July 13, 1937. H. D. TANNER 2,086,750

WHEEL POSITIONING DEVICE FOR GEAR GRINDERS

Filed June 11, 1934 4 Sheets-Sheet 1

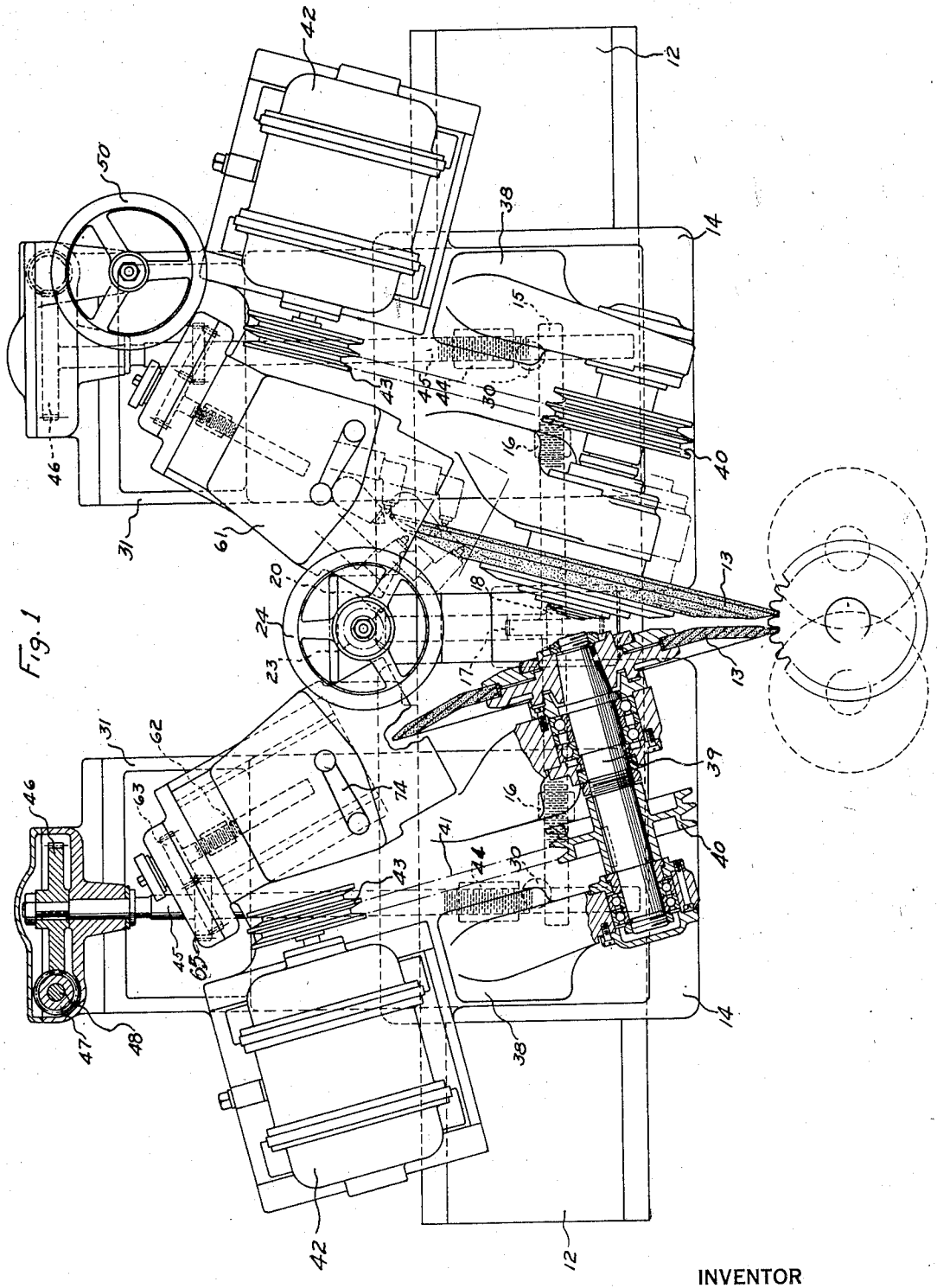

Fig. 1

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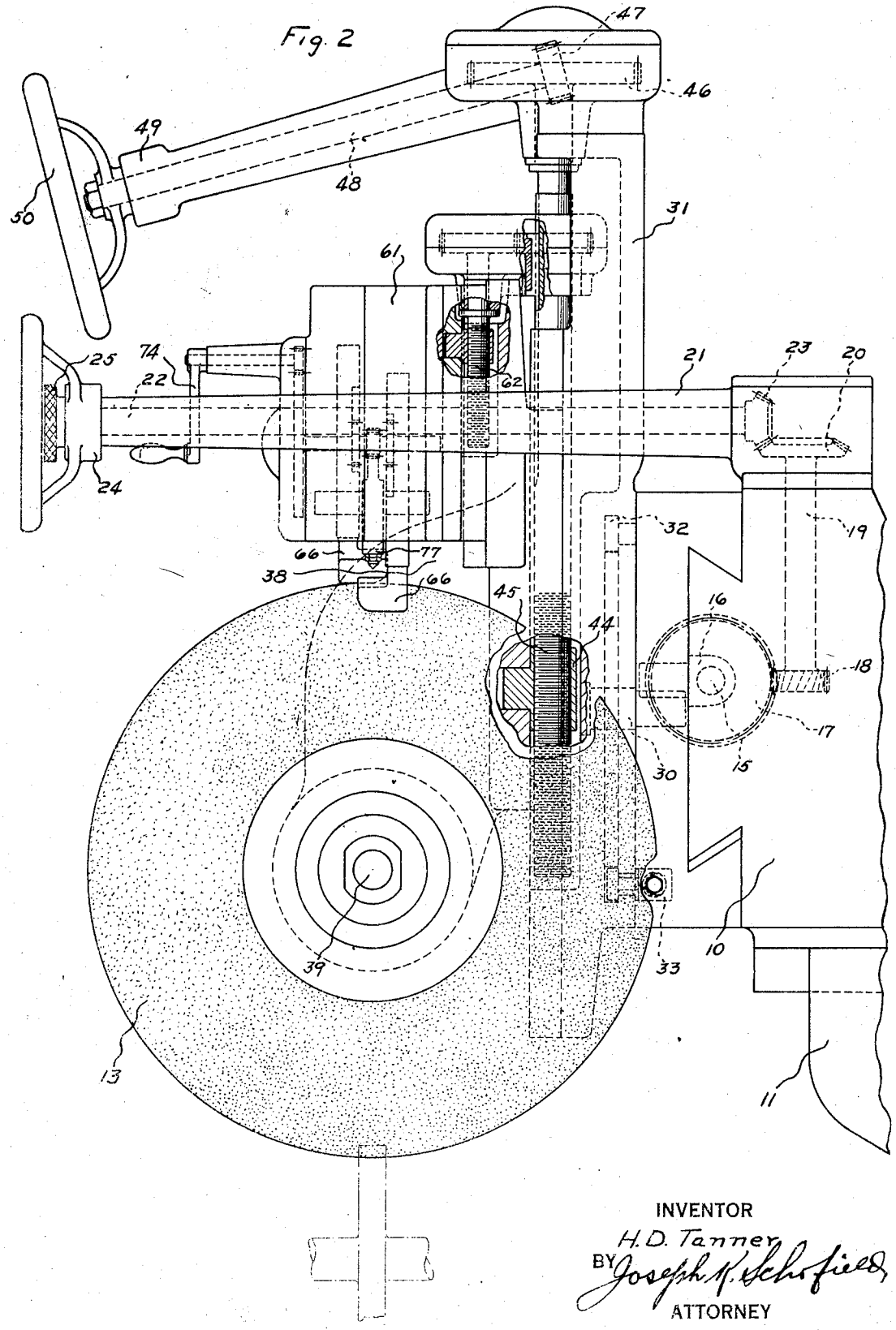
Filed June 11, 1934 4 Sheets-Sheet 2

Fig. 2



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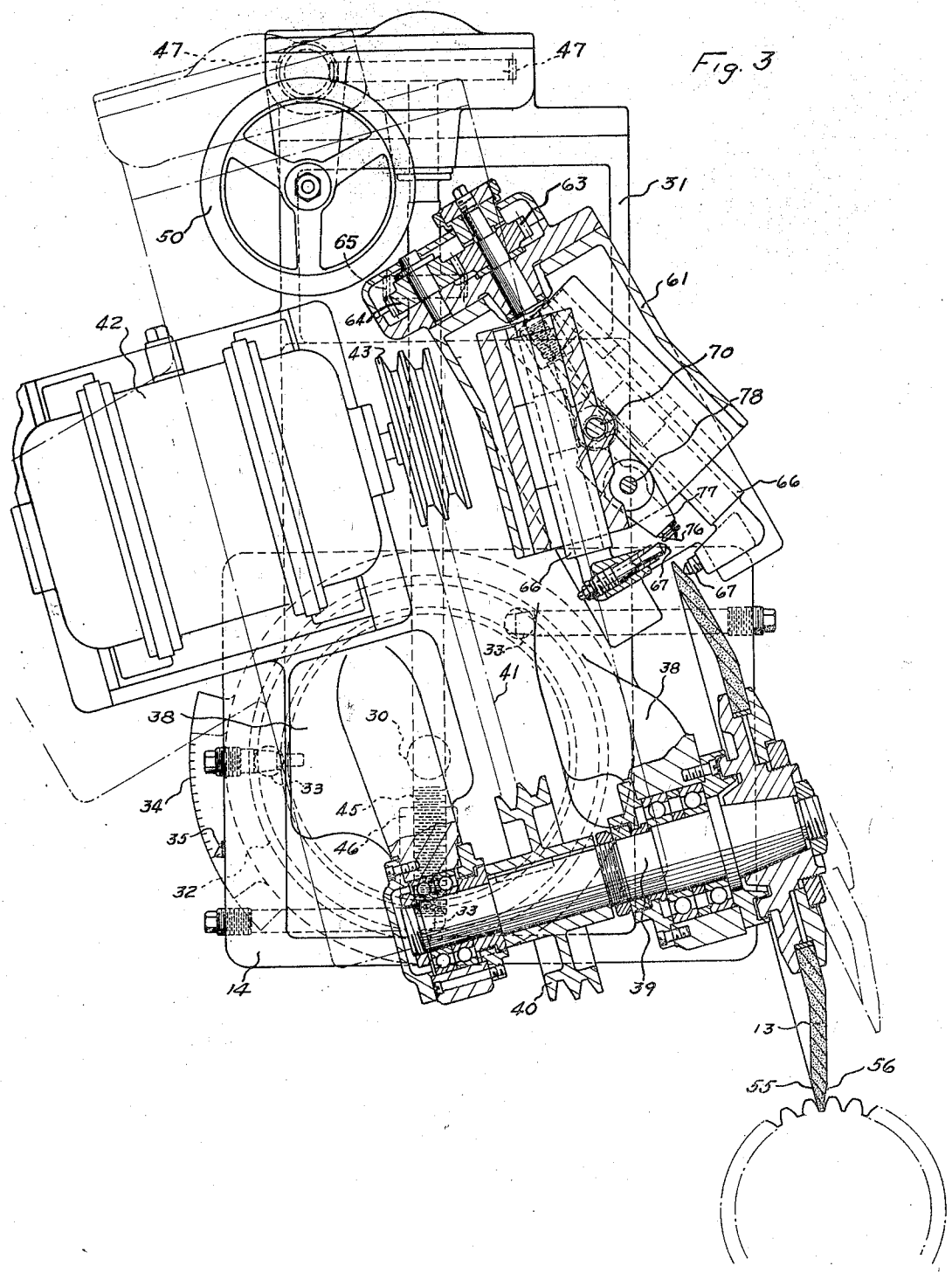
Filed June 11, 1934 4 Sheets-Sheet 3

Fig. 3



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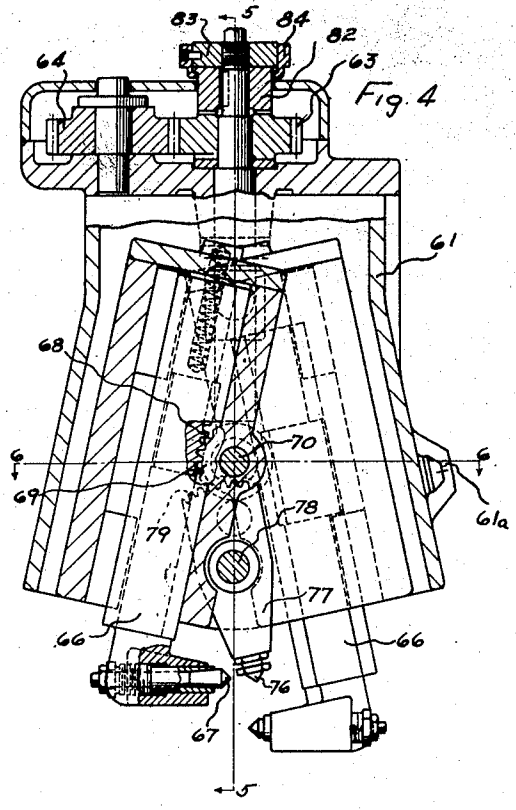

Fig. 4

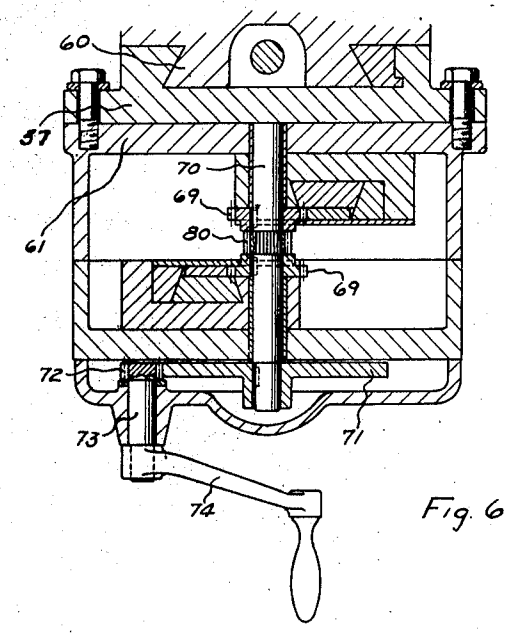

Fig. 6

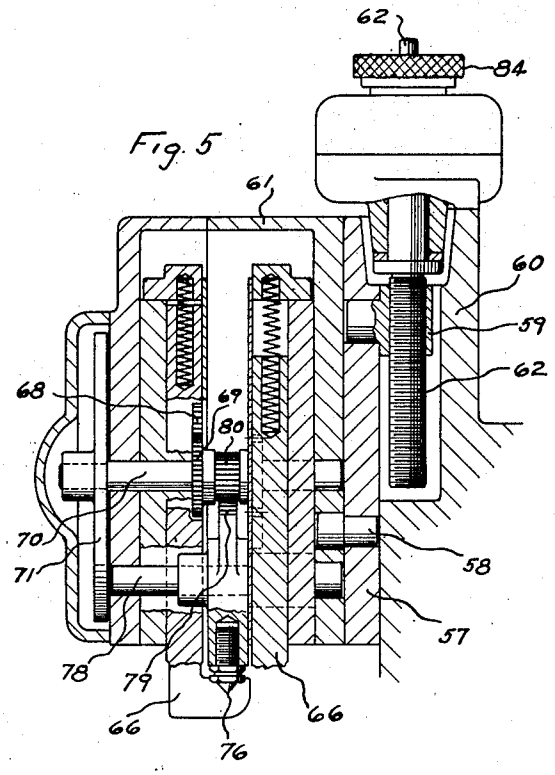

Fig. 5

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Patented July 13, 1937

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UNITED STATES PATENT OFFICE

2,086,750

WHEEL POSITIONING DEVICE FOR GEAR GRINDERS

Hubert D. Tanner, West Hartford, Conn., assignor, by mesne assignments, to Niles-Bement-Pond Company, New York, N. Y., a corporation of New Jersey

Application June 11, 1934, Serial No. 729,962

2 Claims. (Cl. 51—123)

This invention relates to gear grinding machines and particularly to a wheel positioning device whereby abrasive wheels may be maintained in proper position relative to the gear tooth surfaces to be ground, the wheel or wheels being adjustable for different sizes, pitches and pressure angles of spur or helical gears, and for different diameters of the abrasive wheels.

A primary object of the invention is to provide opposed wheel supporting heads each rotatably supporting an abrasive wheel and provided with a dressing attachment for the work engaging surfaces of the wheel, so that the grinding surfaces of the wheels may be maintained accurately in position for operation upon different types and sizes of gears, and the two wheels with their supporting heads may be individually advanced as their diameters are reduced.

Another object of the invention is to provide a wheel mounting for gear grinders on the supporting slide of which is mounted a dressing attachment, the positions of these dressing attachments being adjusted simultaneously as the slides are adjusted to compensate for reduction in diameter of the wheel in a manner to always properly dress the wheel surfaces and maintain the correct positions of their work engaging surfaces.

With the above and other objects in view my invention includes 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 the specification, I have shown my invention embodied in a grinding machine for spur and helical gears, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a front elevation of the wheel supporting members shown partly in section, the wheels being shown in operative relation to a spur gear being ground.

Fig. 2 is a side elevation of the wheel supporting members shown partly in section to more clearly disclose their construction.

Fig. 3 is a front elevation partly in section of one of the wheel supporting members, the dressing attachment being shown in section.

Fig. 4 is a front elevation of the dressing attachment shown partly in section.

Fig. 5 is a transverse sectional view through the dressing attachment substantially upon the line 5—5 of Fig. 4, and

Fig. 6 is a horizontal plan view of the dressing attachment taken substantially upon the line 6—6 of Fig. 4.

In the above mentioned drawings I have shown but one embodiment of the invention which is 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 and in its preferred aspect, my invention may include the following principal parts: First, a cross rail mounted upon a column or base of a machine for grinding involute gear teeth; second, carriages slidably mounted for movement laterally on the rail; third, a saddle or intermediate member on each carriage, the angular position of which may be adjusted about a pivot over a limited range; fourth, a slide on the intermediate slides or saddles having supporting bearings for a spindle for an abrasive wheel; fifth, a supplemental slide on each slide or saddle on which dressing tools for the surfaces of the grinding wheel are mounted; and sixth, manually operated adjusting means for relatively positioning the carriages and the slides and for operating the dressing tools.

In grinding machines of the type shown in my copending application Serial No. 688,714 filed September 9, 1933, now Patent No. 2,022,061, dated Nov. 26, 1935, there is provided a single wheel for grinding involute curves of spur and helical gear teeth, the wheel engaging the tooth surfaces of the gear being ground upon opposite conical or bevel surfaces. The present invention is designed for a machine having the same supporting, actuating and indexing means for the gear being ground to simultaneously reciprocate and rotate the gear below the active or grinding surfaces of the wheel and for presenting successive teeth for the grinding operations. In the present instance, however, there are two wheels provided disposed in opposed relation to each other and adapted to contact with the tooth curves of the gear being ground upon their relatively outer plane surfaces. The wheels also are materially increased in diameter over those shown in my copending application so that there is sufficient area in contact with the teeth being ground that reciprocatory movement of the wheels, as by the ram shown in my copending application, is not necessary. In the pres-

ent application a ram or slidable support may be employed substantially as shown in my copending application but instead of being reciprocated during the grinding operation may be provided with manual or other adjusting means enabling it to fixedly position the wheels properly with respect to the gear being ground.

Referring more in detail to the figures of the drawings, there is provided an adjustable member 10 mounted in suitable ways extending horizontally within the base 11 of the machine. The base 11 may be similar to the base of the machine shown in my copending application and have similar ways within which the member 10 may be longitudinally adjusted. The front end surface 12 of this slide or supporting member 10 for the wheels 13 is extended laterally and provided also with laterally extending horizontal ways upon which carriages 14 may be slidably mounted. There are two of these laterally movable carriages 14, one for each of the wheels 13, the positions of which may be simultaneously adjusted toward or from each other so that the wheels 13 thereon may be positioned for gear teeth having different pitches. For this purpose a horizontal laterally disposed shaft 15 having left and right screw threads on its opposite ends is supported for rotation within the supporting member 10. This shaft 15 extends laterally of the grinding machine across the front surface 12. The screw threads on this shaft are engaged by fixed nuts 16 provided respectively within the rear faces of the carriages 14. A helical gear 17 mounted centrally of the threaded shaft 15 is engaged by a helical pinion gear 18 on the lower end of a vertical shaft 19 rotatable within the forward end of the adjustable member 10. The upper end of this shaft 19 is provided with a bevel gear 20. Extending forwardly within a suitable supporting bracket or housing 21 is a shaft 22 having a bevel pinion 23 in mesh with a bevel gear 20 on the upper end of this shaft 19. At the forward end of this shaft or rod 22 there is a hand wheel 24. By rotation of the hand wheel 24 therefore the threaded shaft 15 may be rotated in either direction to position the carriages 14 at proper distances apart for any thickness or spacing of gear teeth being ground. Indicating means 25 are provided for the forwardly extending shaft 22 in the form of a graduated knob so that the carriages 14 when once adjusted to an operative position may be relocated in other correct operative positions predetermined distances apart.

The front faces of these carriages 14 are each provided with a horizontally disposed pivot 30 about which a saddle 31 may be oscillated. Arcuate slots 32 in the rear face of each saddle 31 engaged by headed bolts 33 extending through portions of the carriage 14 enables a saddle 31 to be locked in any desired angular position. In order to determine the adjustment of this saddle 31, circular graduations 34 are provided upon the portion of the carriage 14. Adjacent these graduations 34 and cut into or provided on the saddle is a zero line 35. On the front face of the saddle 31 are guideways in a vertical plane engaged by a wheel supporting head 38 adjustable manually therealong. On this head 38 are bearings provided in outstanding brackets thereon within which is rotatably mounted a spindle 39, on an end of which the wheel 13 and its mounting are secured. A grooved pulley 40 on an intermediate portion of this spindle 39 through belt 41 may be driven by a motor 42 provided on the head 38. A grooved pulley 43 is provided upon the shaft of the motor 42 over which the belt 41 may pass.

In order to adjust the vertical position of the head 38 upon its saddle 31 there is provided a screw 45 supported at one end within the upper portion of the saddle 31 and held against endwise movement. This screw 45 is engaged by a nut 44 provided on or formed in the head 38 so that rotation of the screw 45 will raise or lower the head 38 and its abrasive wheel 13. In order to rotate this screw 45 its upper end has secured thereon a gear 46 in mesh with a pinion 47 preferably these gears 46 and 47 may be of helical or worm gear type. The pinion or worm 47 is at an oblique angle to gear 46 and is mounted upon the rear end of the forwardly and downwardly extending shaft 48. This forwardly extending shaft 48 is housed within a supporting bracket 49 and at its forward end is provided with a hand wheel 50. It will be seen, therefore, that by rotating the hand wheel 50 in either direction a wheel 13 may be advanced or retracted relative to the position of the gear being ground, the direction along which the head 38 moves being determined by the angular adjustment of the saddle 31.

The mechanism described above by means of hand wheels 24 and 50, enables two abrasive wheels disposed in opposed relation to each other to be positioned for operation upon any involute spur or helical gear within the capacity of the machine. The active or grinding surfaces 55 of the wheels 13 are plane and normal to the axis of rotation of spindles 39. The opposite side of the wheels 13 are beveled as shown at 56 so that this surface will clear the tooth adjacent that being ground, the thickness of the wheel at its periphery being less than the minimum width of the space between adjacent teeth. Within the heads the spindles 38 are disposed so that with the saddles 31 extending vertically the surfaces 55 of the opposed wheels 13 are properly positioned for grinding gears having the smallest pressure angle found in practice. The oblique adjustment of the saddles 31 enables gear teeth having from minimum to maximum pressure angle (approximately 15° to 25°) to be ground.

Provided on the front faces of the heads 38 are ways 60 upon which may be slidably mounted housing 61 for a dressing attachment within which are slidably mounted the wheel dressing diamonds or other tools presently to be more fully described. The ways 60 upon which each dressing attachment 61 is mounted are disposed at an oblique angle to the ways on the saddle 31 on which its head 38 slides and may be raised and lowered upon the head 38 by connections from the above mentioned screw 45. For this purpose a screw 62 rotatable within the head 38 and engaging nut 59 on the dressing attachment is provided with a gear 63 upon an intermediate portion of the screw 62 in mesh with an idler gear 64 upon the dressing attachment. This gear 64 in turn is in mesh with a gear 65 upon the upper end of the threaded shaft 45. By rotation, therefore, of the screw 45 to raise and lower the head 38 carrying the wheel 13 the housing portion of the dressing attachment 61 slidably mounted upon the ways 60 is also moved in the same direction. The ratio of these motions, that is of the head 38 and the attachment 61, is one to one. For any motion downward of the wheel 13 and head 38, therefore, the dressing attachment 61 is moved upon its oblique angle a similar distance. The resulting position of the gear en-

gaging surface 55 of the wheel 13 after successive redressing operations will be maintained at all times precisely identical as the head 38 is adjusted to compensate for wearing away of the wheel. To permit slight angular adjustment of the housing 61 relative to its head 38 there is provided a pivot 58 outstanding from the slide 57. By these means the direction of movement of the dressing tools 67 can be accurately adjusted. Clamping means shown in Fig. 6 enables the housing 61 to be clamped in any predetermined position indicated by graduations 61a.

Referring now to the dressing attachment per se shown in Figs. 4, 5, and 6, it will be seen that the housing 61 for the wheel dressing tools is slidably mounted upon the dovetail ways 60 and contains two slides 66 each of which carries a diamond wheel dressing tool 67 upon its lower end. These slides 66 are positioned in opposed relation to each other so that the diamonds 67 face toward each other. Opposite faces of the abrasive wheel 13 may therefore be dressed. Each of these slides 66 is provided with racks 68 along a portion of one side face which engage respectively gears 69 of equal size mounted upon a central horizontal shaft 70 within the housing 61 adapted to be rotated in opposite directions. The positions of the slides 66 are disposed so that one of the dressing tools 67 is at one end of its movement while the other tool is at its opposite end. While one tool 67, therefore, is moving downward the opposite tool 67 will be moving upward as their rack teeth 68 are upon opposite sides of the central driving gears 69. In order to rotate this shaft 70 and the gears 69 to traverse the dressing tools 67 back and forth there is a large gear 71 attached to the forward end of the shaft 70 in mesh with a pinion 72 on a forwardly extending stud or shaft 73 having a crank 74 on its forward end in front of the housing 61. By rotating this crank 74 therefore in opposite directions the dressing tools 67 may be traversed over the active surfaces of their wheel 13. By reference to Fig. 3 of the drawings it will be seen that the slide 66 carrying the diamond or other tool 67 for dressing the operative side 55 of the wheel moves substantially in a direction normal to the axis of spindle 39 in head 38.

Also mounted within each dressing attachment 61 is a third diamond or other tool 76 adapted to engage the outer peripheral edge of a wheel 13. This tool 76 is carried by an arm 77 oscillated upon a pivot 78 provided within the housing 61 of the dressing attachment. This arm 77 has its dressing tool directly upon its lower extended end, the upper end being provided with gear teeth 79 engaging a gear 80 on the shaft 70 referred to above. Movement, therefore, of the dressing tools 67 by rotation of the shaft 70 carrying pinions 69 and 80 will simultaneously oscillate this dressing tool 76 across the periphery of the wheel 13.

To enable the dressing tools to be initially positioned for operation when a wheel 13 is being mounted on spindle 39 the connection between screws 45 and 62 is made adjustable. For this purpose the gear 63 on screw 62 is secured by means of a collar 82 keyed to shaft 62 and having serrations on the face contacting with corresponding serrations on the face of the gear 63. Collar 82 is held on the shaft of screw 62 by a threaded nut 83 retained preferably by a locking ring 84.

In operation and as the wheels become worn and require dressing the heads 38 are individually adjusted downward by hand wheels 50 and their connected mechanism. This movement gives the housing 61 for the dressing tools thereon a downward movement of the same amount as the head. Simultaneously with this downward movement of a head 38 and housing, the housing 61 is moved along the guideway 60. Thus the dressing tools 66 and their housing 61 are given two simultaneous movements, these movements being of equal amount due to the ratio of the connections between the heads of screws 45 and 62. The acute angle between the guideway for head 38 in saddle 31 and the axis of spindle 39 is equal to the acute angle between axis of spindle 39 and the guideway 60 on which the dressing tool housing 61 slides. The two movements of the housing 61 have a resultant direction normal to the axis of the wheel 13. The final position of the dressing tools, therefore, by reason of this ratio and disposition of slides 38 and 61, is correct for any diameter of wheel. With the head 38 moved to its new position the tools 66 are traversed by operation of their bars or slides as described above.

By means of the pivot 58 the housing 61 may be oscillated slightly to vary the direction of movement of the dressing tools 66. This adjustment is sufficient to dress the operative side 55 of the wheel 13 to a slightly concave surface sometimes preferred as the active face of a wheel rather than a perfectly plane surface.

What I claim is:

1. A gear grinding machine comprising in combination, a support, opposed carriages slidably mounted thereon, means to adjust the position of said carriages toward and from each other, heads on said carriages, means to pivotally adjust said heads about their carriages, means to adjust said heads in directions at an angle to the direction of movement of said carriages, abrasive wheels rotatably supported on said heads, dressing attachments for the wheel slidable on said heads, dressing tools in said heads slidable obliquely therein, one of said tools in each head being movable in a direction normal to the axis of the wheel in said head, and means to simultaneously adjust a head on its carriage and a dressing attachment on its head in directions oblique to the plane of the wheel, whereby the active plane of the wheel will remain in predetermined relationship to the work.

2. A gear grinding machine comprising in combination, a support, opposed carriages slidably mounted thereon, means to adjust the position of said carriages toward and from each other, heads adjustable on said carriages in directions at an angle to the direction of movement of said carriage, abrasive wheels supported on said heads for rotation upon axes oblique to the direction of movement of said carriages and heads, dressing attachments movable on said heads in directions oblique to the movement of said heads, opposed slides having dressing tools thereon within said attachments and movable over the work engaging surfaces of said wheels, means to simultaneously adjust a head on its carriage in one direction and adjust a dressing attachment on its head in a direction oblique to the movement of the head, whereby the active plane of said wheel is maintained in predetermined relationship with the work, and manual means to traverse said slides over said wheel.

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