Feb. 23, 1932. C. G. OLSON 1,846,272

METHOD OF GRINDING HOBS

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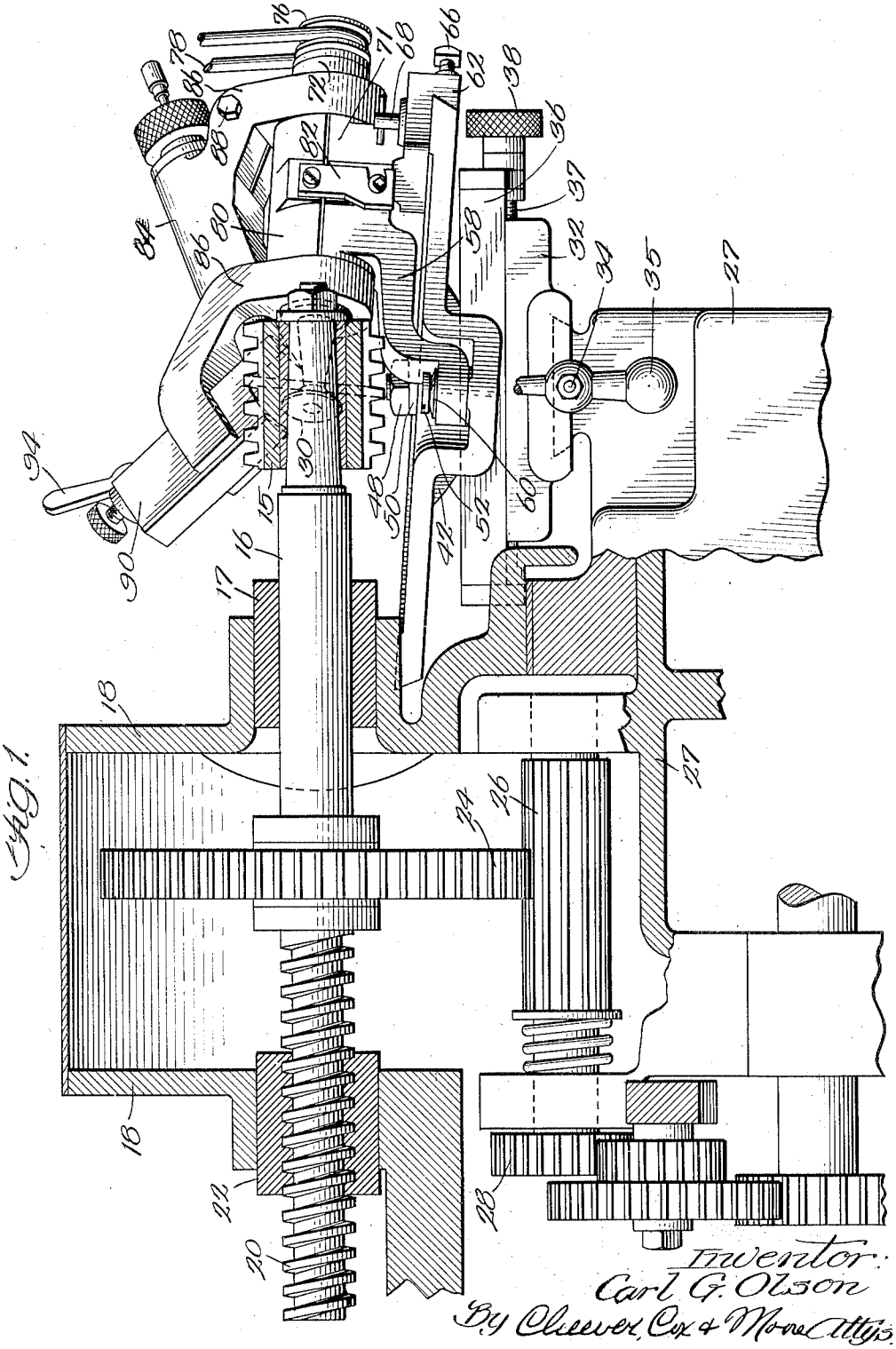


Fig. 1.

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Fig. 2.

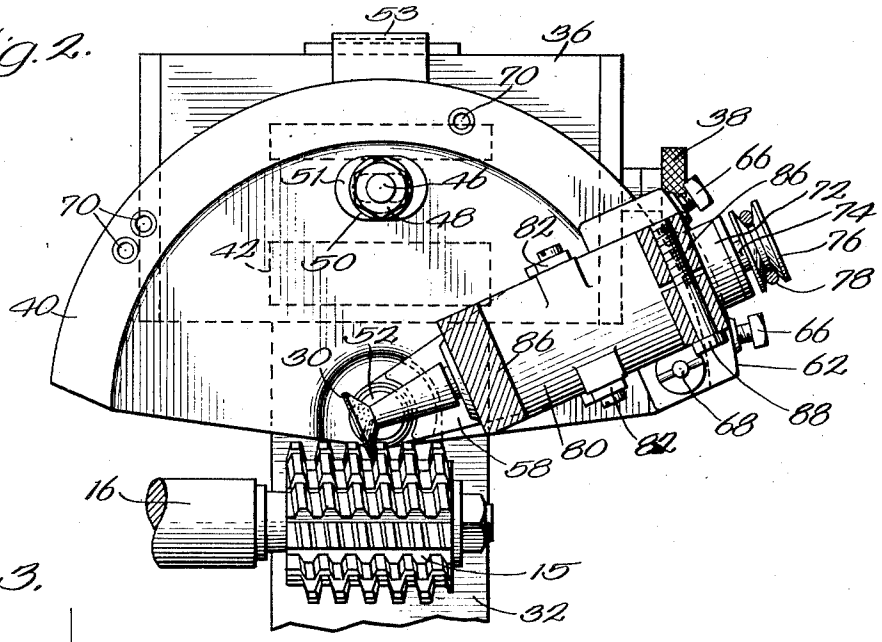


Fig. 3.

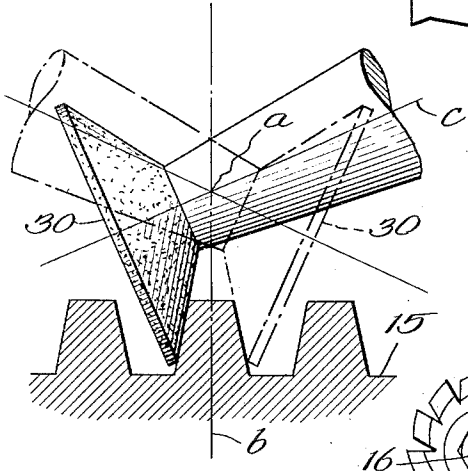


Fig. 4.

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Fig. 5.

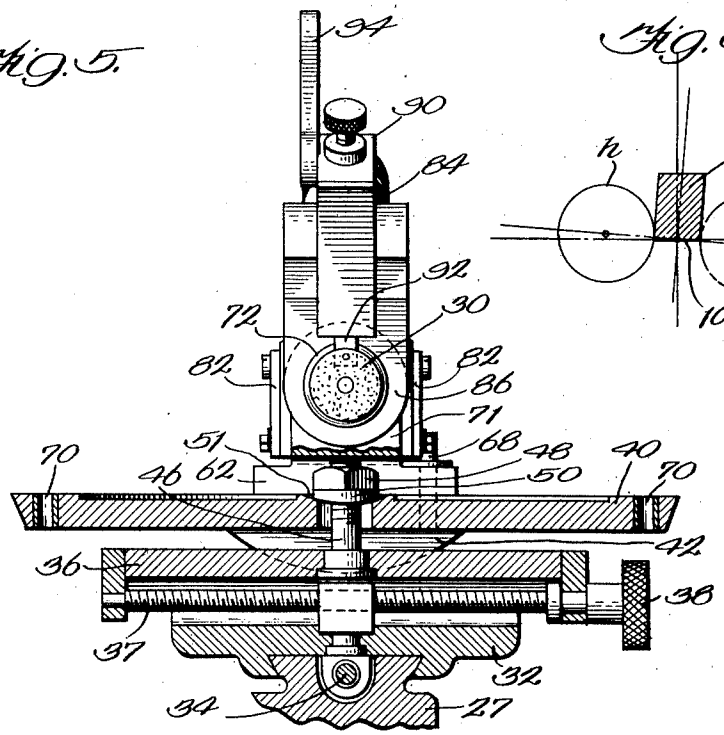


Fig. 8.

Fig. 7.

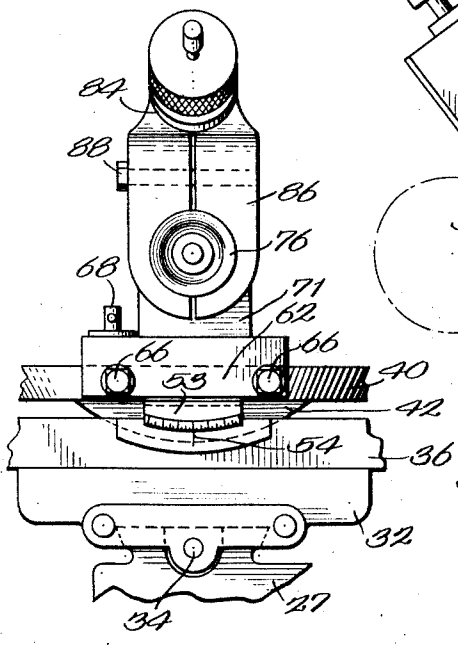
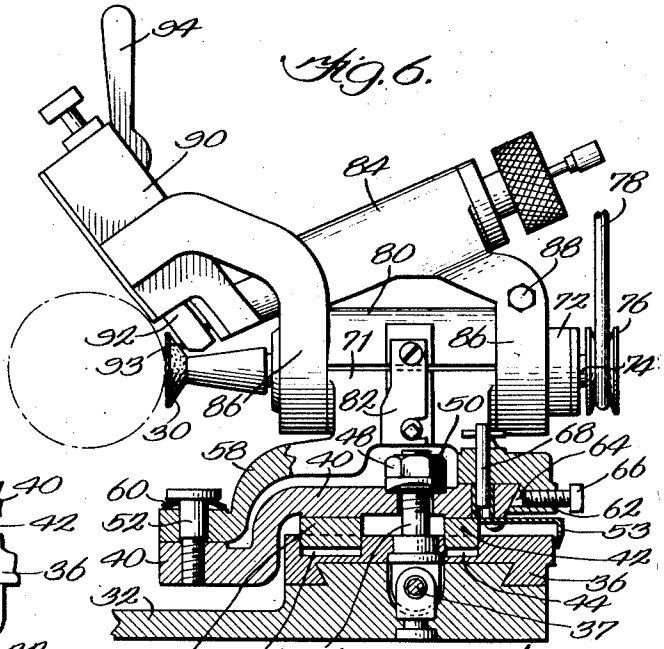


Fig. 6.



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UNITED STATES PATENT OFFICE

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METHOD OF GRINDING HOBS

Original application filed May 1, 1926, Serial No. 105,966, now Patent No. 1,702,520, dated February 19, 1929. Divided and this application filed April 15, 1929. Serial No. 355,306.

My invention relates to methods of grinding hobs and particularly to improved methods of grinding the peripheral surfaces of the hob teeth after hardening.

This invention is a division of the invention set forth in my Patent No. 1,702,520.

One of the primary objects of my present invention is to provide an improved simple method of grinding hob teeth which will make for accuracy in the work produced and which will enable hob teeth to be ground with considerable ease and without the necessity of complex manipulations and adjustments.

In order to more fully comprehend the advantages and objects of my present invention, attention is directed to the accompanying drawings herein:

Figure 1 is a front elevation of a machine partly in section, said machine being representative of one means whereby the method of the present invention may be effectively practiced.

Figure 2 is a top plan view partly in section showing the tool holder or grinder head and associated parts.

Figure 3 is a detail view illustrating the manner in which the grinding wheel may be reversed to grind opposite sides of the hob teeth.

Figure 4 is an end elevation looking towards the left of Figure 1.

Figure 5 is a sectional elevation showing the tool holder and associated parts. In this view the tool holder is shown to be adjusted to the center of the sector plate or quadrant.

Figure 6 is an elevation looking toward the left of Figure 5. This view is partly in section.

Figure 7 is an elevation looking toward the left of Figure 6.

Figure 8 is a diagram illustrating the application of the machine to hobs having relatively small teeth. The action illustrated is in accordance with the construction in the Figures 1 to 7 inclusive.

Like numerals denote like parts throughout the several views.

Referring first to the form shown in Figures 1 to 7 inclusive, the hob 15 is mounted upon a spindle 16, journaled in a bearing 17, mounted in a rocking frame 18. The outer end of the spindle is in the form of a lead screw 20 which works within a nut 22 mounted in the said rocking frame. The lead of the screw is the same as in the hob to be ground. Thus spindle 16 has two bearings, one of which is in the form of a lead nut, and it is evident that when the spindle rotates it will simultaneously move in an axial direction in accordance with the helical lead of the hob teeth.

Spindle 16 is rotated by means of a gear 24 meshing with a wide face pinion 26 which has a fixed axis in the main frame or bed 27. It is rotated by means of gearing including the gear 28 shown at the left of Figure 1. The rocking frame 18 oscillates back and forth upon the main frame to bring the hob toward and from the grinding wheel 30 to produce the necessary relief in the hob teeth. The mechanism for accomplishing this purpose need not be described for it is not intimately concerned with my present invention and furthermore is described and shown in detail in my prior Patent Number 1,575,713.

Referring now to the parts more closely concerned with my present invention:

A slide 32 is mounted on the main frame 27 and is controlled by a feed screw 34 provided with a handle 35 in the usual manner. Transversely mounted on slide 32 is a second slide 36 adjustable by means of a screw 37 provided with a knurled head 38. These slides 32, 36 and their associated parts constitute a tool post or compound rest. On the upper slide 36 is an element 40 which for convenience may be termed a "sector plate". It carries the grinder head which will presently be described. Said plate is rockable on slide 36 in order that the grinder wheel may be adjusted to the helix angle of the hob to be ground. It has, on the bottom, two rockers 42 which rest in channels 44 in the slide as best shown in Figures 4 to 7. The sector plate is held in the position to which it is adjusted by means of an anchor bolt 46 best shown in Figures 5 and 6. This bolt is secured to slide 36 and at the upper end has a nut 48 which screws down upon a washer 50. Said washer has a cylindrical under sur-

face concentric with the rockers 42 and with the axis of the grinding wheel when the latter is in the centralized position shown in Figures 5 and 7. The washer fits in a correspondingly curved countersink 51 formed in the top of the sector plate, and the result is that said plate and the parts carried thereby may be tilted to various degrees to harmonize with the helix angle of the hob which is being ground. This adjustment also provides for the grinding of right hand or left hand hobs. In order to determine the angle of tilt the sector plate is provided with a graduated scale 53 adapted to cooperate with a center line 54 marked on slide 36 as shown in Figure 7.

At the center of curvature of the sector plate 40 is a stud 52 shown at the lower left corner of Figure 6 and elsewhere. This forms a pivot for the grinder head presently to be described. It will be observed that this stud is approximately vertical, the obliquity depending upon the angle to which the sector plate is tilted for adjustment to the helix angle of the hob. The dot and dash circle in Figure 6 indicates the position of the hob and it will be noted that the axis of the stud 52 would, if produced, pass near but outside of said circle.

The base 58 of the grinder head is apertured to receive said pivot pin or stud 52. It is held yieldingly in close contact with the sector plate by means of a leaf spring 60 which underlies the head of the pin and presses down upon the said grinder head base. The base of the grinder head is arched so as to clear the anchor bolt 46 as shown in Figure 6. The outer end of the said base rests slidingly upon the upper peripheral surface of the sector plate and has a depending flange 62 for engaging the outer rim thereof. The parts are beveled in order to hold the base element firmly seated. This action is promoted by a block 64 which engages the outer edge of the sector plate and is backed up by a set screw 66. A locking pin 68 is carried by the grinder head base and is adapted to drop into sockets 70 formed at different points in the sector plate. These sockets are distributed in such manner as to hold the grinding wheel in contact with the sides of the hob teeth, and ordinarily there are sufficient of these sockets to correspond to the usual pressure angles employed in the making of hobs.

The grinder head base has formed upon it a bearing or holder 71 for a "quill" 72 in which the grinder wheel spindle 74 is rotatably mounted. This spindle is driven by a sheave 76 and belt 78, or any other suitable means. A cap 80 forms the upper part of the holder for the quill, and this cap is normally held down in place by latches 82.

The machine is equipped with a tool dressing device which, according to the illustrated design, has a body 84 equipped with two rings 86 which encircle the quill at either end of the quill holder. Consequently the dressing device is rotatable about the axis of the quill holder. One of the rings is split and is clamped in position by means of a clamping bolt 88. A housing 90 is secured to the body 84 of the dressing device and this forms a guide for a sliding bar 92 which is provided with a diamond point 93 for dressing the grinding wheel. Bar 92 is reciprocated when necessary by an operating handle 94. These parts need not be herein described in detail, as they are shown in the pending application of Charles J. Irwin for truing device, Serial No. 622,275. By thus making the dressing device rotatable about the axis of the grinder spindle it may be rotated to different positions where it will be least in the way of the operator and of the hob and adjacent parts of the machine. In other words, it may be swung out of the way without necessitating actual removal from the machine, and it is operative in any of its positions with equal results.

In practice, the parts will be adjusted as shown in Figures 1 to 7 inclusive. The sector plate 40 will be tilted to bring the grinding wheel to the proper helix angle and the grinder head will be adjusted about the pivot pin 52 to the angle called for by the pressure angle of the hob teeth. The operator then starts the machine which causes the grinder to revolve and causes pinion 26 to rotate the gear 24 and spindle 16. Thus the work rotates and simultaneously moves axially and it also oscillates toward and from the grinding wheel in the manner described in my above mentioned Patent 1,575,713. After the hob teeth have been ground upon one side the grinder head is reversed by rotating it about the axis of the pivot pin 52. For this purpose the locking pin 68 is lifted from one of the sockets 70 and replaced in another one near the opposite end of the sector plate. This reverses the position of the grinding wheel from the full line position shown in Figure 3 to the dotted line position shown in that figure.

While it may not be essential, I consider it desirable to so adjust the machine in the beginning that the pivotal axis of the grinding head will pass through the point *a* shown in Figure 3. This point lies in a plane *b* which is perpendicular to the axis of the hob and in the illustrated case this plane is at the center of a tooth. The point *a* also lies on the axis of the grinding wheel indicated by the line *c* Figure 3. It is also at a somewhat greater distance from the hob axis than the radius of the hob.

The reversing of the grinding wheel will theoretically introduce an error into the work, but where the hob teeth are comparatively small this error will be so small as to

be negligible. This fact is illustrated in Figure 8. The hob tooth 100 has a front line 101 which, being parallel to the axis of the hob as in a straight gash hob, is not at right angles to the sides of the tooth. The grinding wheel should start tangentially at the front of the tooth, but when adjusted, as shown, it will be a little above the front of the tooth when at one side, as indicated by the full line circle h and will be a little below the front line of the tooth when on the opposite side as shown by the dot and dash circle h'.

In grinding hobs having larger teeth this error can not be neglected and an adjustment may be made whereby the grinder head when swung from one angular position to the opposite one to grind the opposite side of the tooth, said wheel may be lowered or raised as the case may be. My present invention contemplates a method whereby this vertical adjustment of the grinding wheel when swung from one grinding position to another may be effectively accomplished.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of grinding a hob having a spiral series of relieved teeth which includes the steps of positioning a grinding wheel with its axis of rotation in a plane substantially normal to the hob helix, rotating the wheel and the hob and effecting relative reciprocation between the wheel and the hob to effect the grinding of one side of each of said relieved teeth, and reversing the position of the wheel to cause the latter to assume a position less than 180 degrees removed from the first position, the axis on which such reversal occurs being substantially perpendicular to the plane of reciprocation.

2. The method of grinding a hob having a series of relieved teeth which includes the steps of positioning a grinding wheel with its axis of rotation in a plane substantially normal to the hob helix, rotating the wheel and the hob and effecting relative reciprocation between the wheel and the hob to effect the grinding of one side of said relieved teeth, and reversing the position of the wheel to cause the latter to assume a position less than 180 degrees from the first position, the axis on which such reversal occurs being substantially perpendicular to the plane of reciprocation, said axis of reversal intersecting the axis of the grinding wheel at a point spaced from the axis of the hob.

3. The method of grinding a hob having a spiral series of relieved teeth which includes the steps of positioning a grinding wheel with its axis of rotation in a plane substantially normal to the hob helix, rotating the wheel and the hob and effecting relative reciprocation between the wheel and the hob to effect the grinding of one side of each of said relieved teeth, and reversing the position of the wheel to cause the latter to assume a position less than 180 degrees removed from the first position, the axis on which such reversal occurs being substantially perpendicular to the plane of reciprocation, said axis being included within a plane which is perpendicular to the axis of the hob and which passes through the center of the hob tooth, whereby opposite sides of the hob teeth may be ground without the necessity of axially shifting the position of the hob.

4. The method of grinding a hob having a spiral series of relieved teeth which includes the steps of positioning a grinding wheel with its axis of rotation in a plane substantially normal to the hob helix, rotating the wheel and the hob and effecting relative reciprocation between the wheel and the hob to effect the grinding of one side of each of said relieved teeth, reversing the position of the wheel to cause the latter to assume a position less than 180 degrees removed from the first position, the axis on which such reversal occurs being substantially perpendicular to the plane of reciprocation, and simultaneously vertically adjusting the position of the grinding wheel so as to bring it tangential to the sides of the hob teeth at the front thereof.

In witness whereof, I have hereunto subscribed my name.

CARL G. OLSON.