Aug. 4, 1942. F. H. ADAMS ET AL 2,292,260

HOBBING MACHINE

Original Filed July 21, 1932 5 Sheets-Sheet 1

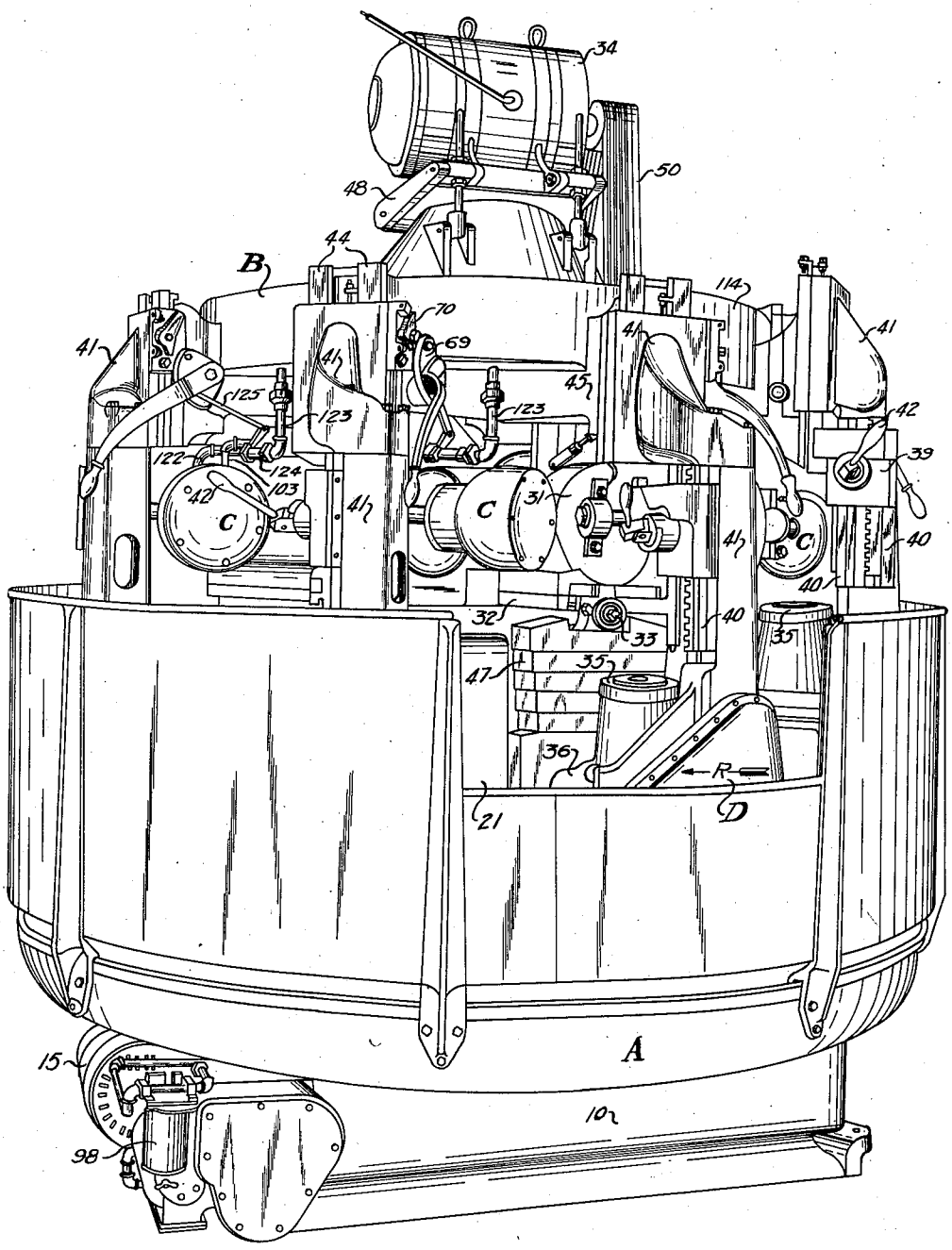


Fig. 1

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Original Filed July 21, 1932 5 Sheets-Sheet 2

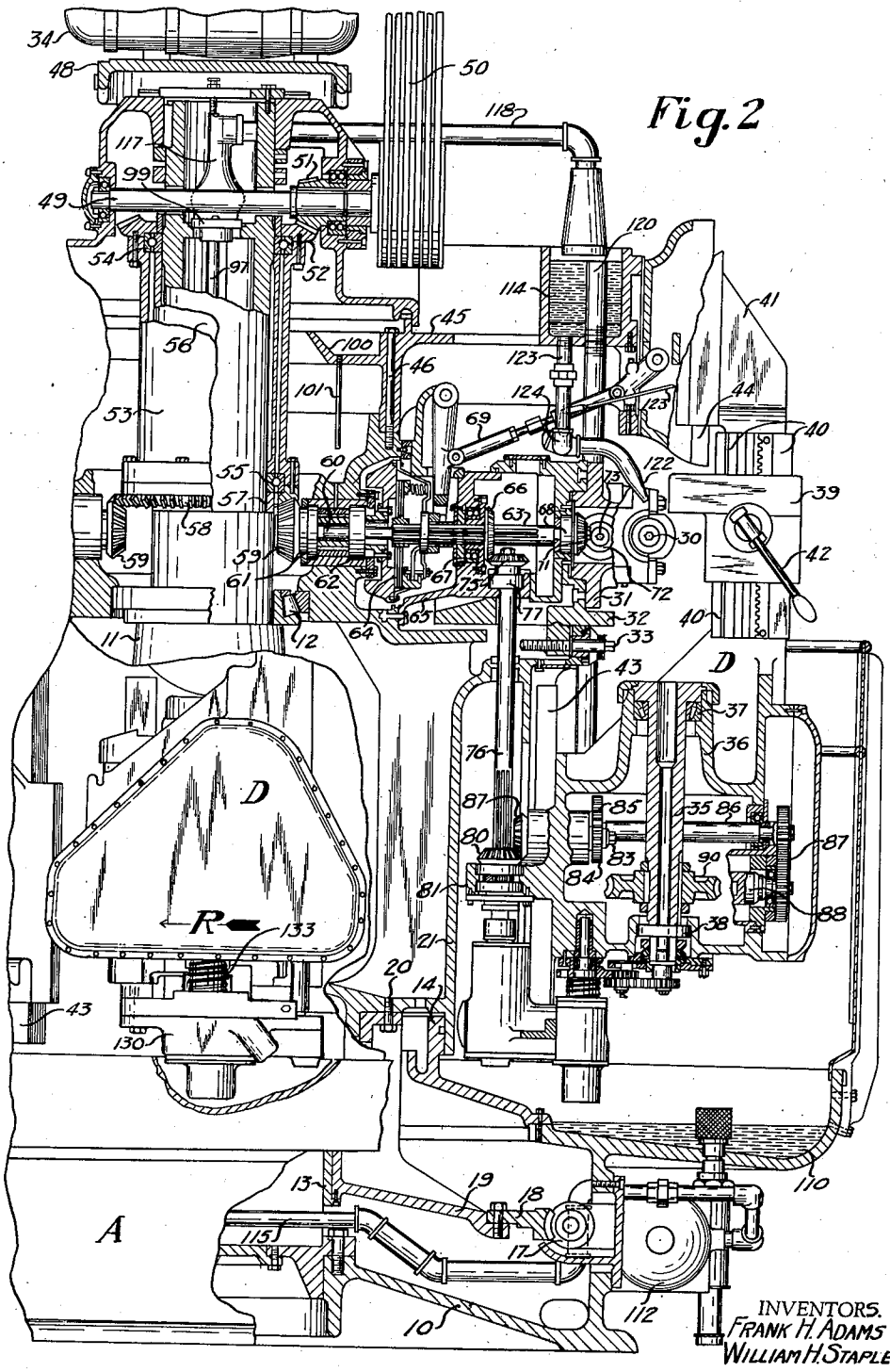


Fig. 2

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HOBBING MACHINE

Original Filed July 21, 1932 5 Sheets-Sheet 3

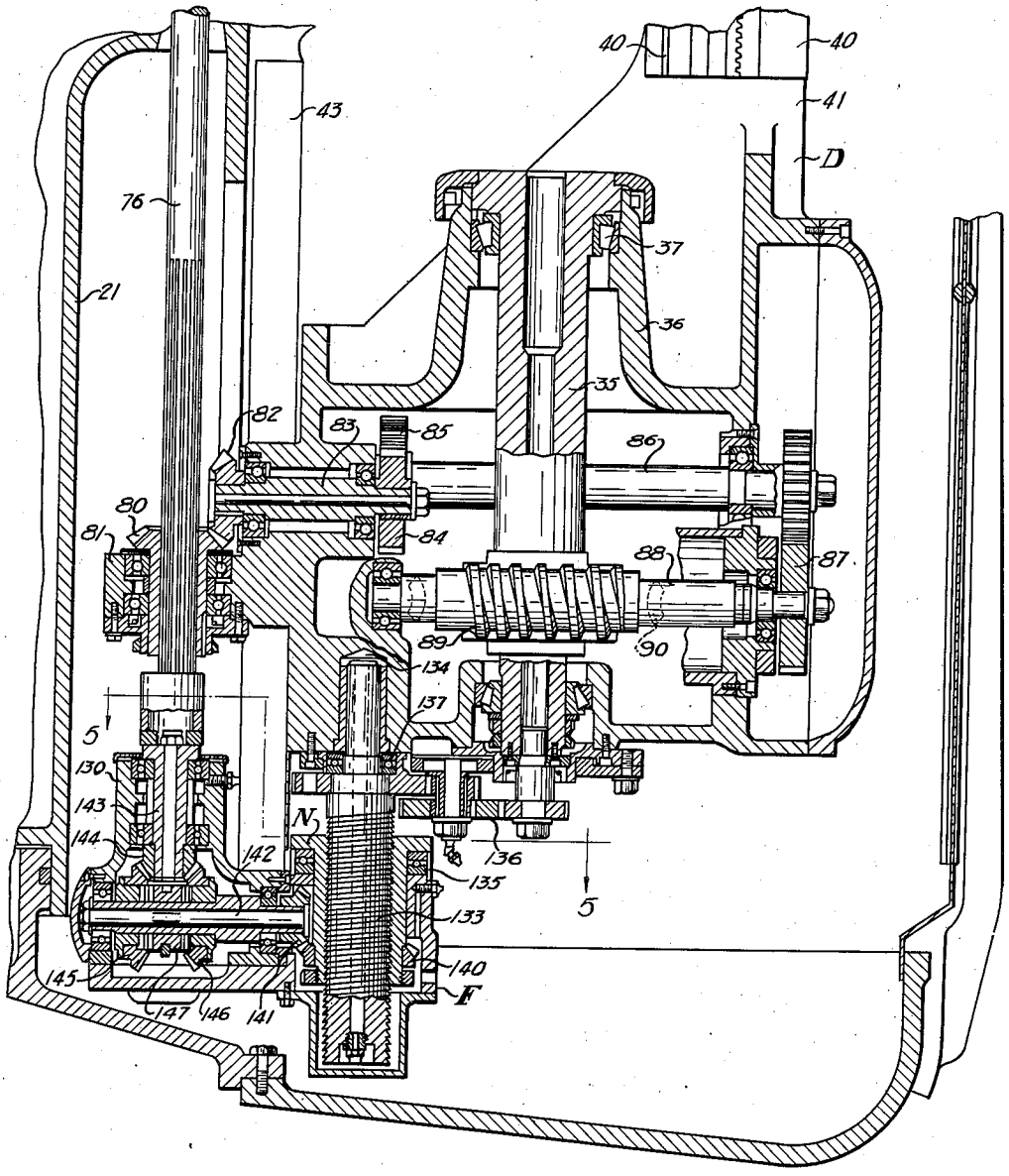


Fig. 3

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HOBBING MACHINE

Original Filed July 21, 1932 5 Sheets-Sheet 4

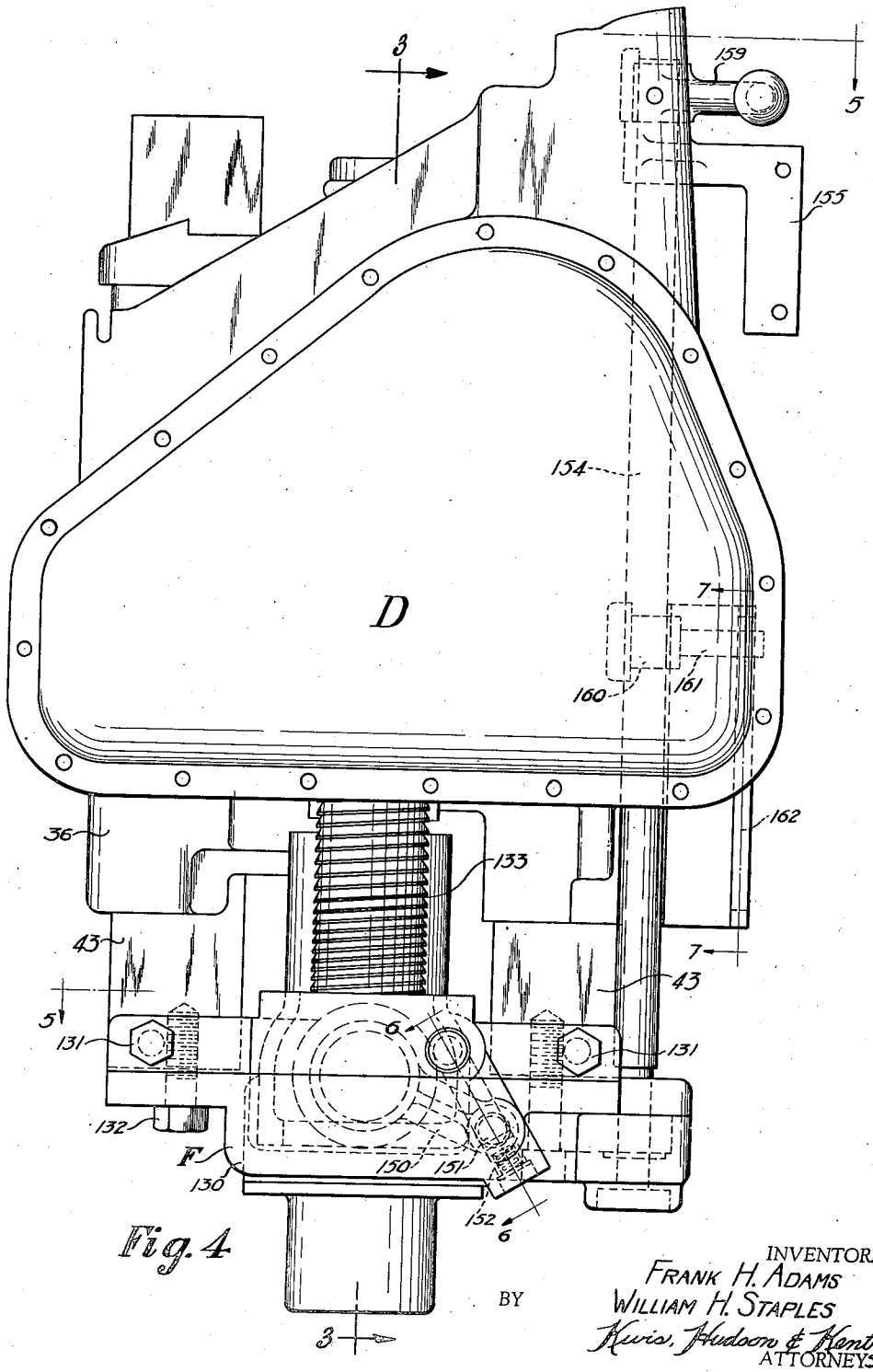


Fig. 4

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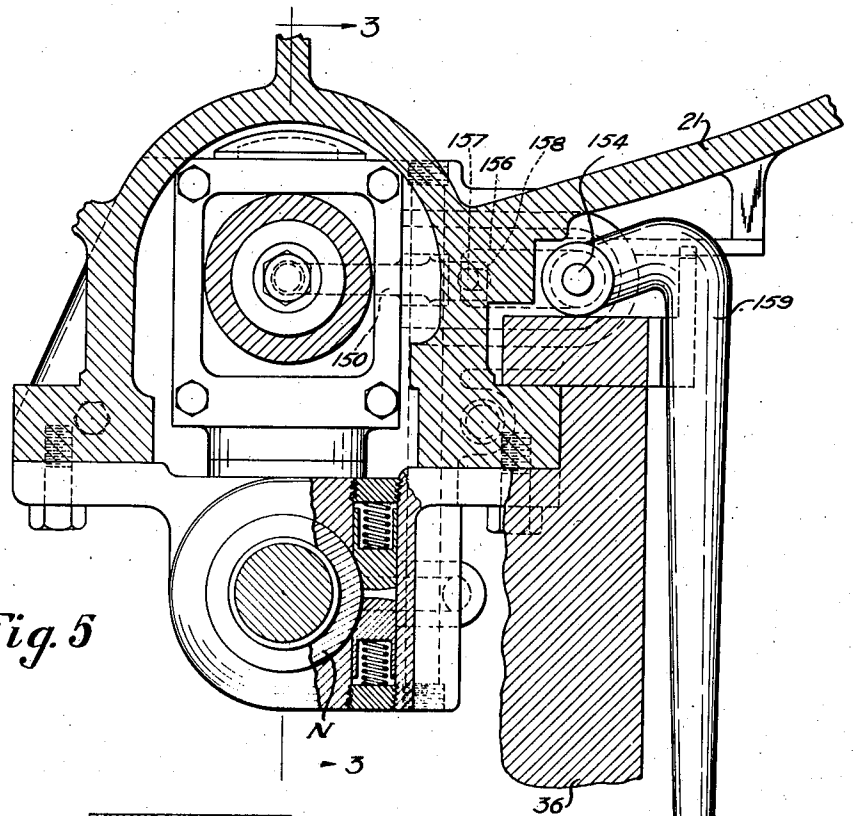


Fig. 5

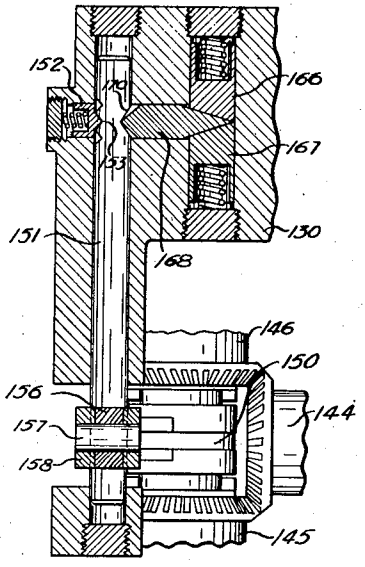


Fig. 6

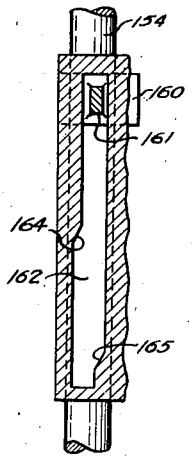


Fig. 7

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UNITED STATES PATENT OFFICE

2,292,260

HOBBING MACHINE

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Original application July 21, 1932, Serial No. 623,830. Divided and this application August 17, 1935, Serial No. 36,708

6 Claims. (Cl. 90—4)

The present invention relates to metal working machines and more particularly to rotary gear cutting or hobbing machines, and this application is a division of our copending application, Serial Number 623,830, filed July 21, 1932, entitled "Hobbing machine," upon which application United States Patent No. 2,048,173, issued July 21, 1936.

An object of the present invention is the provision of a novel means for effecting relative movement between the tool and work of a metal working unit comprising relatively movable tool and work supports carried by a rotatable turret.

Another object of the invention is the provision of a novel means for controlling relative movement between the tool and work of a metal working unit comprising relatively movable tool and work supports carried by a rotatable turret.

Another object of the invention is the provision of a novel metal working machine comprising relatively movable tool and work supports carried by a rotatable turret and means for producing relative movement between the tool and work supports.

Another object of the invention is the provision of a novel metal working machine comprising relatively movable tool and work supports carried by a rotatable turret and means for producing relative movement between the tool and work supports at different speeds controlled by the movement of one of the supports.

Another object of the invention is the provision of a novel metal working machine comprising relatively movable tool and work supports carried by a rotatable turret, and a cooperating lead screw and nut or producing relative movement between the tool and work supports at different speeds.

The invention resides in certain novel features, details of construction, and combinations and arrangements of parts, and further objects and advantages thereof will be apparent to those skilled in the art to which it pertains from the following description of the preferred embodiment thereof described with reference to the accompanying drawings, in which similar reference characters represent corresponding parts throughout the several views, and in which

Fig. 1 is a perspective view of a hobbing machine embodying the present invention;

Fig. 2 is a section of the machine shown in Fig. 1 approximately on the center line, with portions shown in elevation;

Fig. 3 is an enlarged section appropriately on the line 3—3 of Fig. 4 looking in the direction of the arrows, with portions shown in elevation;

Fig. 4 is a front elevation with portions broken away, of the device shown in Fig. 3, looking from the right as viewed in Fig. 3;

Fig. 5 is a view on the lines 5—5 of Figs. 3 and 4 looking in the direction of the arrows;

Fig. 6 is a section on the line 6—6 of Fig. 4 looking in the direction of the arrows, and

Fig. 7 is a section on the line 7—7 of Fig. 4 looking in the direction of the arrows.

The preferred embodiment of the invention is illustrated as embodied in a machine somewhat similar to the machines illustrated in United States Patent Nos. 1,732,700; 1,878,656; and 1,973,133, and only those parts of the machine are illustrated which are necessary to convey a complete understanding of the invention to those skilled in the art.

In the embodiment of the invention illustrated the turret B is continuously rotated in the direction of the arrow R, and the work spindles loaded and unloaded as the hobbing units, of which there are eight, successively pass a definite position referred to as the loading station. As the hobbing units are carried in a closed path about the axis of the turret and returned to the loading station the work heads D are moved vertically on the turret B by the feed mechanism F to feed the work past the cutter. The tool heads C are preferably adjustably supported by the turret B for movement in a plane normal to the vertical movement of the work heads D, but it is to be understood that a relative feed between the tool and work spindles normal to the turret axis may be provided in addition to the relative movement longitudinally of the work spindle axes.

The frame A comprises a base 10 and a central column 11 about which the turret B is rotatably supported by suitable bearings 12, 13 and 14. The turret B is rotated about the frame A by a motor 15, through the medium of a worm 17 and worm wheel 18. The worm wheel 18 is of large diameter and is bolted on a flange member 19 secured by the bolts 20 to the lower part of a member 21 which forms the main frame of the turret B.

Each of the tool heads C comprises a tool or hob spindle 30 rotatably supported by a spindle member 31 which in turn is carried by a head member 32. The spindle members 31 are adjustable about axes normal to the axes of the hob spindles 30, and the head members 32 are slidably supported on horizontal ways on the

turret member 21 and adjustable therealong radially of the axis about which the turret rotates by screws 33 which engage the head members and are threaded into tapped holes in the turret member 21. Each of the work heads D comprises a work spindle 35 rotatably supported in a work head member 36 by anti-friction bearings 37 and 38, and a tail slide 39 slidably supported on ways 40 on a vertical projection 41 of the work head members 36. The tail slides 39 are movable on the ways 40 and held in any adjusted position thereon by clamp levers 42. The head members 36 are slidably supported on vertical ways 43 on the turret member 21 and vertical ways 44 on a cap member 45 secured to the top of the turret member by bolts 46, and moved therealong by mechanism hereinafter referred to. A collapsible wayguard 47, not shown in Figs. 2 et seq. is used to protect the ways 43 from chips etc.

The tool and work spindles 30 and 35 respectively are rotated at predetermined relative speeds by a motor 34 supported on an adjustable platform 48 on the top of the column 11 and operatively connected to a shaft 49 through a flexible drive 50. A pinion 51 keyed to the shaft 49 meshes with a bevel gear 52 bolted to the upper end of a sleeve 53 rotatably supported by anti-friction bearings 54 and 55 on the central column 11. Spacer sleeves 56 and 57 position the bearings 54 and 55 on said column. A bevel gear 58 bolted to the lower end of the sleeve 53 meshes with a plurality of bevel pinions 59, one for each hobbing unit, keyed to short shafts 60 rotatably supported in the turret member 21 by anti-friction bearings 61 and 62. The drives for the various hobbing units from the gear 58 are duplicates and only one thereof will be described in detail.

The shaft 60 is operatively connected to and drives a spline shaft 63 through a friction plate clutch 64 the driven member of which is splined to said shaft 63. The shaft 63 is rotatably supported in a member 65 bolted to the turret member 21, and the head member 32 by a bevel gear 66 splined thereto and an anti-friction bearing 67 and an anti-friction bearing 68, respectively. The clutch 64 is adapted to be either manually or automatically operated in predetermined timed relation to the other operation of the machine through mechanism designated in general by the reference character 69 adapted to be automatically operated by cam mechanism 70 controlled by the vertical movement of the work head D. The hob spindle 30 is driven from the shaft 63 through miter gears 71 and 72 keyed to the shaft 63 and a short shaft 73 rotatably supported in the spindle member 31, and change gears, not shown, one of which is keyed to the shaft 73 and the other to the spindle shaft 30. The spline shaft 63 permits adjustment or movement of the hob head C radially of the turret axis without interruption of the hob spindle drive, and the miter gears 71 and 72 permit angular adjustment of the spindle member 31 and the hob spindle 30 about the axis of the shaft 63.

The work spindle 35 is driven from the shaft 63 through the following mechanism: bevel gear 66, previously referred to; bevel gear 75 keyed to the upper end of a vertical shaft 76 rotatably supported by an anti-friction bearing 77 in the member 65; the shaft 76; bevel gear 80 rotatably supported in a projection 81 on the rear of the work head member 36 and splined to the lower end of the shaft 76; bevel gear 82, continuously in mesh with bevel gear 80, keyed to a short shaft 83 the other end of which carries a spur gear 84 also keyed thereto; the shaft 83 and the spur gear 84; spur gear 85, keyed to a shaft 86 rotatably supported on the work head member 36, in mesh with the gear 84; change gears 87; a shaft 88 rotatably supported in the member 36 and connected to one end of the train of change gears 87; and a worm 89, see Fig. 3, keyed to the shaft 88 and in mesh with a worm wheel 90 keyed to the work spindle 35.

Oil is supplied to the various bearings by a cascade system which includes a pipe 97 through which oil is pumped from a reservoir in the base of a machine by a pump 98 of any desired construction, to a small reservoir 99 at the top of the column 11. From the reservoir 99 the oil flows down the outer surface of the column 11, lubricates the bearings 54, 55, 12, 13, etc., and over the bevel gear 52 onto a ledge 100 formed integral with the cap member 45. From the ledge 100 the oil is conducted by a pipe or pipes 101 to a trough on the top of the turret member 21 from which it passes to the bearings 61, 62. Oil is also conducted from the reservoir 99 to the front bearings of the tool head by pipes 103, see Fig. 1.

The lubricating and cooling fluid for the cutting tools is supplied from a reservoir 110 in the base 10 of the machine, from where it is pumped by a pump 112 to a small annular reservoir 114 at the top of the turret B through pipes 115 and 116, connection 117, and pipe 118. The pipe 116 projects up through the center of the column 11 and the connection 117 is bent to accommodate the shaft 49. The reservoir 114 is provided with an overflow pipe 120. A plurality of nozzles 122, one at each hobbing unit, are connected to the reservoir 114 by pipes 123. The flow of fluid through the nozzles 122 is controlled by valves 124 either manually or automatically operated. The valves 124 preferably operatively connected by a rod 125 to the clutch operating mechanism 69 and operated thereby in such a manner that the flow of fluid is interrupted when the spindles 30 and 35 are stationary in the loading station, and uninterrupted during the rotation of said spindles.

As previously stated the hobbing units are carried in a closed circular path about the axis of the turret B as the same rotates, and the work loaded and unloaded at one or more positions referred to as loading stations. In the embodiment of the invention illustrated, only one loading station is employed at which position the finished work is removed and a new work piece inserted without interrupting the rotation of the turret, and as the units are moved in a closed path back to the loading station the work heads D are moved along the vertical ways 43 and 44 to feed the work supported thereby past the cutters or hobs carried on the spindles 30. As the hobbing units successively pass the loading station, the finished work pieces are removed, a rapid traverse movement imparted to the work heads D to lower the same to the starting position, new work pieces inserted and the work heads given a rapid traverse movement in the reverse direction to bring the work up to the tool, after which the feed movement is imparted to the work heads. The mechanism for performing these operations is the same for each work head D and only one thereof will be described in detail.

A bracket 130 secured to the lower ends of the ways 43 by the bolts 131 and 132 rotatably supports a nut N continuously in engagement with a lead screw 133 rotatably secured in a suitable aperture 134 in the work head member 36. An anti-friction thrust bearing 135 positioned between a flange on the upper end of the nut and the bracket 130 takes the downward thrust of the nut N. The lead screw 133 is rotated in predetermined timed relation to the other operations of the machine, from the work spindle 35 through change gears indicated in general by the reference character 136. An anti-friction thrust bearing 137 is positioned between the lead screw 133 and the work head member 36 to take the weight of the work head.

As illustrated, the feed movement is imparted to the work head D by the relatively slow rotation of the lead screw 133, and the nut N is adapted to be rapidly rotated in either direction to impart the rapid traverse movement to the head by the following mechanism: A bevel gear 140 keyed to the nut N is continuously in mesh with a bevel gear 141 fixed on one end of a shaft 142 rotatably supported in the bracket 130. The shaft 142 is adapted to be driven at a comparatively high speed by a shaft 143 coupled to the lower end of the shaft 76, through a bevel gear 144 keyed to the lower end of shaft 143 and continuously in mesh with bevel gears 145 and 146 rotatably supported on shaft 142. The bevel gears 145 and 146 are adapted to be selectively connected to the shaft 142 by a clutch, the movable element 147 of which is keyed to the shaft 142 in a manner well known in the art.

The movable clutch element 147 is shifted to connect and disconnect either of the gears 145 and 146 with the shaft 142 through the medium of a yoke member 150 carried by a rod 151 slidably supported in a suitable aperture in the bracket 130. A spring pressed plunger 152 engages notches 153 in the rod 151 and retains the clutch element 147 in its neutral or either of its engaged positions. A vertical shaft 154 rotatably supported by the bracket 130 and a bracket 155 secured to the turret member 21, carries an arm 156 on the lower end thereof provided with a slotted end which engages a pin 157 fixed in a member 158 formed integral with the yoke member 150. A hand lever 159 secured to the upper end of the vertical shaft 154 provides for manual operation thereof and the same is adapted to be actuated automatically to shift the movable clutch element 147 through the medium of a collar 160 fixed to the shaft 154 which carries a projection 161 formed integral therewith adapted to engage in a cam slot 162 formed in a member 163 secured to the work head member 36. In the present instance the cam slot 163 is so formed that the clutch element 147 is automatically shifted to neutral position as the work head D reaches its lower position and again as the work is brought up to the tool by the inclined surfaces 164 and 165, but may be formed to connect either of the gears 145 and 146 with the shaft 142 at predetermined intervals etc., controlled by the vertical movement of the work head D.

In operation it is desirable to prevent rotation of the nut N during the rotation of the lead screw 133 and to permit free rotation thereof during the rapid traverse movement of the work heads D. To effect this result a plurality of spring pressed plungers 166 and 167 slidably supported in suitable apertures in the bracket 130 are adapted to engage the outside surface of said nut. The plungers 166 and 167 are held from engagement with the nut N when the same is being rotated by a wedge-shaped member 168, the upper end of which engages between the plungers 166 and 167. The lower end of the member 168 engages in a slot 170 in the rod 151 when the clutch element 147 is in its neutral position and rides up on said rod when the same is shifted to connect either of the gears 145 and 146 with the shaft 142.

It is believed that the operation of the machine will be apparent from the foregoing description, suffice it to say that the turret B is continuously rotated about the frame A, and the tool and work spindles of each unit rotated in predetermined timed relation to each other by the motor 34. As the hobbing units are carried in a closed path by the rotation of the turret B the work pieces supported by the work heads D are fed vertically past the cutters by the lead screws 133, which as previously described are driven at a comparatively slow speed from the drive for the work spindle. As the hobbing units are successively brought to the loading station by the rotation of the turret B, the rotation of the tool and work spindles and the lead screw of that particular unit is stopped by the automatic release of the clutch 68 which interrupts the drive thereto without disturbing the continued operation of the other units. As soon as the finished work is removed from the unit in the loading station, the hand lever 159 is moved to connect the shaft 142 to the splined shaft 76 and rotate the nut N in a direction to lower the work head D. As the work head D reaches its lower position the clutch element 147 is returned to neutral position by the inclined surface 164 of the cam slot 163. After a new work piece has been inserted in the work holder, the clutch 147 is manually engaged and the lever 159 moved in a reverse direction to rotate the nut N in a direction to bring the work up to the cutting position, whereupon the shaft is automatically moved to the neutral position by the engagement of the projection 161 with the inclined surface 165 of the cam slot 162 without interrupting the drive to the tool, work spindle, and lead screw 133.

From the foregoing description it will be apparent that a new and improved machine and feed mechanism therefor has been provided. As one alternative construction it is suggested that the feed screw might be driven from the motor 34 independent of the spindle drive and a clutch interposed in the drive whereby the feed could be interrupted without stopping the work spindle. If desired the work and tools may be interchanged, or the lead screws positioned above the tool spindles instead of below, as illustrated. Each unit may also be driven by an individual motor. The machine may be set up to machine various pieces of work other than splined shafts, spur gears, spiral gears, bevel gears, spiral bevel gears, etc., and the cutter employed may be either a cylindrical, conical or face hob, or any mill cutter etc. A constant friction brake may be substituted for the mechanism shown for holding the nut N against rotation during rotation of said screw, etc. The adjustments of the spindles permit the cutting of such articles as spiral bevel gears with face hobs.

The preferred embodiment of the invention shown and described is merely illustrative of the invention and we do not wish to be limited

thereby. We particularly point out and claim as our invention the following:

1. In a machine of the character described, the combination of a frame, a tool spindle rotatably supported by said frame, a work head slidably supported by said frame for vertical movements, a work spindle rotatably supported in said work head, means for rotating said spindles in timed relation to each other, means comprising a lead screw and a cooperating nut for moving said work head, means operatively connected to the first-named means adapted for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means operatively connected to the first named means adapted for producing relative rotation between said lead screw and its cooperating nut at a relatively fast speed, said last-named means comprising a movable clutch member, and means automatically actuated in timed relation to the movement of said work head for moving said movable clutch member.

2. In a machine of the character described, the combination of a frame, a tool spindle rotatably supported by said frame, a work head slidably supported by said frame for vertical movement, a work spindle rotatably supported in said work head, a cam carried by said work head, means for rotating said spindles in timed relation to each other, means comprising a lead screw and a cooperating nut for moving said work head, means operatively connected to the first-named means for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means for producing relative rotation between said lead screw and its cooperating nut at a relatively fast speed, said last-named means comprising a movable element adapted to control the actuation thereof, and means controlled by said cam for moving said movable member.

3. In a machine of the character described, the combination of a frame, a tool spindle rotatably supported by said frame, a work head slidably supported by said frame for vertical movement, a work spindle rotatably supported in said work head, means for rotating said spindles in timed relation to each other, means comprising a lead screw and a cooperating nut for moving said work head, means operatively connected to the first-named means for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means operatively connected to the first-named means for producing relative rotation between said lead screw and its cooperating nut at a relatively fast speed, said last-named means comprising a movable clutch member, and cam means automatically actuated in timed relation to the movement of said work head for moving said movable clutch member.

4. In a machine of the character described, the combination of a frame, a tool spindle rotatably supported by said frame, a work head slidably supported by said frame for vertical movement, a work spindle rotatably supported in said work head, a cam on said work head, means for rotating said spindles in timed relation to each other, means comprising a lead screw and a cooperating nut for moving said work head, means operatively connected to the first-named means for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means operatively connected to the first-named means for producing relative rotation between said lead screw and its cooperating nut at a relatively fast speed, said last-named means, comprising a movable clutch member, and means operatively engaging said cam for moving said movable clutch member.

5. In a machine of the character described, the combination of a base, a turret rotatably supported by said base, cooperating tool and work spindles rotatably carried by said turret, means for rotating said spindles in timed relation to each other, means for rotating said turret whereby said spindles periodically travel through a loading station, means comprising a lead screw and a cooperating nut for producing relative movement between said spindles in a vertical direction, means operatively connected to the first-named means adapted for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means operatively connected to the first-named means adapted for producing relative rotation between said lead screw and its cooperating nut in different directions and at relatively fast speeds, said last-mentioned means comprising a movable clutch element and means automatically actuated in timed relation to the movement of one of said spindles for moving said movable clutch element.

6. In a machine of the character described, the combination of a base, a turret rotatably supported by said base, a tool spindle rotatably supported by said turret, a work head slidably supported by said turret, a work spindle rotatably supported in said work head for vertical movement, a cam carried by said work head, means for rotating said spindles in timed relation to each other, means comprising a lead screw and a cooperating nut for moving said work head, means operatively connected to the first-named means adapted for producing relative rotation between said lead screw and its cooperating nut at a relatively slow speed, means operatively connected to the first-named means adapted for producing relative rotation between said lead screw and its cooperating nut at a relatively fast speed, said last-named means comprising a movable clutch element, and means controlled by said cam for moving said movable clutch element.

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