Nov. 7, 1933. C. G. OLSON 1,933,872

HOB GRINDER

Filed July 9, 1931 4 Sheets-Sheet 1

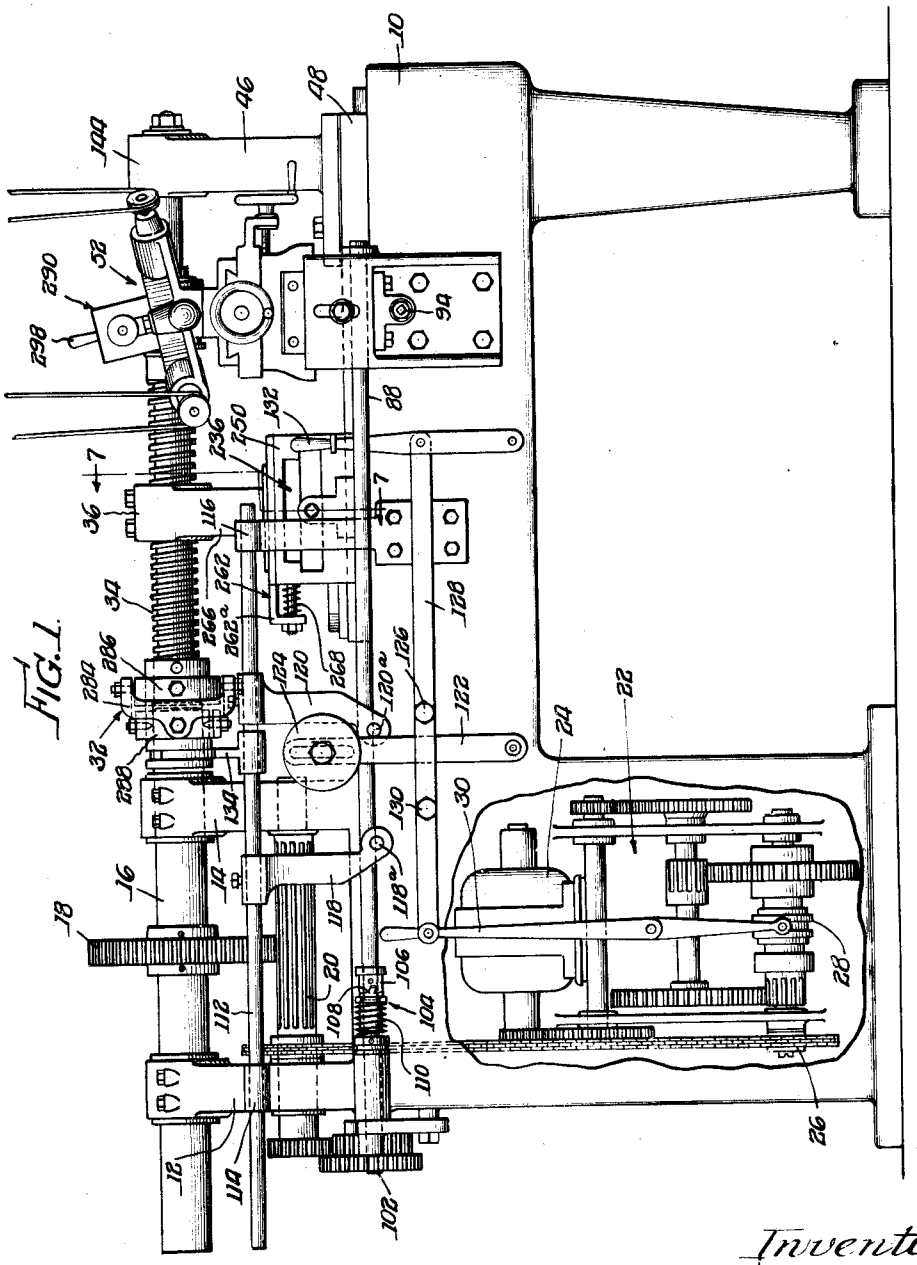


FIG. 1.

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FIG. 2.

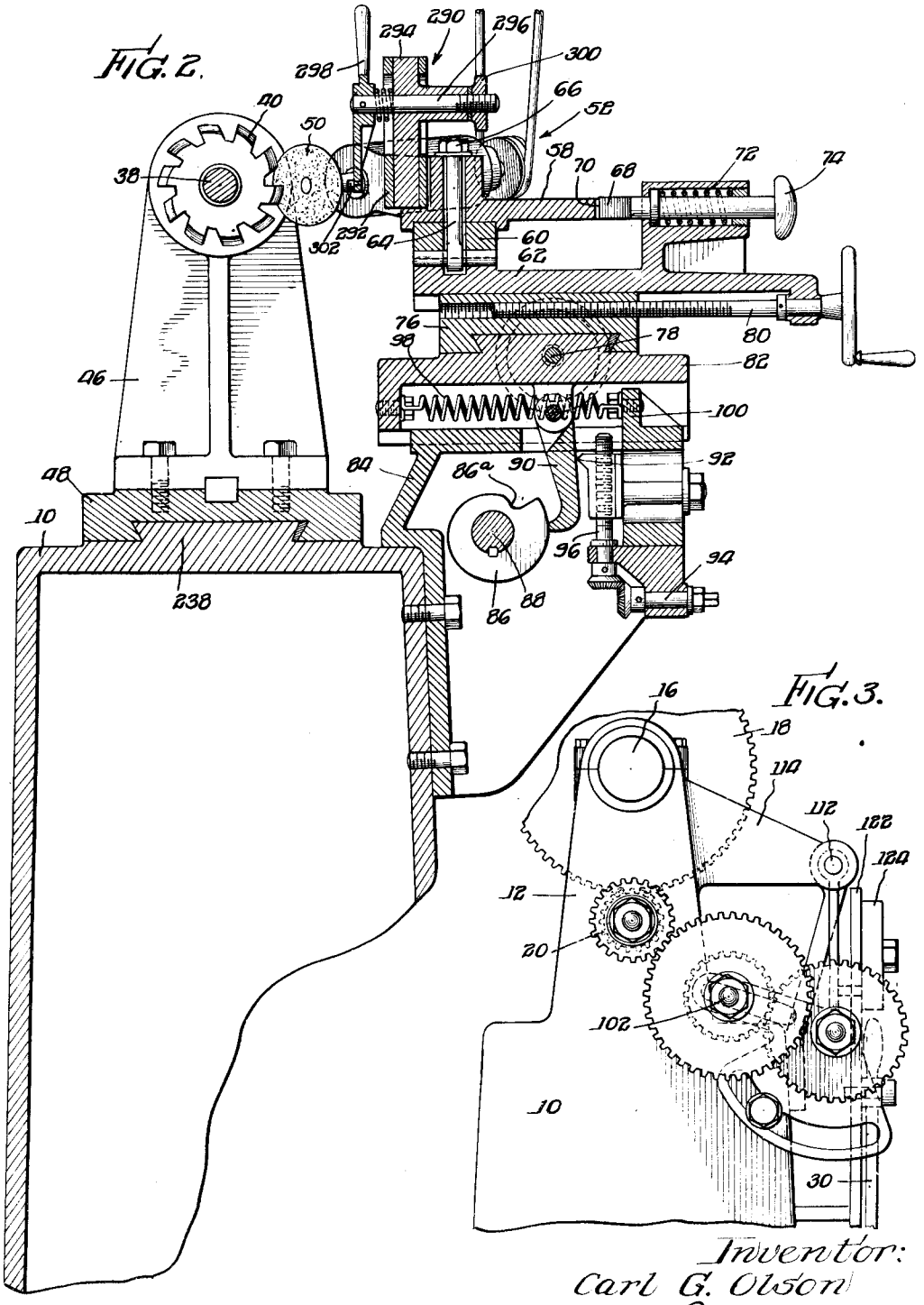


FIG. 3.

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HOB GRINDER

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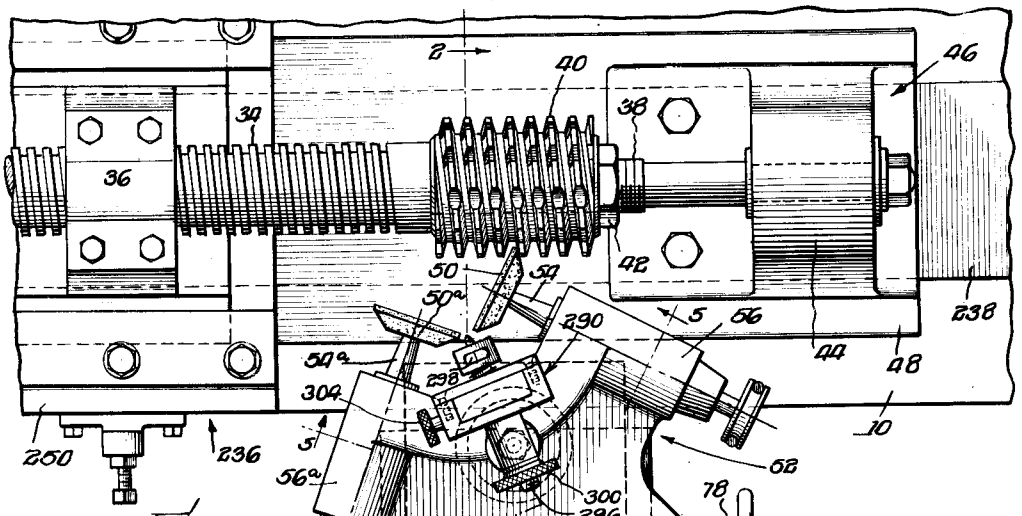


FIG. 4.

FIG. 6.

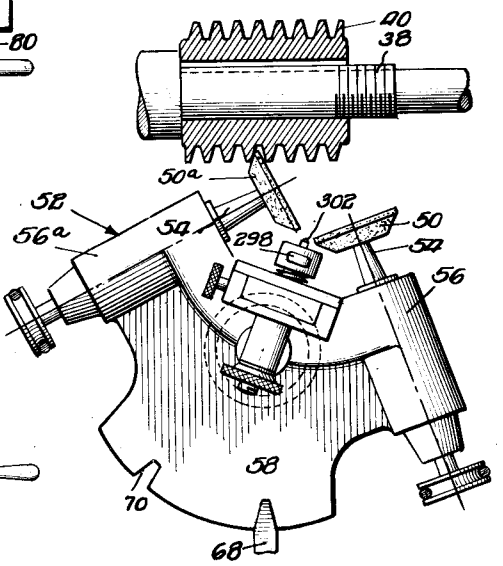
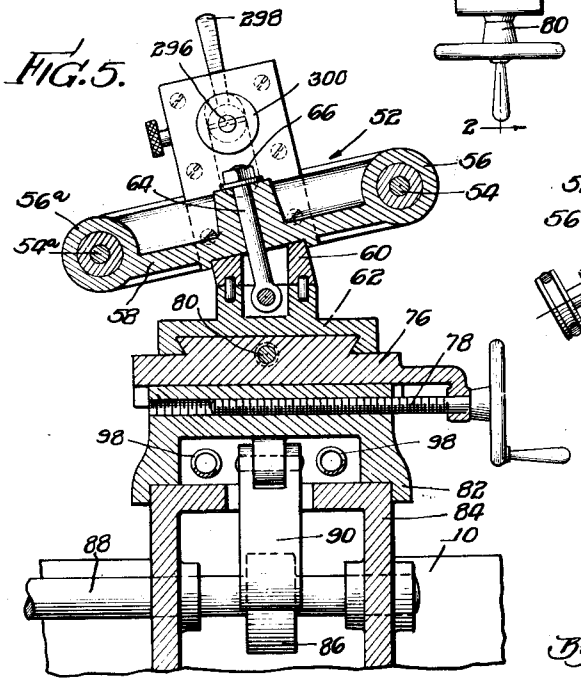


FIG. 5.



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FIG. 7.

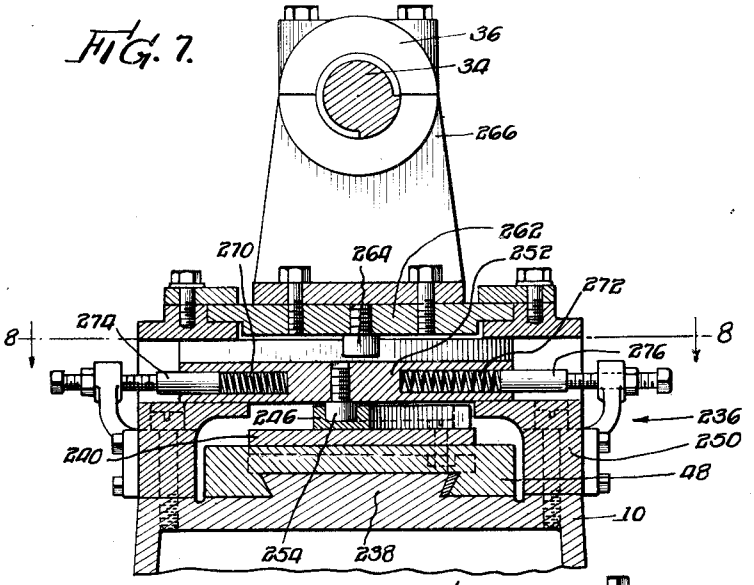


FIG. 8.

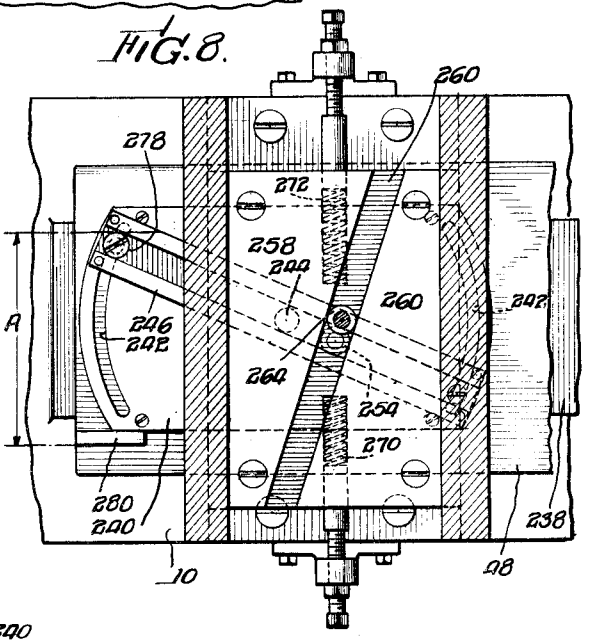
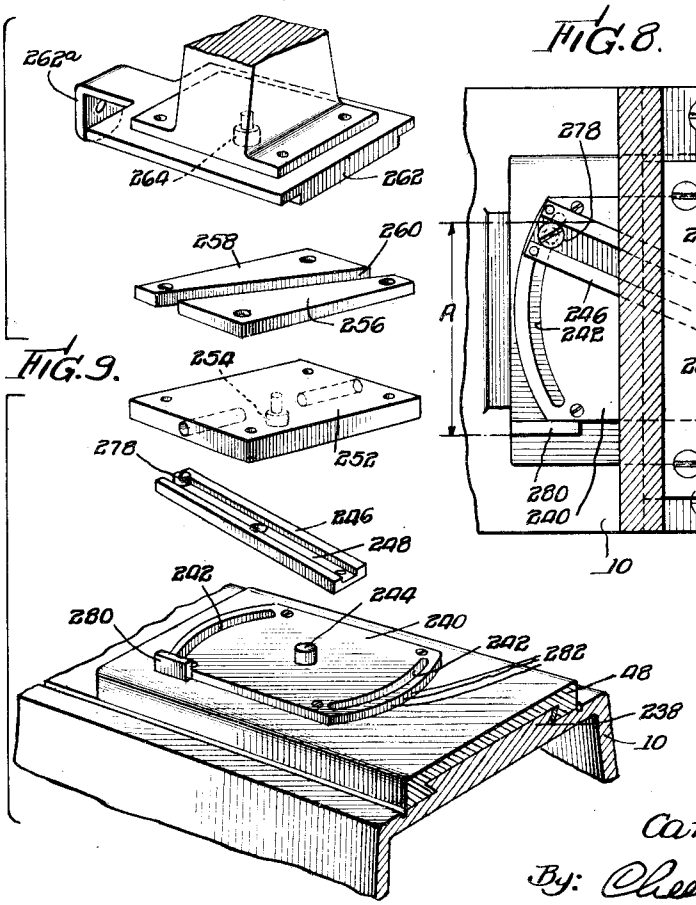


FIG. 9.



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UNITED STATES PATENT OFFICE

1,933,872

HOB GRINDER

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Application July 9, 1931. Serial No. 549,679

7 Claims. (Cl. 51—45)

My invention relates generally to grinding machines and particularly to machines for grinding the relieved surfaces on the teeth of rotary cutters, such as hobs and the like.

One of the objects of my present invention is to provide a grinding machine of improved practical construction, whereby the relieved surfaces of hob teeth and the like may be efficiently ground, and to this end I propose to provide a grinder arrangement which will enable both sides of the hob teeth to be ground from the same side of the hob by a pair of grinder wheels, which are shiftable into and out of operative association with the hob teeth.

More specifically, my invention contemplates the provision of a grinding machine, in which a pair of grinder wheels are so arranged on one side of the supported work piece that one wheel may be employed to grind one side of the hob teeth, and upon the completion of its grinding action, the other grinder may be shifted into position for grinding the other side of said teeth.

Another object of my invention is to provide a grinding machine, as above set forth, which is equipped with a rotary work spindle having a mounting, this mounting serving to rigidly secure said spindle against lateral deflection.

Still another object of my invention is to provide, in combination with the elements as above set forth, an improved compensating or sine bar mechanism for imparting axial movement to the work spindle and thereby alter the axial movement which is imparted to the hob by a master lead screw.

A further object is to provide improved means for dressing a pair of conical grinder wheels.

Another object of my invention is to provide a unitary means or cam mechanism for shifting the grinder wheel in accordance with the relief on the hob teeth, said cam mechanism being designed to effect the automatic positioning of the grinder wheel clear of the supported hob when the machine is operated in a reverse direction.

In addition to the above mentioned advantageous structural features, my invention contemplates the provision of a hob grinding machine, as above set forth, having an improved universal joint connection between the master lead screw and the main drive shaft of the machine, whereby to prevent said screw from being subjected to severe stresses.

It is also an object of my invention to provide a hob grinding machine, as above set forth, which is automatically reversible upon the completion of its grinding stroke.

The foregoing and numerous other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawings, wherein—

Figure 1 is a front elevational view of a hob grinding machine, which is constructed in accordance with the teachings of my present invention;

Figure 2 is an enlarged transverse sectional view of the machine taken substantially along the line 2—2 of Figure 4;

Figure 3 is an enlarged fragmentary view of the left end of the machine shown in Figure 1, to more clearly disclose the gear driving mechanism;

Figure 4 is an enlarged fragmentary plan view of the right end of the machine in Figure 1, disclosing a grinder wheel in operative association with the work piece;

Figure 5 is a detail sectional view of the grinder unit and parts associated therewith, said view being taken substantially along the line 5—5 of Figure 4;

Figure 6 discloses the grinder unit of Figure 4 in its shifted position whereby the other grinder wheel is positioned in operative association with the opposite side of the hob teeth;

Figure 7 is an enlarged transverse sectional view taken substantially along the line 7—7 of Figure 1;

Figure 8 is a plan sectional view taken substantially along the line 8—8 of Figure 7; and

Figure 9 is a perspective exploded view of the various elements which constitute the compensating or sine bar mechanism shown in Figures 7 and 8.

Referring now to the drawings more in detail wherein like numerals have been employed to designate similar parts through the various figures, it will be seen that for the purpose of illustrating one practical embodiment of my invention, I have shown the same in association with a hob grinding machine. This machine includes a base or bed 10, the left end of which, Figure 1, carries upright supports 12 and 14. These supports provide a mounting at their upper ends for a drive spindle 16, which carries a large gear 18. This gear 18 meshes with an elongated pinion 20 suitably mounted within the supports 12 and 14, the power is delivered to this pinion from a suitable drive mechanism, which I have indicated generally by the numeral 22 in Figure 1. This drive mechanism may be of any conventional design, and hence a detailed description thereof is not essential for a clear understanding of the present invention. It will suffice

to say that this drive mechanism 22 includes a suitable prime mover or electric motor 24, which is adapted to deliver power through suitable gearing to a shaft 26. The direction of rotation of this shaft may be controlled by a conventional clutch mechanism 28, the functioning of which is controlled by a lever arm 30. When the clutch occupies its middle position shown in Figure 1, no power is delivered to the shaft 26, and when said clutch mechanism is shifted to one side, said shaft will rotate in a given direction, and when shifted to the opposite side, said shaft will be driven in an opposite direction. Thus the direction of rotation of the pinion 20 is dependent upon the positioning of the clutch 28.

Coupled with the drive spindle 16 through the agency of a universal joint 32, is a master lead screw 34. By employing the universal joint 32, I am able to eliminate the stresses and strains otherwise experienced by the lead screw when it is formed integral or positively conected as a unit with the drive spindle 16. The lead screw 34 rotates within a suitable nut 36, and the outer end of the screw provides a work supporting spindle 38. This spindle 38 is adapted to receive a work piece, such as a hob 40 and said hob is clamped in position upon the work piece by a nut 42. The extremity of the spindle 38 is reduced and mounted within a bearing 44. This bearing is provided at the upper end of an upright support or bracket 46, which, in turn, is bolted or otherwise secured to a slide 48, which is horizontally shiftable in a direction parallel to the axis of the spindle 38. From the foregoing it will be apparent that, when the elongated pinion 20 rotates to drive the large gear 18, the screw 34 will operate within the companion nut 36 so as to impart longitudinal movement to the hob 40. This linear travel in one direction is imparted to the hob 40 during the operative association with the hob teeth of one of a pair of grinder wheels 50 and 50*a*, Figure 4.

These grinder wheels 50 and 50*a* form parts of a grinder unit or head which I have designated generally by the numeral 52. This grinder unit 52 includes a pair of grinder spindles 54 and 54*a*, which are disposed at substantially right angles and are rotatable within carriers or holders 56 and 56*a* respectively, which are formed integral with a main base plate 58. The plate 58 is adapted to be shifted within the plane thereof upon a pivotal support or block 60. The block 60 is supported by a slide 62, and a clamping pin 64, which is pivoted within the slide 62, receives a clamping nut 66, which serves to retain the plate 58 in its pivotal relation with respect to the block 60. The plate 58 is adapted to be shifted between two positions, one position shown in Figure 4 and the other position shown in Figure 6. In Figure 4 the grinder wheel 50 is positioned in operative association with one side of the hob teeth, and in Figure 6 this wheel is out of contact with the hob teeth, and the grinder wheel 50*a* is operatively associated with the opposite side of the hob teeth. The grinder unit 52 is adapted to be secured in either of these positions through the agency of a retractable latch member 68, which is adapted to be received by notches 70 formed along an arcuate portion of the plate 58. A coiled spring 72 serves to continuously urge the latch member 68 toward the plate 58, and in order to release the latch member from the plate, it is only necessary to exert an outward pull on a knob 74 provided at the outer end of the latch member. Attention is directed to the fact that the block 60 not only serves as a pivotal support for the grinder unit, but also positions said unit in accordance with the thread angle of the hob 40. This may be more clearly observed from the structure shown in Figure 5. To change the angular disposition of the grinder unit to accord with another thread angle of the hob, it is only necessary to insert another block having a corresponding angular disposition.

The slide 62 which supports the grinder unit, is mounted upon a slide 76. This slide 76 is adjustable longitudinally of the work axis by means of a screw 78, and the slide 62 is adjustable transversely of the work axis by means of a screw 80. A slide 82 which supports the slide 76, is shiftable in a direction transverse to the work axis upon a bed or frame 84. The shifting of the slide 82 is occasioned in response to the actuation by a cam 86 keyed to a shaft 88, Figure 2. This cam engages the lower portion of a finger 90 which is pivoted to the underside of the slide 82. An adjustable fulcrum block 92 is positioned intermediate the ends of the finger 90, and said finger pivots on said fulcrum to effect the transverse shifting of the slide 82. Vertical adjustment of the fulcrum block 92 may be made by turning a shaft 94 which is connected by bevel gears to a screw 96 passing through the fulcrum block. Variation in the position of the fulcrum block will effect a variation in the degree of travel imparted to the slide 82. A coiled spring 98 interposed between one end of the slide 82 and a fixed projection 100 of the frame 84 serves to continuously urge said slide to the right, Figure 2, thereby maintaining engagement between the finger 90 and the surface of the cam 86. The cam 86 causes the slide 82 and the parts supported thereby to be shifted toward the work piece in accordance with the relief on the teeth of the hob 40. It will be seen that when the finger 90 is positioned within a low section 86*a* of the cam 86, the operative grinder wheel will be positioned out of contact with the hob so that, when said hob is moved axially, the grinder wheel will clear the periphery thereof. Thus when it is desired to reverse the axial travel of the hob after a grinding operation has been completed, the cam is automatically shifted so as to position the finger 90 in the low surface portion 86*a* of the cam, thereby permitting the hob to be shifted in a reverse direction without engaging the grinder wheel.

The cam shaft 88 is coupled with a drive shaft 102 through the agency of a clutch mechanism 104, Figure 1. This mechanism 104 includes a clutch member 106 and a clutch member 108. The clutch member 108 is coupled with the shaft 102, and a coiled spring 110 serves to continuously urge the clutch member 108 into operative association with the companion member 106. When rotation is imparted to the clutch member 108 in a clockwise direction, as viewed from the left of Figure 1, positive rotation is imparted to the shaft 88 and cam 86, and this rotation takes place during the grinding of the relieved surfaces on the hob teeth. Upon the completion of the grinding stroke, reverse rotation is imparted to the shaft 102, namely, in a counterclockwise direction, as viewed from the left of Figure 1, and during this rotation the clutch member 108 impositively drives the member 106 so as to move the low surface portion 86*a* of the cam into operative association with the lower end of the actuating finger 90. After the cam has been moved to this position the clutch

member 108 clicks past the companion member 106.

To effect the automatic reversal of the machine, I provide a shifter rod 112, which is longitudinally shiftable within suitable bearings 114 and 116, Figure 1. Arms 118 and 120 depend from and are adapted to be adjustably secured to the rod 112. The lower extremities of these arms 118 and 120 are provided with pins 118*a* and 120*a* respectively, which are adapted to engage a lever 122, the upper end of which carries a weight 124. This lever is adapted, when shifted to the right, to engage a bolt 126 carried by a shifter bar 128, and thereby urge said bar to the right, Figure 1. Likewise, when the lever 122 is shifted to the left, it is adapted to engage a bolt 130 so as to move the bar 128 to the left. This bar 128 is connected at its left extremity to the upper end of the lever arm 30, and at its right end to the pivoted control lever 132. The shifter rod 112 is moved in response to the longitudinal actuation of the spindle 16, and is coupled with said spindle in any suitable manner, such as by means of an arm 134. As one of the pins 118*a* and 120*a* moves into engagement with the lever 122 and causes the weight 124 thereof to be shifted beyond the vertical plane, said weight will cause the arm 122 to be suddenly shifted, thereby effecting the sudden actuation of the clutch mechanism 28. Thus when one of the grinder wheels completes its cutting action, the pin 118*a* will cause the weighted arm 122 to be shifted to the right, thereby actuating the clutch mechanism 28 so as to effect reverse rotation of the elongated driving pinion 20. Likewise, when the work piece or hob reaches this extreme position to the left, Figure 1, the pin 120*a* will cause the reverse shifting of the weighted arm 122. My invention is in no sense limited to the particular type of reversing mechanism disclosed herein, but contemplates the use of other control devices without departing from the spirit and scope thereof.

Attention is now directed to the compensating or sine bar mechanism, which I have designated generally by the numeral 236. This mechanism includes the slide 48 which is shiftable in a direction parallel to the work axis upon a guide 238 provided along the upper surface of the machine bed 10. One extremity of this slide 48 carries the upright spindle support 46, as clearly shown in Figure 1. The opposite end of the slide 48 supports a plate 240 having arcuate slots 242 provided in each end thereof, which slots are concentric with a pin 244. This pin 244 extends within the medial portion of an adjustable sine bar 246 provided with a groove 248. A bridge frame 250 is secured to the bed 10 and provides a slidable support for a plate 252, which is shiftable in a direction transverse to the movement of the slide 48. Depending from the center of the plate 252 and positioned within the groove 248 is a pin 254. Secured to the upper surface of the plate 252 is a pair of plate sections 256 and 258, which are spaced to provide a groove 260, which is angularly disposed with respect to the direction of movement of the plate 252. Extending within the groove 260 and carried on the underside of a slide 262 is a pin 264. This slide 262 supports an upright frame member 266, which carries the nut 36 in which the master lead screw 34 operates. To continually urge the slide 262 to the left, Figure 1, I employ a coiled spring 268, which is interposed between an extension 262*a* on the slide and the outer surface of the bridge frame 250.

The operation of the mechanism just described is as follows: The rotation of the master screw 34 in a given direction within the nut 36 causes the hob 40 to be longitudinally shifted to the right. This causes the slide 48, which is coupled with the work spindle, to be also shifted to the right, Figure 1. The bar 246 also moves to the right with the slide 48, and this causes the plate 252 to be shifted transversely within the bridge frame 250. The direction in which the plate 252 shifts will be dependent upon the angular disposition of the bar 246. Consider, for example, that the bar 246 is positioned as shown in Figures 7 to 9 inclusive. As the bar 246 is shifted to the right, the plate 252 and its associated plate sections 256 and 258 will be urged rearwardly, as viewed in Figure 8, or to the right, as viewed in Figure 7. Shifting these parts in this direction causes the slide 262, which carries the filler pin 264, to be shifted to the left, as viewed in Figure 1. In other words, by having the sine bar mechanism set up, as disclosed in the drawings, a movement is superimposed upon the screw 36, which causes the work piece or hob 40 to shift at a rate which is less than the rate at which it would shift if the lead screw were employed as the sole actuating mechanism. It will be clear that this sine bar mechanism 236 serves as a compensating means, which enables a hob having a lead differing from that of the lead screw, to be shifted longitudinally at a rate which corresponds with the lead of the hob. If the lead of the hob is greater than the lead of the master screw, the sine bar 246 may be shifted to its opposite angular position and thereby superimpose an increased rate of travel to the master screw and work spindle. The coiled spring 268 serves to continually urge the pin or roller 264 against the surface of the plate 258, and in order to maintain engagement between the pin 254 and a wall of the groove 248 in the sine bar, I provide a pair of oppositely disposed coiled springs 270 and 272 which are housed within the plate 252. Plungers 274 and 276 respectively may be adjusted so as to increase the compression of one spring and decrease the compression of the other. Thus, when the left wall of the groove 248, as viewed in Figure 7, is the actuating wall of the bar 246, the plunger 274 is moved into the plate 252 so as to increase the compressing action of the spring 270, and the plunger 276 is urged outwardly to decrease the compressing force of the spring 272. Under reverse conditions, namely, the bar 246 is shifted to its opposite angular position, the plunger 276 is moved into the plate and the plunger 274 is shifted outwardly.

Sine bar readings with the aid of a micrometer may be made across the distance indicated at A, Figure 8, which extends between a pin 278 carried at the left end of the bar 246 and an abutment member 280 secured in a fixed position upon the plate 240. In this manner very accurate readings may be made for properly setting the sine bar 246. The angular setting of the sine bar may also be read by graduations 282 positioned along the end arcuate surface of the plate 240, Figure 9.

It will be noted that the universal joint or coupling 32 includes a member 284, Figure 1, which is pivoted about a vertical axis of a collar 286 supported at the left end of the master screw 34. This member 284 is also pivoted about a horizontal axis to a collar 288 carried at the right

end of the drive spindle 16. In this manner any lateral stresses to which the drive spindle may be subjected, will not be transmitted to the lead screw, thereby reducing to a minimum the introduction of errors which otherwise would result in the event that the screw and drive spindle were integral.

The grinder wheels 50 and 50a may be contemporaneously dressed by means of a dressing or truing mechanism indicated generally by the numeral 290, Figures 2 and 4. This mechanism includes a vertically disposed guide 292 supported by the grinder unit 52, and adjustable within the guide 292 is a slide 294. Extending through the slide 294 is a pin 296, one end of which supports a hand lever 298, and the other end a thumb nut 300. The lower end of the hand lever 298 carries a dressing element 302, such as a diamond, and it will be seen that, when the hand lever is pivoted about the axis of the pin 296, the dressing element will be moved across the conical surface of the grinder wheels 50 and 50a. The slide 294 is secured in various positions of vertical adjustment within the guide 292 by means of a set screw 304, Figure 4. The truing element or diamond 302 moves in an arcuate path which lies in the plane of the work faces of the grinder wheels. Moving the truing element in this arcuate path will produce a slight curvature in the conical surfaces of the wheel, and this curvature is often required in order to effect the proper functioning of the wheels. It will be apparent that by vertically adjusting the position of the truing device, the proper surface contour may be imparted to said wheels.

From the foregoing it will be apparent that my invention contemplates the provision of a grinding machine of improved practical construction, whereby hobs and cutters of like nature may be ground with extreme accuracy. By having the grinder wheels disposed in the manner described so as to enable the successive grinding of both surfaces of the hob teeth by simply shifting one wheel out of contact and the other wheel into contact with the work, the speed of grinding the hob is materially increased. The mounting of the master screw and work spindle as described materially contributes to the rigidity of the machine structure. The sine bar mechanism provides a very convenient and practical means for controlling the relative movement between the work spindle and the grinder wheel. Obviously numerous structural modifications may be made without departing from the spirit and scope of my present invention, and the same should be limited only by the appended claims.

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

1. A hob grinding machine including a rotary hob supporting spindle, a pair of grinders positioned on the same side of said spindle, one grinder being adapted to grind the relief on one side of the hob teeth and the other adapted to grind the relief on the opposite side of said teeth, a support for said grinders whereby one may be maintained out of engagement with the work while the other grinder is functionally operative, means for effecting relative movement between the hob and grinders longitudinally of the hob spindle, means for imparting relative transverse movement between the hob and grinders in accordance with the relief on the hob teeth, and a bearing for said grinder support which is adapted to maintain said support at an angle corresponding with the thread angle of the hob to be ground.

2. A hob grinding machine including a rotary hob supporting spindle, a grinder support, a grinder on said support for grinding the relieved surfaces of the teeth of a hob supported by said spindle, means for supporting said spindle on opposite ends of the supported hob, a sine bar mechanism for imparting relative movement between the hob and the grinder longitudinally of said hob, and means for imparting relative transverse movement between the hob and the grinder in accordance with the relief on the hob teeth.

3. A hob grinding machine including a rotary hob supporting spindle, means coupled with said spindle at one end thereof for imparting rotation to said hob, a bearing means for the opposite end of said spindle, a grinder for grinding the relieved surfaces of a hob supported by said spindle, a sine bar mechanism coupled with said bearing means for imparting relative longitudinal movement between the supported hob and said grinder, and means for imparting relative transverse movement between the hob and grinder in accordance with the relief on the hob teeth.

4. A hob grinding machine including a rotary hob supporting spindle, a grinder for grinding the relieved surfaces of a hob supported by said spindle, driving means coupled with said spindle on one side of the supported hob, means for rotatably supporting said spindle on the opposite side of said hob, actuating means operable in response to the functioning of said spindle, said actuating means including a bar adapted to be positioned obliquely with respect to the axis of said hob spindle and means coupling said bar with the last mentioned spindle support and cooperating with said bar to effect relative longitudinal movement between a supported hob and said grinder, and means for imparting relative transverse movement between said hob and said grinder.

5. A hob grinding machine including a rotary hob supporting spindle, a grinder for grinding the relieved surfaces of a hob supported by said spindle, driving means coupled with said spindle on one side of the supported hob, means for rotatably supporting said spindle on the opposite side of said hob, actuating means operable in response to the functioning of said spindle, said actuating means including an adjustable bar adapted to be positioned obliquely with respect to the axis of said hob spindle and means coupling said bar with the last mentioned spindle support and cooperating with said bar to effect relative longitudinal movement between a supported hob and said grinder, and means for imparting relative transverse movement between said hob and said grinder.

6. A hob grinding machine including a hob supporting spindle, a pair of conical grinder wheels positioned on one side thereof for grinding the relieved surfaces on said hob, a support for said grinder wheels, the axes of said wheels being disposed at substantially right angles, a dressing mechanism carried by said support, said mechanism including a shiftable member, a dressing element carried by said member, said member being adapted to shift across the conical surface of one grinder wheel and thence across the conical surfact of the adjacent grinder wheel, whereby to effect the contemporaneous truing of said wheels, means for effecting relative longitudinal movement between the hob and grinder wheels, and

means for effecting relative transverse movement between said hob and grinder wheels.

7. A hob grinding machine including a hob supporting spindle, a pair of conical grinder wheels positioned on one side thereof for grinding the relieved surfaces of said hob, a support for said grinder wheels, the axes of said wheels being disposed at substantially right angles, one of said wheels being out of operative engagement with the work while the other wheel operatively engages the work, a dressing mechanism carried by said support, said mechanism including a shiftable member, a dressing element carried by said member, said member being adapted to shift across the conical surface of one grinder wheel and thence across the conical surface of the adjacent grinder wheel, whereby to effect the contemporaneous truing of said wheels, means for effecting relative longitudinal movement between the hob and grinder wheels, and means for effecting relative transverse movement between said hob and grinder wheels.

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