Dec. 5, 1933. A. P. STEINER 1,937,726

GRINDING MACHINE

Filed Dec. 22, 1928 3 Sheets-Sheet 1

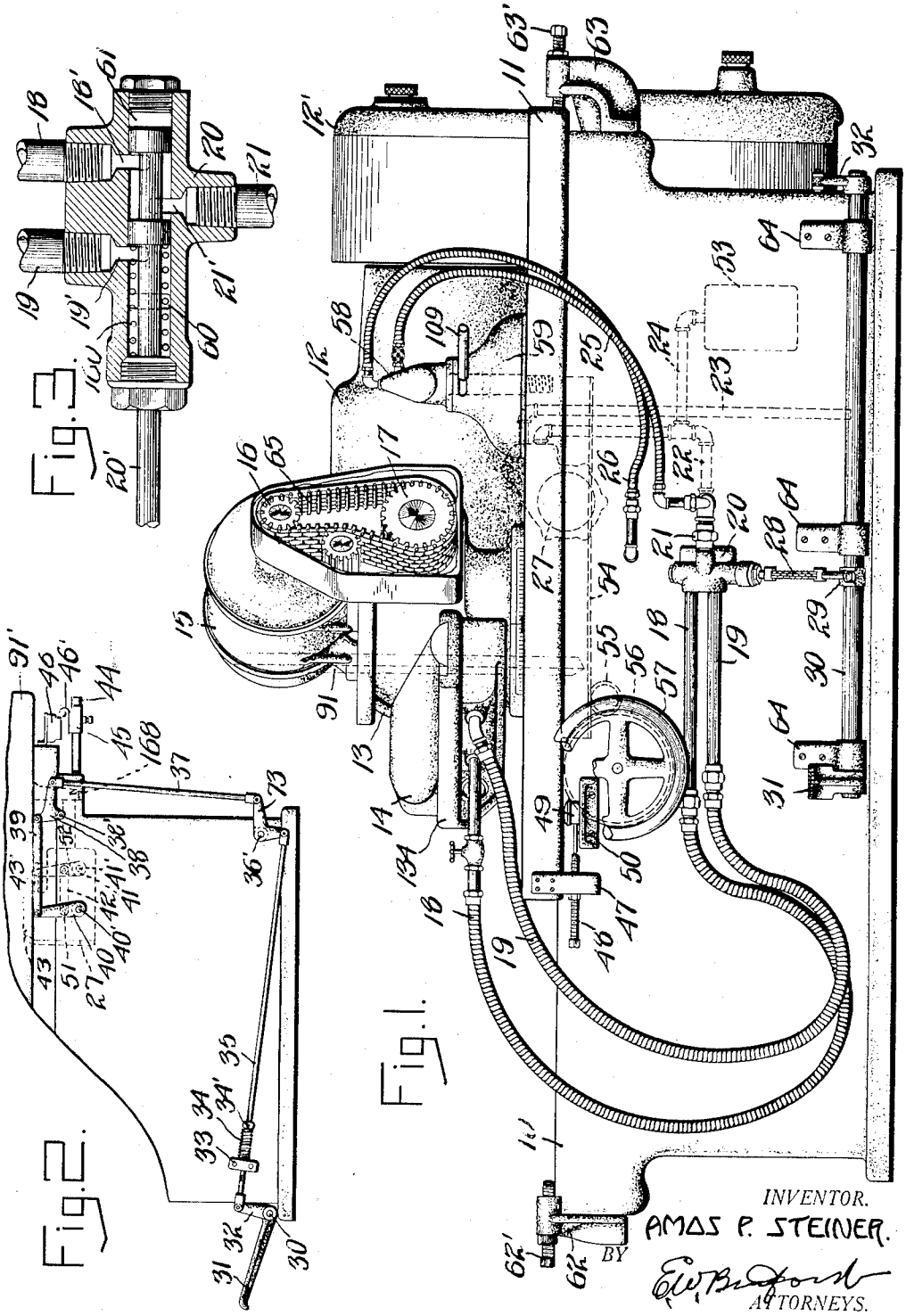

Fig. 1.

Fig. 2.

Fig. 3.

INVENTOR.
AMOS P. STEINER.
BY
ATTORNEYS.

Dec. 5, 1933. A. P. STEINER 1,937,726

GRINDING MACHINE

Filed Dec. 22, 1928 3 Sheets-Sheet 2

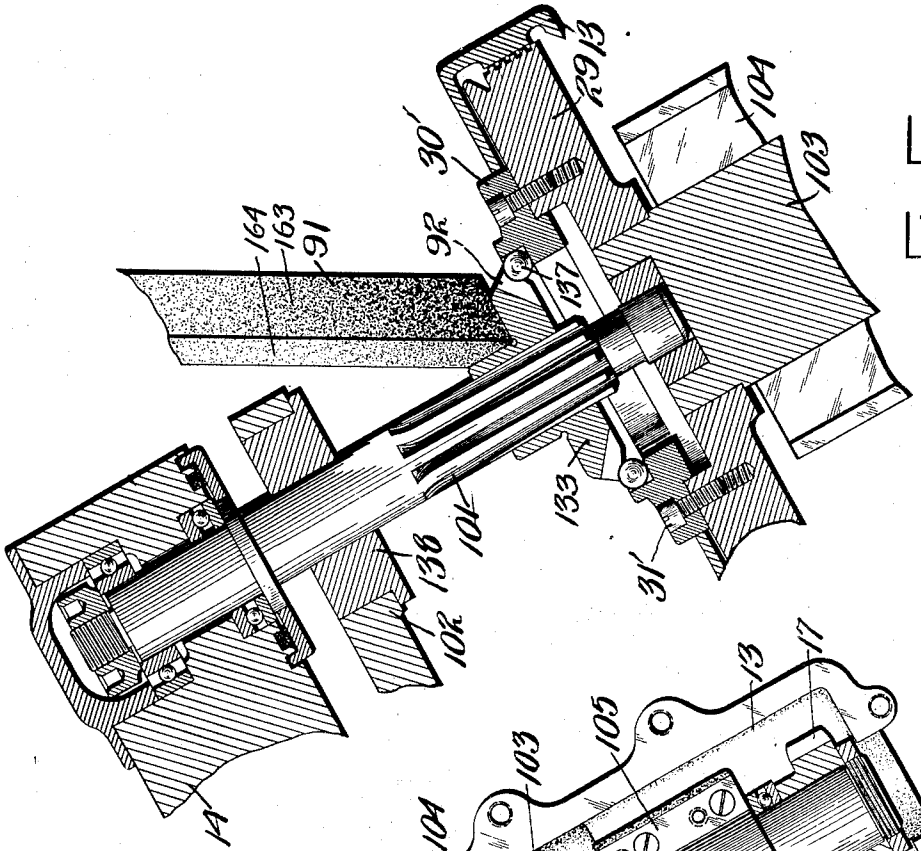

Fig. 5.

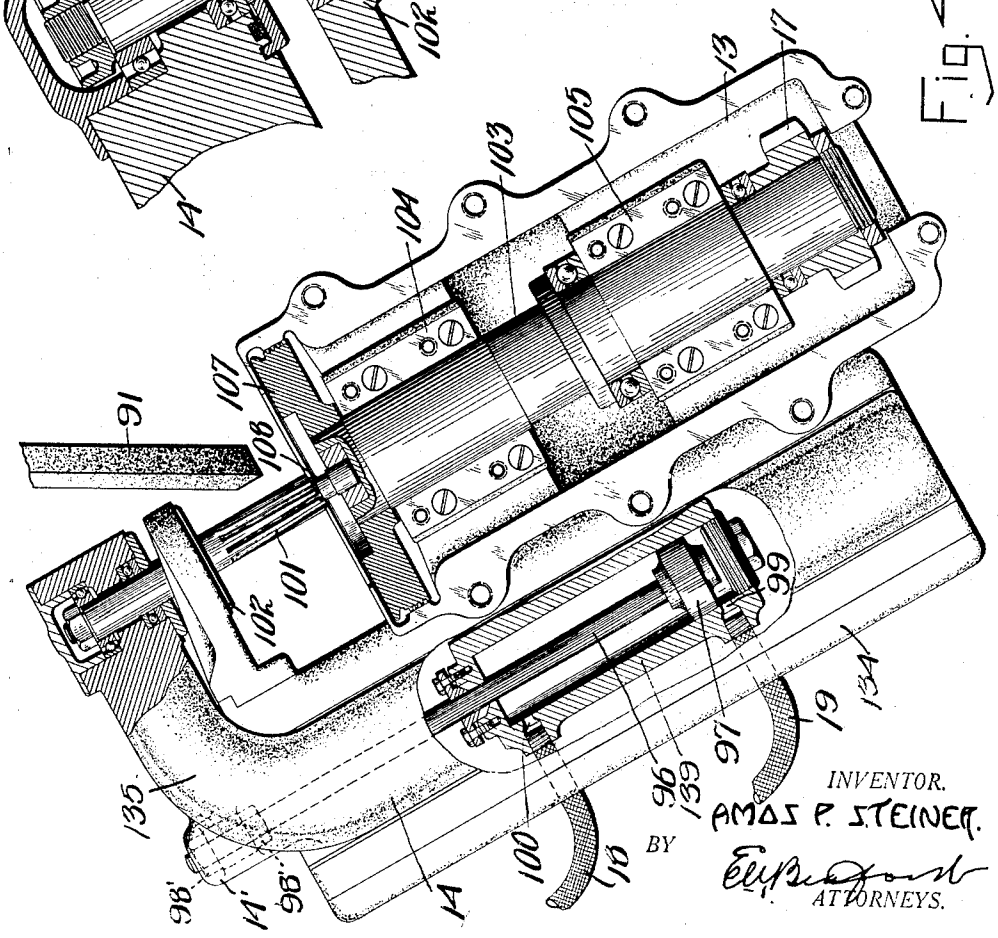

Fig. 4.

INVENTOR.
AMOS P. STEINER.
BY
ATTORNEYS.

Dec. 5, 1933. A. P. STEINER 1,937,726

GRINDING MACHINE

Filed Dec. 22, 1928 3 Sheets-Sheet 3

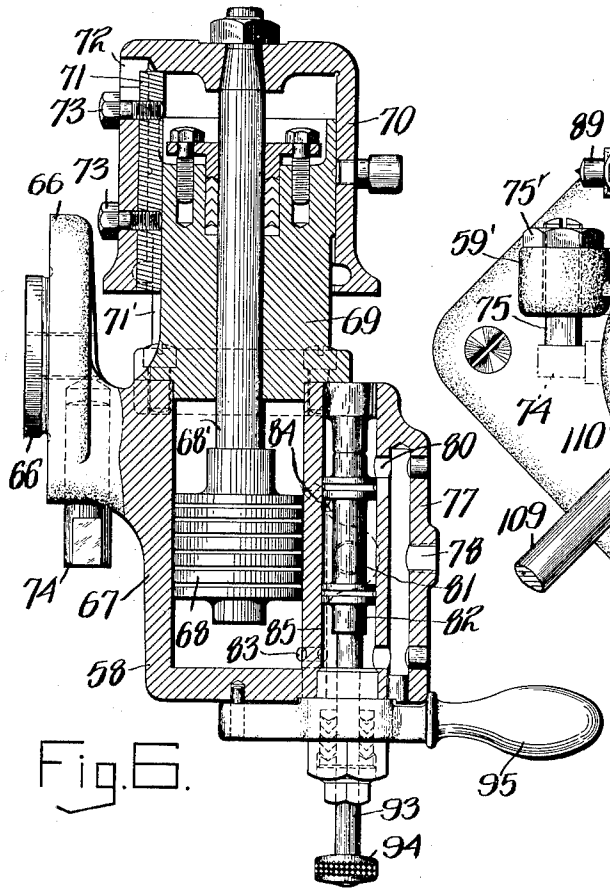

Fig. 6.

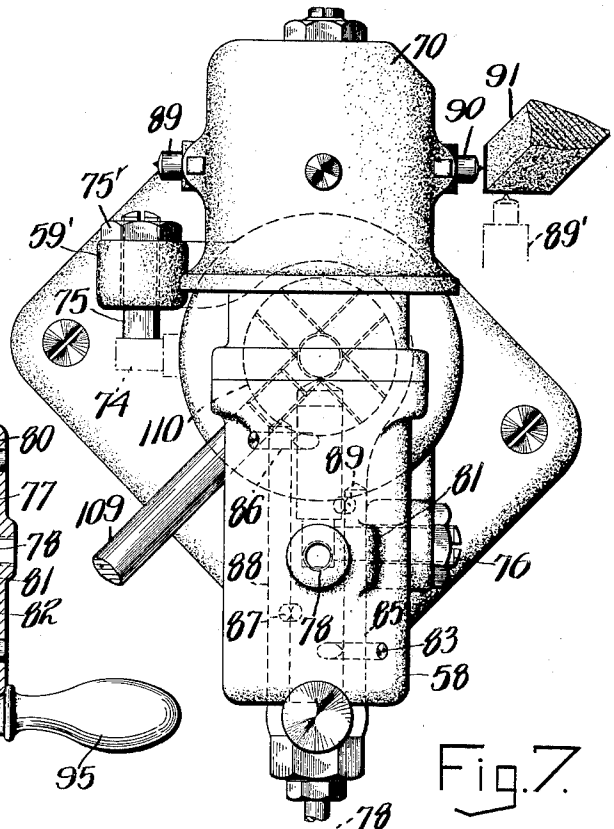

Fig. 7.

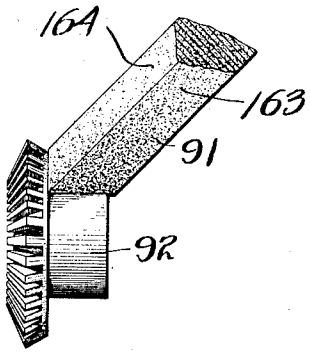

Fig. 8.

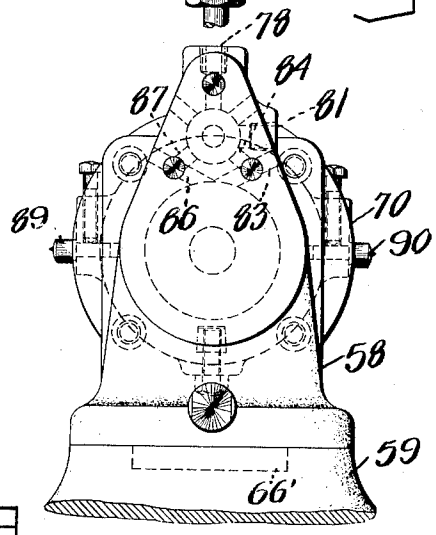

Fig. 9.

INVENTOR.
AMOS P. STEINER.

BY

ATTORNEYS.

Patented Dec. 5, 1933 1,937,726

UNITED STATES PATENT OFFICE

1,937,726

GRINDING MACHINE

Amos P. Steiner, Waynesboro, Pa., assignor to Landis Tool Company, Waynesboro, Pa., a corporation of Pennsylvania

Application December 22, 1928. Serial No. 327,903

10 Claims. (Cl. 51—105)

This invention relates to grinding machines, and particularly to machines for grinding a face and hub of a gear at the same time. Although not limited to such use, it is particularly designed for use in grinding the hub and face of a bevel gear.

An object of the invention is to provide a machine in which the face and hub of a gear may be ground at the same time and with a single abrasive wheel.

A further object is to provide a machine for performing work of this character in which the whole cycle of operations may be controlled by a single control mechanism.

A still further object is to provide a wheel dressing means for a grinding wheel of the character required for grinding both the face and hub of a gear which may be moved to dress a wheel without traversing the work carriage.

Further objects and advantages will become apparent as the description proceeds.

Referring to the accompanying drawings, which are made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a front elevation of my machine,

Figure 2 is a partial end view showing means for operating the grinding wheel feed mechanism,

Figure 3 is a sectional elevation of the foot stock control valve,

Figure 4 is a plan view of the work supporting and rotating mechanism partly in section,

Figure 5 is an enlarged view of portions of the head stock and foot stock showing them in grinding position,

Figure 6 is a section through the operating mechanism for the wheel truing fixture,

Figure 7, a plan view of the wheel truing fixture,

Figure 8, a detail view showing the grinding wheel in position to grind the hub and face of a gear, and

Figure 9, an end elevation of the truing fixture.

In the drawings Fig. 1, numeral 10, indicates the bed of a grinding machine having a work carriage 11 slidably mounted in guideways thereon. Each end of the bed is provided with brackets 62 and 63 in which are threaded adjustable stop screws 62′ and 63′. On one end of the work carriage 11 is a depending bracket 47 carrying an adjustable screw 48 adapted to strike against an indicator 49 mounted in a bracket 50 on the bed of the machine. The indicator is graduated so that the slightest movement of the carriage 11 after the screw 48 engages with it, will indicate the position of the carriage.

In order to secure accurate work the work carriage must be positioned accurately in relation to the grinding wheel. In order to accomplish this, the stop screw 63′ is adjustable to position the work carriage 11 in exact position before the grinding wheel. The screw 48 is adjusted to position the indicator 49 at the zero mark when the work carriage is positioned correctly before the grinding wheel. The adjusting screw 63′ determines the position of the work carriage for accuracy but the indicator is an additional means for indicating when the work carriage is in correct position. Mounted on the work carriage 11 are head stock and tail stock 13 and 14. The head stock 13 has mounted thereon a spindle 103 which spindle is rotatably mounted in bearings 104 and 105 on the head stock. The head stock spindle 103 may be driven by means of a motor 15 driving through a pinion 16, a chain 65 and a pinion 17. The spindle 103 has mounted thereon a suitable chuck support 107 to which is secured a chuck 30′. The chuck may be secured to the support in any suitable way as by screws 31′. For the particular work for which the machine is designed this chuck has balls 137 which fit between the teeth of the bevel gear on the work 133 in order to hold the work to rotate with the spindle. The tail stock 14 is mounted to slide on a slide base 134 mounted on the work carriage 11. As shown, the slide base is made integral with the head stock 13 but need not necessarily be so constructed. The tail stock 14 has a curved portion 135 which carries a spindle 101 rotatably mounted in ball bearings therein. The spindle has a splined end upon which the gear is placed and keyed against rotation on the spindle. A bracket 102 is mounted on the slide base 134. This bracket carries a removable ring 138 which fits around the spindle 101. As the tail stock is withdrawn the work strikes against the bracket and is thereby removed from the spindle. The foot stock 14 is moved into and out of grinding position by means of a fluid motor which consists of a cylinder 139 having a piston 97 reciprocably mounted therein. A piston rod 96 is secured at 98 to the foot stock 14. The cylinder 139 is provided with fluid inlet and outlet ports 99 and 100 to which fluid conduits 19 and 18 are attached.

Since the machine is designed to grind two surfaces on the work, which surfaces are in dif-

ferent planes, it is necessary to position the chuck with its axis oblique with respect to the direction of travel of the work carriage.

Motive fluid to and from the cylinder 139 is controlled by means of a valve 20 shown in detail in Fig. 3. This consists of a valve casing having inlet port 21' for pressure fluid from the fluid line 21 in communication with the discharge line 24 of a pump 53. The valve chamber has an exhaust port 60. Ports 18' and 19' are connected to fluid conduits 18 and 19 for delivering and exhausting fluid to and from cylinder 139. A valve stem 20' is connected by means of a chain 28 to an arm 29 on a shaft 30. Secured to the shaft 30 is a foot pedal 31 by means of which the arm 29 is rocked to operate valve stem 20' in one direction. A spring 160 surrounding the stem 20' acting against a piston on the stem returns the valve stem in the other direction to move the stem to deliver fluid to the cylinder 139 so as to move the tail stock to working position. The shaft 30 is secured in bearings in brackets 64 secured to the bed of the grinding machine.

As shown in Figs. 4 and 5 an abrasive wheel 91 has its periphery cut to provide grinding surfaces 163 and 164 at substantially right angles to each other, which will grind the hub and rear face of the gear 133 so that these surfaces will be at substantially right angles to each other. The angle of the grinding surfaces on the periphery of the grinding wheel obviously could be other than right angles, so as to grind the face of the gear to provide any desired angle between such face and the hub of the gear.

The grinding wheel 91 is mounted upon a base 12 which base is moved into and out of grinding position by means of a fluid motor similar to the one which operates the tail stock. It consists of a piston operating in a cylinder 27. The piston has a piston rod secured to the depending arm 168 on the wheel base. The cylinder has fluid ports at opposite sides of the piston. The admission and discharge of motive fluid to the cylinder 27 is controlled by a valve similar in all respects to that shown in Fig. 3.

The valve which controls the motor which operates the wheel base feed 12 is operated by means of the foot pedal 31 and the following connections: The shaft 30 has on its outer end a rock arm 32 to which is attached a link 35. The link 35 moves in a guide bracket 33 on the end of the base of the machine. A collar 34' secured on the link 35 has a spring 34 positioned between it and the bracket 33. The purpose of this spring is to move the foot pedal 31 to elevated position, as shown in Fig. 2. The link 35 is connected to one arm of a bell crank lever 73 to the other arm of which is connected another link 37. This latter link is connected to one arm of a bell crank 38 to the other arm of which is attached another link 39. This latter link is connected to an arm 40 on a shaft 40' which passes into the base of the machine. To the other end of this shaft 40' is attached a short arm to which is attached a link 42. This link is connected at its other end to another short arm on a shaft 41'. This shaft, in turn, has another long arm 52 secured on its other end. The upper end of this long arm 52 is secured to a valve stem 43' similar in all respects to the valve stem 20' shown in Fig. 3 which valve stem operates the valve 20. The valve stem operated by the arm 52 controls admission of fluid to the motor which moves the wheel base into and out of grinding position. The use of the system of links and levers just described is made necessary with some machines such as this since it is inconvenient to place the valve stem in an easily accessible position. Where possible the valve stem may be operated directly by the link 39.

A short shaft 44 is fixed to the rear of the base 10 of the machine and has secured thereon a wedge-shaped block 45. The rear of the wheel base has a limit switch 46 secured thereon, which switch is operated by a roller 46'. The cam surface on the block 45 strikes the roller 46' as the wheel base 12 is moved into grinding position. The limit switch 46 controls operation of the motor 15 which drives the work. The object of the structure just defined is to start rotation of the work as soon as the grinding wheel is brought to grinding position.

At 58 and 59 is shown a wheel dressing device which may be secured to the bed of the machine by a screw which is operated by a hand lever 109. The wheel dressing device forms no part of the present invention and therefore will not be described further in detail.

The work carriage 11 may be manually operated by means of a hand wheel 57, pinions 56, 55 and a rack 54 secured to the under side of the carriage.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention, and I therefore, do not limit myself to what is shown in the drawings and described in the specification, but only as set forth in the appended claims.

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

1. A grinding machine for grinding the hub and a face of a gear comprising a base, a grinding wheel carriage on said base and movable into and out of grinding position, a grinding wheel on said carriage, a fluid motor for moving said grinding wheel carriage into and out of grinding position, a work carriage, a head stock rotatably mounted upon said work carriage, a tail stock base mounted upon said work carriage, a tail stock slidably mounted in said tail stock base, a motor for moving said tail stock into work engaging position and a common control for both of said fluid motors, substantially as set forth.

2. A machine for grinding the hub and adjacent face of a gear comprising means for supporting the gear in an angular position before a grinding wheel, hydraulic means for moving a grinding wheel into and out of grinding position, hydraulic means for moving the work supporting means into and out of operative position, the said means for moving the grinding wheel out of grinding position operating slightly in advance of the means for moving the work supporting means out of grinding position and a common control for the last two named means, substantially as set forth.

3. A grinding machine comprising a base, a work support, a wheel support, means for moving the wheel support toward the work support, the work support having mounted thereon a head stock and a tail stock, and manually controlled fluid means for moving the work support to grinding position and for moving the tail stock into operative position, and means

for accurately locating it in such position, and an auxiliary means including a stop and a gauge for determining when the carriage is in accurate working position, substantially as set forth.

4. A grinding wheel comprising a base, a work carriage slidably mounted on said base, a grinding weel base slidably mounted on said grinding machine base, work supporting means carried by said work carriage, the said work supporting means comprising a head stock and a tail stock, means for rotating the head stock, means for moving the tail stock into and out of work engaging position, means for removing the work from the tail stock as the latter is moved out of working position, means for moving the grinding wheel base into and out of grinding position, and means on the grinding wheel base for starting the work rotating motor when the grinding wheel is in grinding position and for causing cessation of operation of the work rotating motor when the grinding wheel base is in inoperative position, substantially as set forth.

5. Means for grinding two surfaces on different planes at the same time with a single grinding wheel comprising a work support, a grinding wheel having its peripheral grinding surface cut on two planes, means for moving the grinding wheel into and out of operative position, and means for moving the work support into and out of work grinding position, and a common control for said two last named means substantially as set forth.

6. A machine for grinding the hub and an adjacent face of a beveled gear comprising a base, a work support, a grinding wheel, a work chuck on the work support having its axis oblique with respect to the axis of rotation of the grinding wheel, the grinding wheel having its peripheral grinding surface cut cn two planes substantially at right angles to each other for grinding the hub and the face of the gear simultaneously, a bracket mounted on the base, a work spindle mounted on the work support and extending through the said bracket, the said bracket serving to remove the work from the spindle as the work support is withdrawn, and means for moving the work and the grinding wheel into and out of grinding position, substantially as set forth.

7. A grinding machine for grinding the hub and adjacent face of a gear comprising a grinding wheel base, a grinding wheel mounted thereon, means for supporting the gear so that the plane of the gear will lie at an oblique angle with respect to the plane of the grinding wheel, means for rotating the gear while being ground, hydraulic means for moving the grinding wheel into and out of grinding position, hydraulic means for moving the work supporting means into and out of grinding position, control means for the said hydraulic means so arranged that in moving into grinding position the work is first brought to position and then the grinding wheel is moved up and in moving out of grinding position, the wheel is first moved and then the work is withdrawn, substantially as set forth.

8. In a grinding machine for grinding the hub and adjacent face of a grear, a work support, means for securing the work thereon, means for rotating the work support, means for moving the work securing means to bring the work piece into grinding position, and means for centering the work support and the work itself, and means for driving the work by the work centering means, substantially as set forth.

9. In a machine for grinding the hub and adjacent face of a gear comprising the combination with a grinding wheel, of a work support having its axis oblique with respect to the plane of the wheel, means for rotating the work support, means for centering the work, said means serving also to support the work, and a work removing device positioned to remove the work as it is withdrawn from grinding position, substantially as set forth.

10. In a machine for grinding the hub and an adjacent face of a gear, a work support comprising a head stock and a recess therein adapted to receive a work holder, a tail stock, a work centering and supporting shaft carried by the tail stock, said shaft having a fluted end to receive the gear and to hold it against rotating thereon, and means engageable with a face of the gear as the holding means is withdrawn for removing the work from its support, substantially as set forth.

AMOS P. STEINER.