July 22, 1958 A. H. KUHNS 2,843,977

MACHINE FOR GRINDING DOUBLE HELICAL GEARS

Filed Jan. 16, 1956 2 Sheets-Sheet 1

Fig. 1.

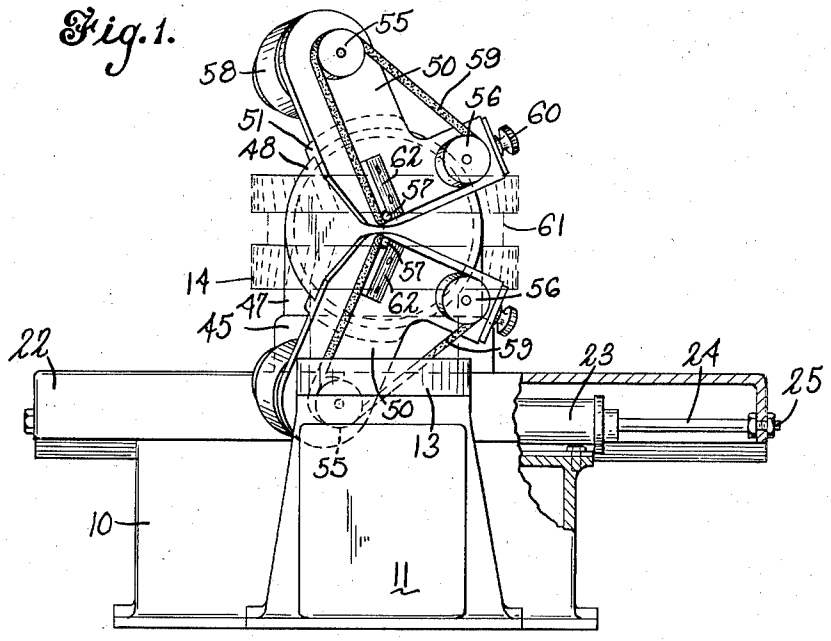
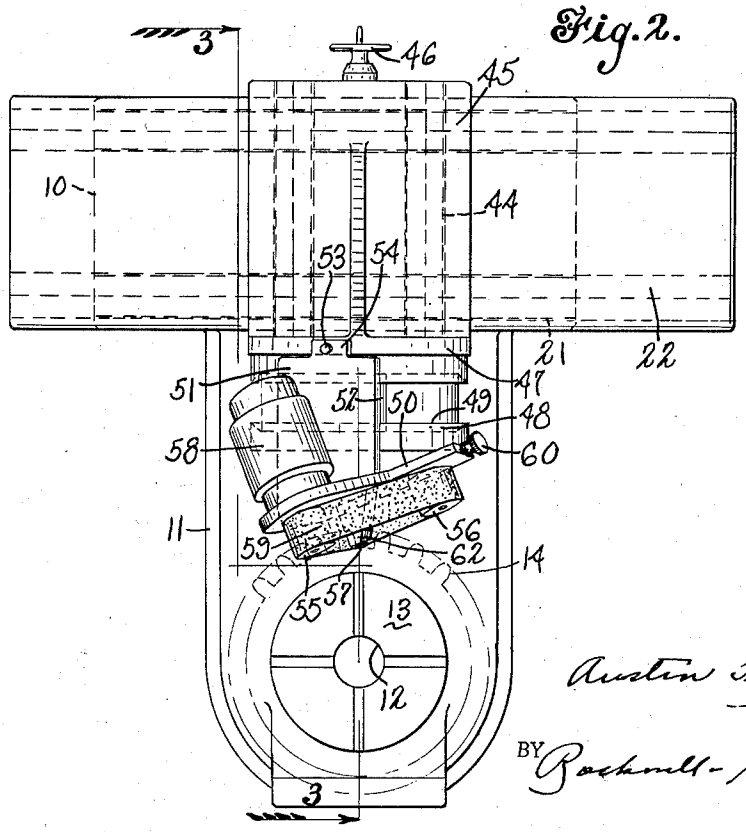


Fig. 2.



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Filed Jan. 16, 1956 2 Sheets-Sheet 2

Fig. 3.

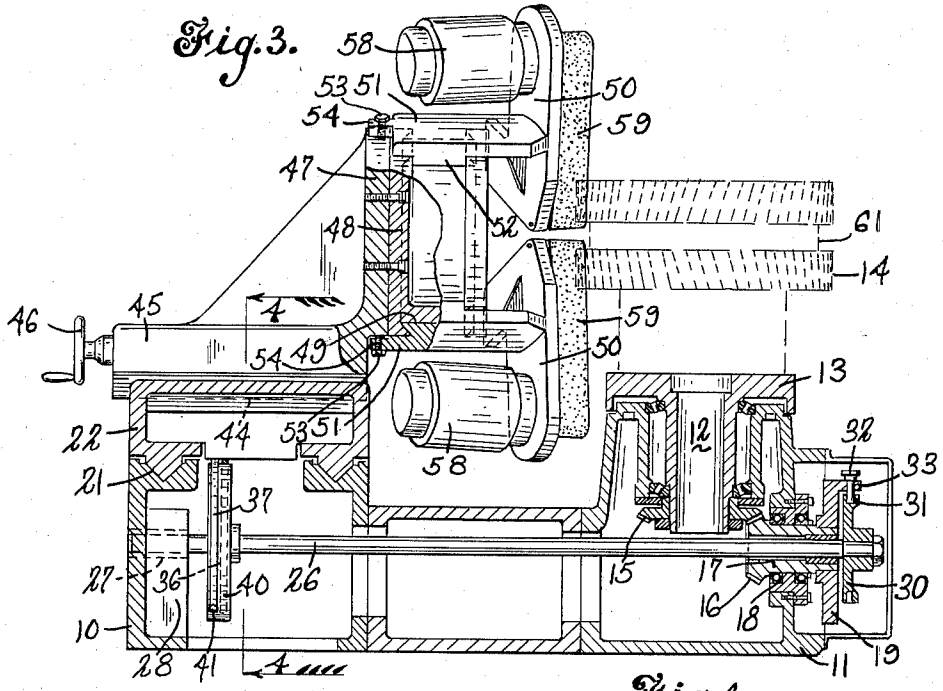


Fig. 4.

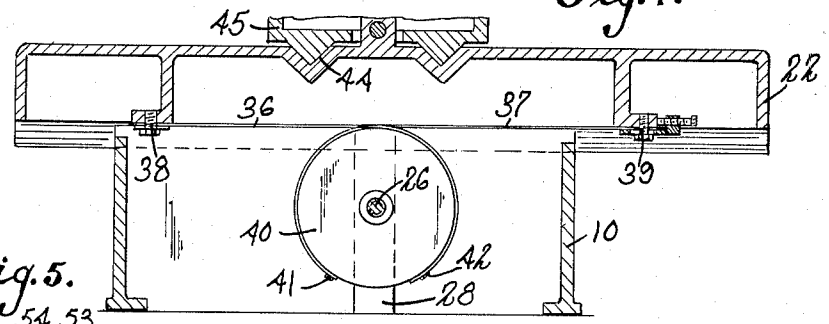
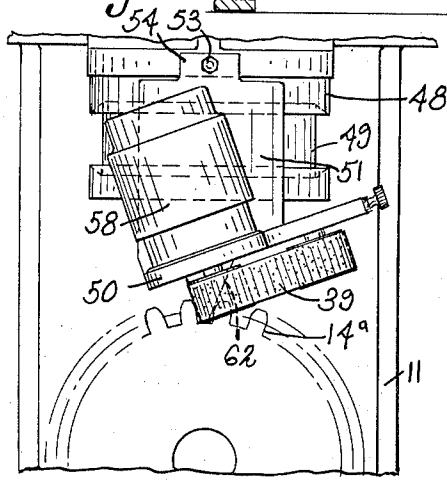


Fig. 5.



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MACHINE FOR GRINDING DOUBLE HELICAL GEARS

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Application January 16, 1956, Serial No. 559,303

5 Claims. (Cl. 51—142)

This invention relates to gear-grinding machines, and more particularly to a device for grinding or finishing the teeth upon a gear blank by means of a traveling abrasive belt or other traveling flexible member, either covered with abrasive or having abrasive or cutting or grinding members secured thereto.

Gear grinding machines which have generally been used in the past employ rotary grinding wheels, the grinding wheels rotating on their own axes and being engaged with the surface of a tooth of the gear to be ground. With machines of this character the grinding process is a relatively slow one as the grinding wheel can only engage local areas on the tooth to be ground, and it is, therefore, necessary for the machine to operate through a combination of a rolling action to cover the curved portion of the tooth together with a motion parallel to the length (width of the gear) of the tooth to cover the whole face of the tooth.

In the gear-grinding machine of the present invention a rectilinearly traveling belt is employed, the operative portion of which travels parallel to the axis of the gear so that it will grind over the entire length of the face of the tooth and it is, therefore, only necessary to roll the gear relatively to the traveling belt to grind the entire face of the tooth. This rolling action is readily obtained by the combination of a reciprocating movement imparted to the supporting mechanism for the traveling belt and a rotary or oscillating movement of the gear blank.

In the present application I have illustrated a device particularly useful in the grinding of helical or double helical gears although it is applicable to the grinding of gears of other types. In the mechanism illustrated, a pair of traveling belts are employed, each of these belts being adapted to move across the face of a gear tooth upon one half of the gear, the two belts being adapted to approach each other closely in the gap between the teeth at the center of the gear and to travel outwardly through this gap out of engagement with the gear teeth.

Moreover, provision is made for adjusting the angle of the operative run of the belt so that it may be adapted to helical gears, the teeth of which have various helix angles and, if desired, one of the belts may be employed in finishing the teeth of spur gears.

As illustrated, the belts are mounted upon three pulleys so that the belt travels around a triangular course, one of these pulleys being employed to drive the belt and a second being a pulley of small size which may be disposed within the gap between the teeth of a double helical gear. Also a backing member is provided for the operative or effective grinding area of the belt so that the latter will be held firmly against the face of a tooth and engage the entire length (widthwise of the gear) of a tooth at one time.

One object of the present invention is to provide a new and improved gear-grinding mechanism which will effect a saving of time in the operation of finishing gears.

A still further object of the invention is to provide a

gear grinding mechanism of simple construction which will operate efficiently in the grinding of double helical or spur gears.

Still another object of the invention is the provision of a gear-grinding machine in which the gear-grinding mechanism is actuated along the face of the gear tooth in a rectilinear path substantially parallel to the axis of the gear blank and in which the gear blank and grinding belt are moved in timed relation in order that the belt cover the entire surface of the teeth of the gear.

Still another object of the invention is to provide a gear-grinding machine as previously described wherein the gear may be indexed with respect to the grinding belt after the grinding of one tooth has been finished in order to enable the belt to engage and grind a further tooth.

A further object of the invention is to provide a novel machine for grinding gears, and particularly gears of double helical form.

To these and other ends the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a front elevational view of a gear-grinding machine embodying my invention, some parts being broken away;

Fig. 2 is a top plan view of the machine;

Fig. 3 is a sectional view on line **3—3** of Fig. 2 with some parts being broken away;

Fig. 4 is a sectional view on line **4—4** of Fig. 3; and

Fig. 5 is a fragmentary top plan view showing the grinding of a spur gear by my improved mechanism.

To illustrate a preferred embodiment of my invention I have shown in the drawings a gear grinding mechanism comprising base or frame portions **10** and **11**, the portion **10**, as will be hereinafter described, serving as a support for the grinding mechanism, and the portion **11** serving as a support for the gear blank. A hollow shaft **12** is rotatably mounted by suitable bearings within the supporting base portion **11**, this shaft carrying at its upper end a table or support **13** upon which the gear blank **14** is adapted to be secured, as shown in dotted lines in Figs. 1 and 3.

Secured at the lower end of the shaft **12** is a bevel gear **15** which meshes with a bevel gear **16** carried by a sleeve **17**. This sleeve is rotatably mounted in the support **11** by suitable bearings **18**, and secured to the projecting end of this sleeve is an indexing wheel **19**.

The base **10** is provided with parallel ways **21** upon which is mounted a reciprocating carriage **22**. The reciprocation of the carriage may be effected hydraulically by means of a cylinder **23** carried by the supporting base and a piston rod **24** secured at **25** to the end of the carriage. It will, of course, be understood that suitable connections (not shown) are provided for introducing fluid pressure into the cylinder to effect reciprocation of the carriage over a path of the length desired depending on the dimensions of the tooth to be ground. The carriage may, of course, be reciprocated by means other than that shown without departing from the present invention.

As shown more particularly in Fig. 3, a shaft **26** is rotatably mounted at one end in bearings **27** carried by a standard **28** which may be a part of the base **10**, and the other end of this shaft is freely mounted within the sleeve **17** previously described. This shaft projects outwardly from the sleeve **17** and upon its outer end is secured a disk **30** having recesses **31** in its periphery to cooperate with the indexing wheel **19** previously described.

A pin **32** is removably mounted in the flange **33** of the indexing wheel, and the inner end of this pin is received in one of the recesses **31** so as to connect the

disk 30 with the indexing wheel 19. It will be understood that when it is desired to index the work table 13 so as to present a subsequent tooth to the grinding mechanism, the pin 32 may be withdrawn from one of the recesses 31 and the indexing wheel rotated with respect to the disk 30 and again connected thereto by the pin 32.

It will be understood that the particular indexing means shown in purely illustrative, and other suitable indexing means, either manual or automatic, may be provided, if desired. With this arrangement it will be apparent that the work table 13 will be actuated by the shaft 26 so that when this shaft is oscillated the table 13 will also be oscillated to move the gear blank and the gear teeth thereon in an arcuate path, this movement being coordinated with the reciprocation of the carriage as will be hereinafter explained.

The oscillation of the shaft 26 from the reciprocation of the carriage 22 is effected by means of flexible straps 36 and 37, these straps being secured at one end to the carriage as shown at 38 and 39, and the other end of each of the straps being wrapped around a driving disk 40 secured to the shaft 26. The wrapped-around ends of the straps 36 and 37 are secured to the disk, as shown at 41 and 42.

Slidably mounted upon the carriage 22 in ways 44 (Fig. 4) is a tool support 45. Suitable mechanism (not shown) is provided for moving the tool support transversely of the carriage 22 along the ways 44, this mechanism being actuated by the hand wheel 46. As will be hereinafter explained, the abrasive belts are carried by the tool support 45, and the adjustment of this tool support transversely of the carriage enables the blets to be moved in a direction toward and from the work .

The tool support 45 is provided with an upstanding portion 47 to which is secured a drum 48, this drum being provided externally with an annular dovetailed groove or slot 49, as shown more especially in Figs. 3 and 5, and as will be explained below, the abrasive belts are directly supported upon this drum.

Each of the belts is carried upon a frame 50, and secured to each of the frames is a rearwardly extending bracket 51 having on its inner face a dovetailed lug 52 adapted to be snugly received in the dovetailed recess 49 of the drum 48 so that the frames 50 may be rotatably adjusted on the drum about the axis thereof. A set screw 53 threaded into a lug 54 upon the bracket 51 is adapted to engage the portion 47 of the standard to hold the belt-carrying frame in the desired adjusted position.

Upon the face of the supporting frame 50 are three belt rollers or sheaves 55, 56 and 57. The shaft of the sheave 55 extends through the frame member to be driven by the motor 58 carried at the rear face of this member so that this motor drives the abrasive belt 59 which is trained around the rollers 55, 56 and 57.

The roller 56 is an idler roller, and its shaft may be, if desired, mounted adjustably upon the frame 50 so that it may be adjusted by the turn button 60 to maintain the abrasive belt in taut condition. The roller 57 is also an idler roller and is of relatively small size so that it may enter in the gap 61 between the teeth of the gear blank 14 and guide the abrasive belt in engagement with a tooth of the blank into this gap.

It may be noted that the frame 50 is set at a slight angle to the axis of the drum 48, as shown in Fig. 2, so that after the lower run of the belt leaves the roller 57, it may run out of the space 61 so that it will not be fouled by the teeth of the blank. It is, of course, understood that the mechanism just described for one of the abrasive belts is duplicated for the other so that each belt has its own motor, and each can be independently adjusted with respect to the drum 48.

Each of the belts 59 is provided with a backing member 62 secured upon the outer face of the frame member 50, this backing member lying against the effective area of the belt between the rollers 55 and 57 which engages the tooth of the gear so as to back up the belt at this area and firmly support it in order that it makes positive and firm engagement with the surface of the gear tooth.

As shown in Fig. 5, if dsired, one of the belts 59 and associated structure may be employed to grind the teeth of a spur gear 14^a. In this instance the procedure would be the same as that previously described except that the lower run of the belt will lie below the teeth of the gear blank instead of in the gap between the teeth, as shown in Figs. 1 and 3.

In the operation of the gear grinding mechanism the gear to be ground is mounted upon the table 13, as shown. The supporting frames, if two are employed, are adjusted to the proper position on the drum 48 depending on the helix angle of the gear to be ground. The hand wheel 46 is manipulated to move the abrasive belts into proper position between the teeth of the gear so that the belt will engage the surface thereof. The device is then placed into operation, the motors 58 driving the belts, and the carriage 22 being reciprocated by the hydraulic mechanism 23 and 24. It will be apparent that upon reciprocation of the carriage the gear blank will be oscillated in an arcuate path in timed relation to the movement of the carriage so that the traveling abrasive belts 59 will cover the entire surface of one face of the tooth which is being ground. When one tooth is finished, the table 13 is indexed as previously explained and a succeeding tooth may then be ground. For the indexing operation the carriage may be moved to the left, as shown in Fig. 1, so as to remove the belt from engagement with the gear teeth and enable the blank to be rotated the distance of one tooth space.

While, as shown, the carriage is reciprocated horizontally and the gear blank supported with its axis vertically disposed, it will be understood that the invention is equally applicable to a device wherein the gear may be mounted with its axis in the horizontal position and the other parts of the device rearranged accordingly.

While I have shown and described a preferred embodiment of my invention, it will be understood that it is not to be limited to all of the details shown, but is capable of modification and variation within the spirit of the invention and within the scope of the claims.

What I claim is:

1. A gear-grinding apparatus comprising an oscillatably supported table for supporting a gear blank, an endless abrasive belt, a set of three suitably supported rollers for supporting said belt and guiding it in a substantially triangular path, means for driving one of said rollers to cause the belt to move across the face of a tooth on the blank, means for moving the belt in a direction generally transverse to the direction of its travel across the face of the tooth and oscillating the gear blank in synchronism with said movement, one of said rollers being of small size and being positioned close to one edge of a tooth on the blank, and another of said rollers being positioned at a greater distance from the axis of the blank than said one roller to move the belt sharply away from the blank.

2. A gear-grinding apparatus for grinding the teeth of a double helical gear blank having an annular groove centrally disposed on its face, said apparatus comprising a reciprocable carriage, an oscillatably mounted support for the gear blank to be ground, means for reciprocating said carriage and oscillating said support in synchronism, a drum mounted on the carriage, the axis of which is substantially transverse to that of the support, a supporting frame mounted on said carriage carrying a plurality of rollers, an endless abrasive belt trained about said rollers and adapted to travel across the face of a gear tooth on the blank, one of said rollers being disposed in the groove on the face of the blank, and means for rotatably adjusting said supporting frame about the drum member.

3. A gear-grinding apparatus comprising a reciprocable

carriage, an oscillatably mounted support for the gear blank to be ground, means for reciprocating said carriage and oscillating said support in synchronism, a tool support on the carriage, a pair of supporting frames carried by said tool support, a set of three rollers on each of said frames, and an endless abrasive belt trained about the rollers on each frame for movement in a substantially triangular path, with a roller on one frame being in close proximity to a corresponding roller on the other frame whereby the belts approach each other closely in passing about said set of three rollers.

4. A gear-grinding apparatus as in claim 3 whereby the frames are adjustable on said tool support about an axis transverse to the axis of the gear blank support for the gear blank to vary the angle of the run of the belt in contact with the teeth of the blank.

5. A gear-grinding apparatus as in claim 3 wherein the axis of one of said rollers of each set is located on the side of the tooth being ground opposite that upon which the axes of the other rollers of the set are located.

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