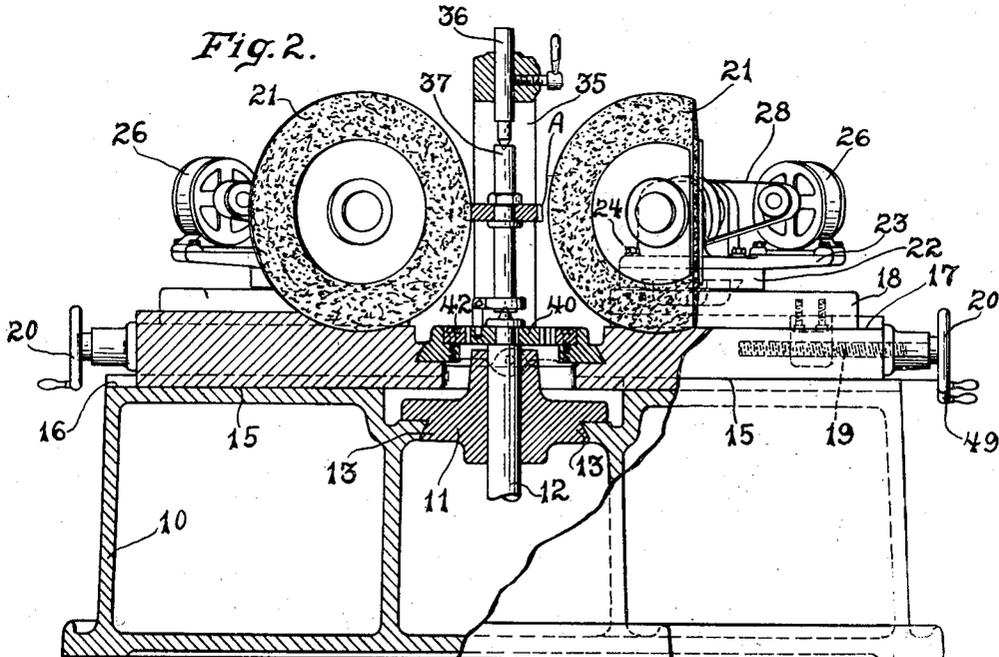


Fig. 2.



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## GEAR-GRINDING MACHINE.

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This invention relates to gear grinders and in particular to a grinder for gears preferably provided with two grinding wheels mounted on a slide so that the wheels may be actuated to correctly engage successive teeth on the gear blank and generate involute tooth curves thereon.

One of the objects of the invention is to mount the gear blank being ground on a rotating spindle carried in a reciprocating slide movable at right angles to the direction of movement of the slide carrying the wheels.

Another object of the invention is to provide special means for guiding and controlling the relative movements of the wheels and the blank on their respective supporting slides, these means comprising a member having a toothed periphery carried preferably by the slide mounting the wheels. This is adapted to be engaged by a master gear on the spindle carrying the blank.

Another object of the invention is to provide a modified form of machine operating upon the same general principle defined in the application of H. D. Tanner, Serial No. 544,176, filed March 16, 1922.

Another object of the invention is to provide special feeding means for the blank relative to the wheels comprising means to advance the member carrying the toothed periphery in a direction normal to the direction of movement of the slides carrying the wheel.

With these and other objects in view, my invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, I have shown my invention embodied in a grinding machine for spur gears but it will be understood that certain features of the invention may be otherwise embodied, or adapted for gears of other types, and that the drawings are not to be construed as defining or limiting the scope of this invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a plan view of the complete machine.

Fig. 2 is an elevation partly in section of the complete machine.

Fig. 3 is a plan of a modified form of the machine, and

Fig. 4 is a sectional elevation of this modified form.

In the above mentioned drawings, I have shown but two modifications of the invention which are now deemed preferable but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, my invention in its broadest aspect comprises the following principal parts: first, a base; second, a vertically supported rotatable spindle carried in a slide movable horizontally along the base; third, a master gear on the spindle; fourth, means on the spindle adapted to support and rotate a work arbor; fifth, a second slide engaging ways on the base so that it may be moved horizontally in a direction normal to the movement of the spindle carrying slide; sixth, independently adjustable slides on said second slide carrying a wheel head, these latter slides permitting the rotatable wheel spindle and abrasive wheel thereon to be adjusted to any desired position with the wheel rotatable about a horizontal axis.

Referring more in detail to the figures of the drawings, and particularly to Figs. 1 and 2, I provide a base having substantially in the center thereof a support 11 for a rotatable spindle 12 disposed vertically therein. The support 11 is provided with dove-tailed projections 13 engaging dove-tailed ways provided horizontally on the base 10. The spindle 12 carried in this support 11 is adapted to be continuously rotated by any convenient means not shown.

On the upper horizontal surfaces 15 of the base 10 are provided ways extending at right angles to those for the spindle support 11 and in which may be guided the projection formed on a large slide 17. This slide 17 provides means for mounting the wheel head or heads 18 in a manner permitting it or them to be reciprocated to the left or right.

On this upper or second slide 17 are mounted suitable individual wheel supporting slides 18 which may be adjusted longi-

tudinally on the slide 17 by means of suitable screws 19 as shown in Figs. 1 and 2. These screws 19 may be rotated by means of the hand wheels 20. In this way, the wheel or wheels indicated at 21 may be adjusted to operate upon gears of different diameters. Slides 18 have mounted thereon slides 22 carrying swivelling wheel heads 23 which may be clamped in any adjusted angular position by means of the clamping bolts 24. The swivelling heads 23 are provided with motors 26 which may be placed in driving connection with the wheel spindles 27 by means of suitable belts 28. The swivelling heads 23 together with the wheels 21 mounted thereon may be moved axially of their spindles 27 by means of suitable screws 30 rotated by a hand wheel 31 fixed directly thereto. On the spindles 27 are the abrasive wheels 21 each adapted to contact with work upon one of their plane radial surfaces. As the particular form of the slides 18 and the parts thereon for mounting the wheels 21 are, or may be, similar to those described in the above-mentioned application of H. D. Tanner, further description of them is thought to be unnecessary. In all positions of adjustment, the wheels rotate about a horizontal axis.

Fastened to the opposite ends of the slide 11 on which is mounted the spindle 12 is an arch 35 extending completely across the machine. This arch 35 at its uppermost and central position is provided with an adjustable plunger 36 which is in direct alignment with the vertical rotating spindle 12 previously referred to. This plunger 36 and also the spindle 12 are provided respectively with centers thus furnishing means for rotatably mounting the work arbor 37 and the work A between them. In this way also, rotation of the spindle 12 provides means to rotate the work arbor 37 in accordance therewith about the axis of the spindle 12. As above described the spindle 12 may be moved to different positions by movement of the supporting slide 11.

Detachably fastened to the upper end of the vertical spindle 12 is a master gear 40, this being of the same form, pitch, diameter and number of teeth, etc., as the gear blank A being ground. As this master gear 40 must be chosen with particular reference to the gear being ground and must be changed whenever the type or size of gears being ground is changed, it is made readily removable. This master gear 40 is adapted to contact with internal gear teeth 41 formed on a member 42 having an elongated or elliptical opening. This member 42, as shown clearly in Fig. 1, is slidably mounted within the slide 17 carrying the wheel slides 18 and wheels 21. The form of this toothed periphery is such that opposite portions have short sections provided with teeth of rack form.

These are disposed on the periphery of the opening directly below the wheels 21. The ends of the toothed periphery, including all of its toothed outline except those portions which are of rack form, comprise segments of internal gears. It will be seen from this construction that rotation of the vertical spindle 12 and its master gear 40 thereon will force the slide 17 carrying the wheels to the left and right and also will force the slide or support 11 carrying the spindle 12 to reciprocate in a direction normal to the direction of movement of the wheel slide 17. During these movements of the slides 11 and 17, the master gear 40 contacts with the teeth forming the outline of the opening in plate 42. These movements will take place simultaneously and in timed relation to each other in such a manner that the master gear will always be about in an orbital or generally elliptical path. Also, as the wheels 21 are mounted on the slide 17 and move therewith, they will be alternately advanced and retracted into and out of contact with the work A on the spindle 37. In this way, involute toothed curves will be formed upon the gear blank. In effect the relative movements of the wheels 21 and the blank A in the present construction are similar to their movement in the application of H. D. Tanner. In the Tanner construction the wheels are stationary and the work spindle is moved about while rotating whereas in the present construction both the work spindle and the wheels have movements in timed relation to each other. The separate components effect a relative orbital movement.

During operation, the work engaging surfaces of the wheels 21 may be adjusted by means of the screws 19 and 30 so that the slide 18 and swivelling heads 23 on which they are mounted may be positioned relative to the toothed periphery in member 42 to properly engage the work A. During this engagement, the abrasive surface of one of the wheels 21 is in alignment with one side of one of the rack teeth on this periphery and the other abrasive surface, when two wheels are used, is in contact with the opposite side of another rack tooth. In this way, when two wheels are used, rotative movement of the master gear 40 sufficient for it to be engaged by all the teeth in the toothed path in member 42 will cause the abrasive wheels 21 to contact with the opposite sides of different teeth. Each of the wheels 21 will be advanced into and withdrawn out of contact with the opposite sides of teeth on the gear blank A. This action will take place during a relative rolling movement of the master gear 40 about the toothed periphery of member 42 during which time its teeth contact with all of those on the elliptical outline.

In operation, the rotation of the spindle

12 and blank A is continuous so that engagement of the master gear 40 with the periphery of member 42 reciprocates the support or slide 11 and the slide 17. These slides 5 11 and 17 will be simultaneously reciprocated in a direction at right angles thereto. The result of these component movements of the slides 11 and 17 is to roll the blank A about its pitch cylinder while momentarily in contact with the abrasive surfaces of the wheels 21. To hold the slide in either 10 of its limits of movement, a spring pressed detent 50 is provided adapted to engage a projection 51 outstanding from the slide 17.

15 It will be seen also that if the toothed periphery of member 42 be formed so that it has a number of teeth incommensurate with the number of teeth on the master gear, and therefore of the blank being ground, 20 then each successive rotation of the blank A will vary the relative positions of the slides 11 and 17 carrying the spindle 12 and wheels 21. In other words, one complete cycle of movements of the slides 11 and 17 due to the 25 engagement of the master gear 40 with the entire periphery of the toothed outline on member 42 occurs while the master gear 40 and blank A rotate somewhat more than a complete revolution. The angular or rota- 30 tive position of the blank A therefore with each cycle of operations will be advanced relative to its previous position thus effecting an indexing of the blank A relative to the wheels 21. In this way, no special indexing mechanism is required and continuous 35 rotation of the spindle 12 and relative movements of the parts connected therewith as above described will completely grind the tooth curves upon each of the teeth in the 40 blank.

In operation, after the blank A has been mounted in position on the spindle 12 and the wheel heads 18 adjusted for the particular gear to be ground, the rotation of 45 this blank A will cause each of the wheels 21 to alternately contact therewith. Also during operation to effect feeding movements of the blank A relative to the abrasive surfaces of the wheels 21, the member 42 may 50 be advanced slightly in a direction normal to the movement of the slide 17 by means of a suitable screw 46. As shown in Fig. 1, this screw 46 is connected by bevel gears 47 to a long shaft or rod 48 suitably mounted 55 on the slide 17 and having a hand wheel 49 on its end.

Coming now to a description of the modified form of the invention shown in Figs. 3 and 4, it will be seen that the form of the 60 slide carrying the wheels is materially changed. The remaining parts of the machine, however, are for the most part duplicates of the parts shown in Figs. 1 and 2. For this reason, the same reference characters 65 have been applied to these parts in

both embodiments of the invention. Instead of the slide 17 having wheels mounted on opposite sides of the work, a slide 17<sup>a</sup> is provided mounted on the base 10<sup>a</sup> carrying two 70 adjacent slides 18<sup>a</sup> respectively movable toward and from each other. These wheel carrying slides 18<sup>a</sup> on slide 17<sup>a</sup> correspond in every way (except in respect to their positions) to the slides 18 shown in Figs. 1 and 2. In fact this modification may be so 75 designed that identical slides 18 may be used on the slide 17<sup>a</sup> as on slide 17. In order to move these slides 18<sup>a</sup> toward and from each other, a screw 19<sup>a</sup> is provided having right and left hand threads thereon respectively 80 engaging the two slides 18<sup>a</sup>. Rotation of this screw 19<sup>a</sup> by means of the hand wheel 20<sup>a</sup> shown serves to position the wheels 21<sup>a</sup> on these slides 18<sup>a</sup> correctly relative to the work A, and to feed them relative to the 85 work during the grinding operation. To hold the slide 17<sup>a</sup> in its operative and inoperative positions during the grinding operation, a spring pressed detent 50<sup>a</sup> is provided similar in every way to the detent 50 90 shown in Fig. 1.

As shown clearly in Figs. 3 and 4, the slide 17<sup>a</sup> is mounted on suitable guideways 16<sup>a</sup> provided on the upper surface of the 95 base 10<sup>a</sup>. Mounted in this manner the slide 17<sup>a</sup> is free to move directly toward or from a slide 11<sup>a</sup> on which is mounted the work spindle 12<sup>a</sup> and its arbor 37<sup>a</sup>.

The work spindle 12<sup>a</sup> is mounted upon slide 11<sup>a</sup> which in every way corresponds to 100 slide 11 shown in Figs. 1 and 2. This is provided with the vertically disposed rotatable spindle 12<sup>a</sup> corresponding exactly with that shown in Figs. 1 and 2. Also an arch 35<sup>a</sup> may be provided on slide 11<sup>a</sup> 105 similar to the arch 35 to support the work arbor 37<sup>a</sup>.

On the portion of the slide 17<sup>a</sup> directly adjacent the vertically disposed spindle 12<sup>a</sup> is provided the plate or member 42<sup>a</sup> corre- 110 sponding to the member 42 and provided with a similar toothed periphery. This is adapted to engage with a master gear 40<sup>a</sup> removably mounted on the spindle 12<sup>a</sup> carrying the work arbor. As the slide 11<sup>a</sup> is 115 movable at right angles to the direction of movement of the slide 17<sup>a</sup>, rotation of the spindle 12<sup>a</sup> and its master gear 40<sup>a</sup> will cause these slides 17<sup>a</sup> and 11<sup>a</sup> to be reciprocated to advance and retract the abrasive surfaces 120 of the wheels 21<sup>a</sup> laterally into and out of engagement with the work A. The operation of this form of the gear tooth grinding machine is in every way similar to that shown in Figs. 1 and 2. For that reason, 125 a description of the mode of operation is not thought to be necessary.

What I claim is:

1. A gear grinding machine comprising in combination, a base, slides thereon movable 130

- in directions at right angles to each other, a work supporting spindle on one of said slides means to rotate the spindle during the grinding operation, an abrasive wheel on the other of said slides, means to relatively move said slides to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel, and means to constantly rotate said work spindle.
2. A gear grinding machine comprising in combination, a base, slides thereon movable in directions at right angles to each other, a work supporting spindle on one of said slides, an abrasive wheel on the other of said slides, a master gear on said spindle and a member on one of said slides having a toothed periphery engaged by said master gear to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel.
3. A gear grinding machine comprising in combination, a base, slides thereon movable in directions at right angles to each other, a work supporting spindle on one of said slides, means to rotate said spindle, an abrasive wheel on the other of said slides, and means to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel, said means comprising a master gear on said spindle and a member having a toothed periphery mounted on the slide carrying the abrasive wheel and adapted to engage the master gear.
4. A gear grinding machine comprising in combination, a base, slides thereon mounted on independent guideways so that they may be moved in directions at right angles to each other, a rotatable work supporting spindle on one of said slides, an abrasive wheel on the other of said slides, and interengaging means on the spindle and slide carrying the abrasive wheel to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel.
5. A gear grinding machine comprising in combination, a base, slides thereon mounted on independent guideways so that they may be moved in directions at right angles to each other, a rotatable work supporting spindle on one of said slides, an abrasive wheel on the other of said slides, and gear tooth members mounted respectively on the spindle and the slide carrying the abrasive wheel to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel.
6. A gear grinding machine comprising in combination, a base, slides thereon mounted on independent guideways so that they may be moved in directions at right angles to each other, a work supporting spindle on one of said slides, means to rotate the spindle during the grinding operation, a pair of abrasive wheels on and movable with the other of said slides, and means to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheels.
7. A gear grinding machine comprising in combination, a base, slides thereon mounted on independent guideways so that they may be moved in directions at right angles to each other, a rotatable work supporting spindle on one of said slides, a pair of abrasive wheels on and movable with the other of said slides, and means constraining the slides to move within a predetermined path to cause engagement and disengagement of a gear blank on said spindle with said abrasive wheel.
8. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, slides on said base movable respectively at right angles to each other, a member on one of said slides having an internal toothed periphery, an abrasive wheel adjustably mounted on said slide, and means to rotate the spindle while said gear is in engagement with the teeth on said member, and while said slides are actuated to engage the wheel with a gear blank on said spindle.
9. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, slides on said base movable respectively at right angles to each other, a member on one of said slides having an internal toothed periphery, the opposite portions of which have teeth of rack form, an abrasive wheel adjustably mounted on said slide, and means to rotate the spindle while said gear is in engagement with the teeth on said member, and while said slides are actuated to engage the wheel with a gear blank on said spindle.
10. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, slides on said base movable respectively at right angles to each other, a member on one of said slides having an internal toothed periphery, a pair of abrasive wheels adjustably mounted on said slide, and means to rotate the spindle while said gear is in engagement with the teeth on said member, and while said slides are simultaneously actuated in a predetermined path to engage the wheel with a gear blank on said spindle.
11. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, slides on said base movable respectively at right angles to each other, a member on one of said slides having an internal toothed periphery, a pair of abrasive wheels adjustable angularly and toward and from each other on said slide,

and means to rotate the spindle while said gear is in engagement with the teeth on said member, and while said slides are actuated to engage the wheel with a gear blank  
5 on said spindle.

12. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, slides on said  
10 base movable respectively at right angles to each other, a member on one of said slides having an internal toothed periphery, oppo-

site portions of which have teeth of rack form, a pair of abrasive wheels adjustable angularly and toward and from each other  
15 on said slide, and means to rotate the spindle while said gear is in engagement with the teeth on said member, and while said slides are actuated to engage the wheel with a gear blank on said spindle. 20

In testimony whereof, I hereto affix my signature.

ARTHUR L. WILDER.