Feb. 18, 1941. F. H. ADAMS 2,231,866

HOBBING MACHINE

Filed June 5, 1934 4 Sheets-Sheet 1

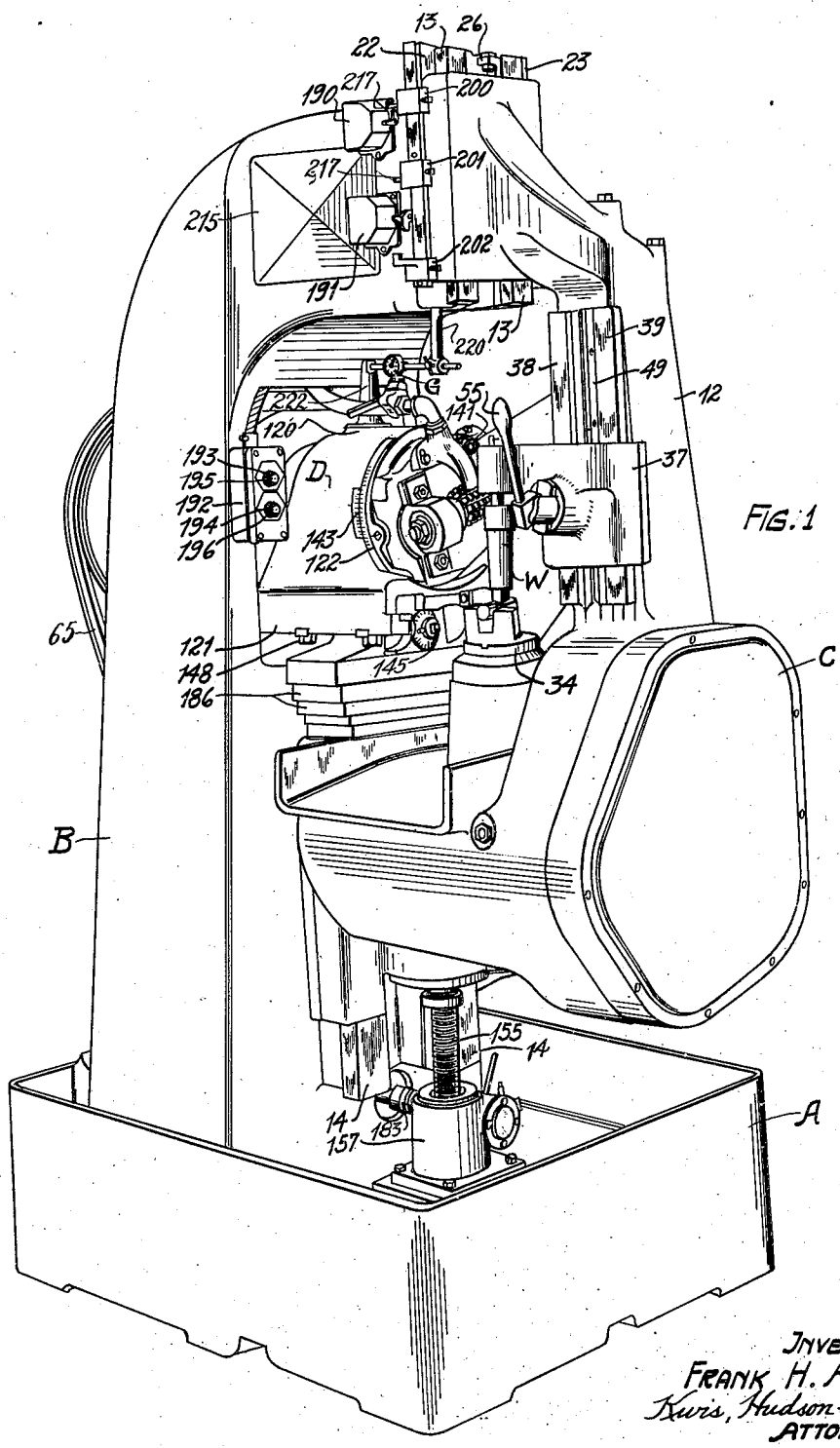


FIG. 1

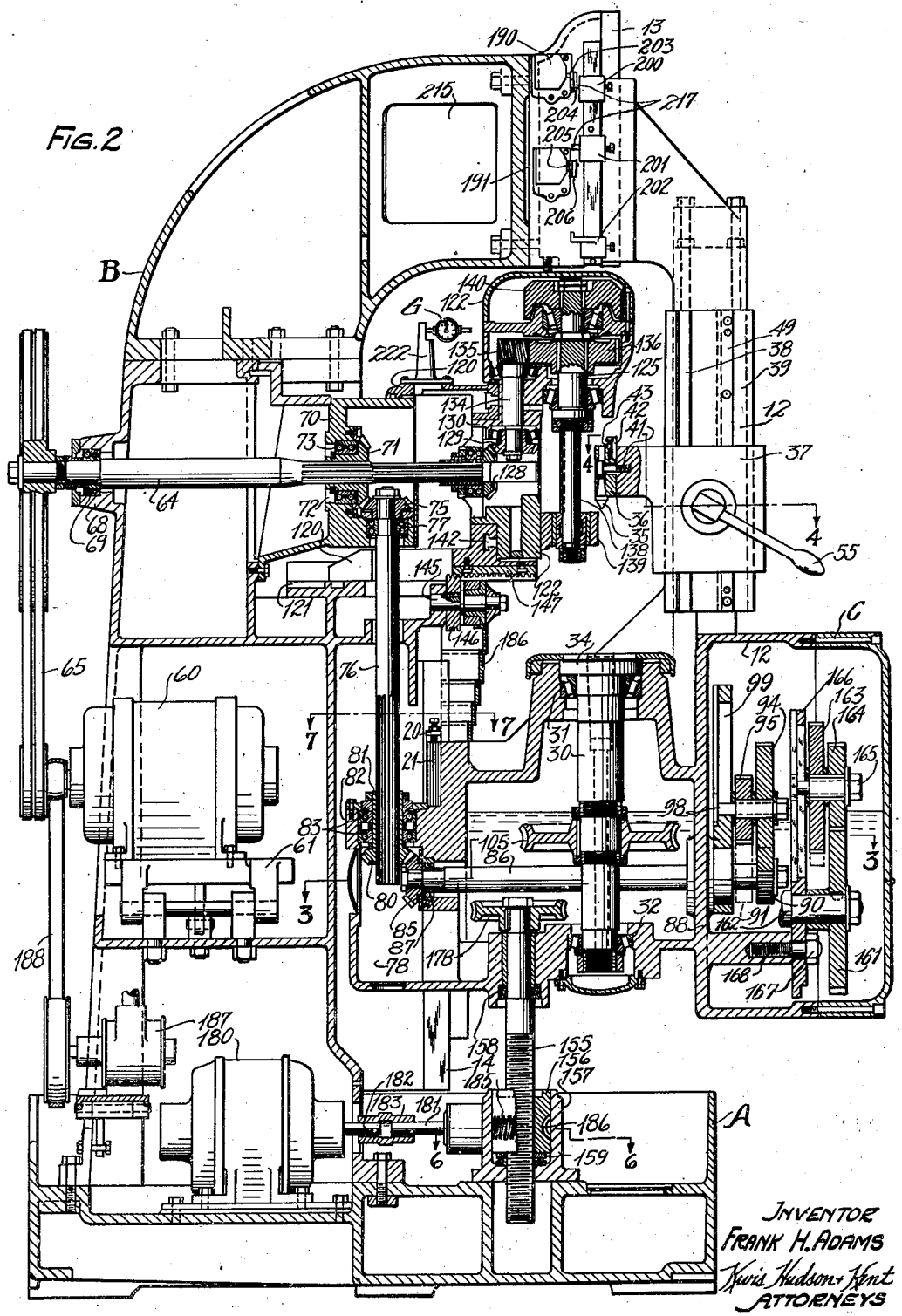
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FIG. 2



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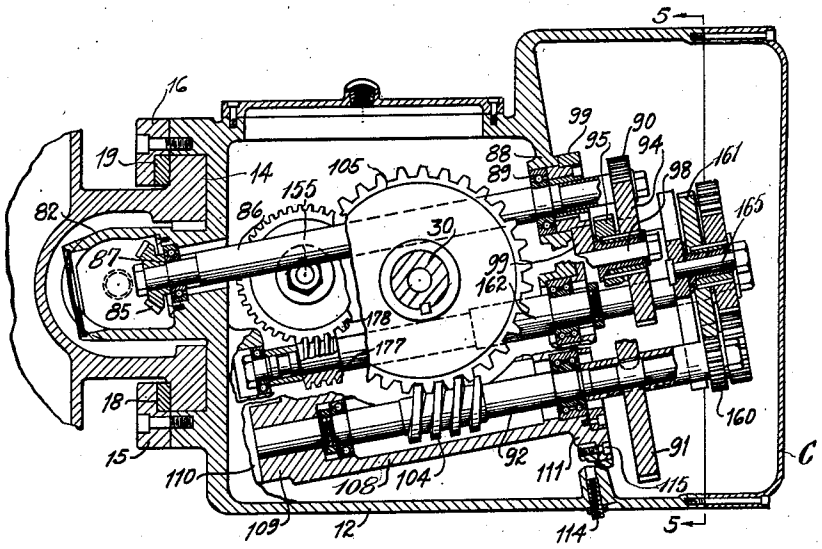


FIG. 3

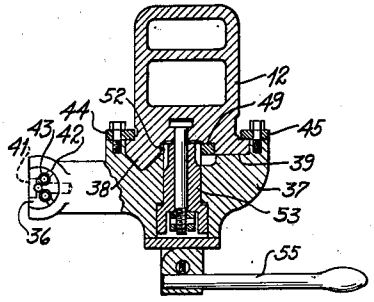


FIG. 4

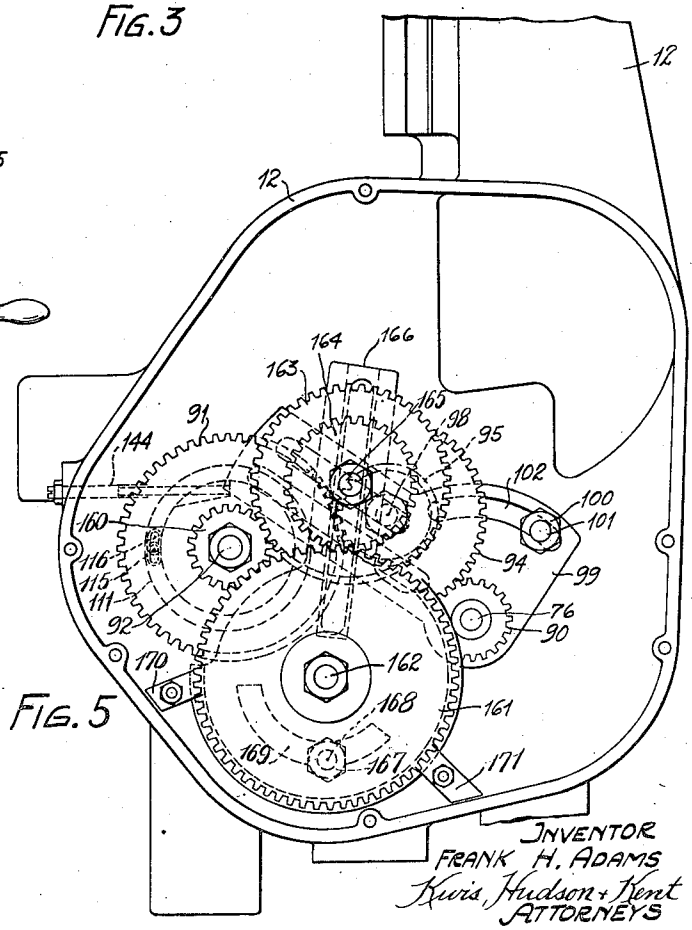


FIG. 5

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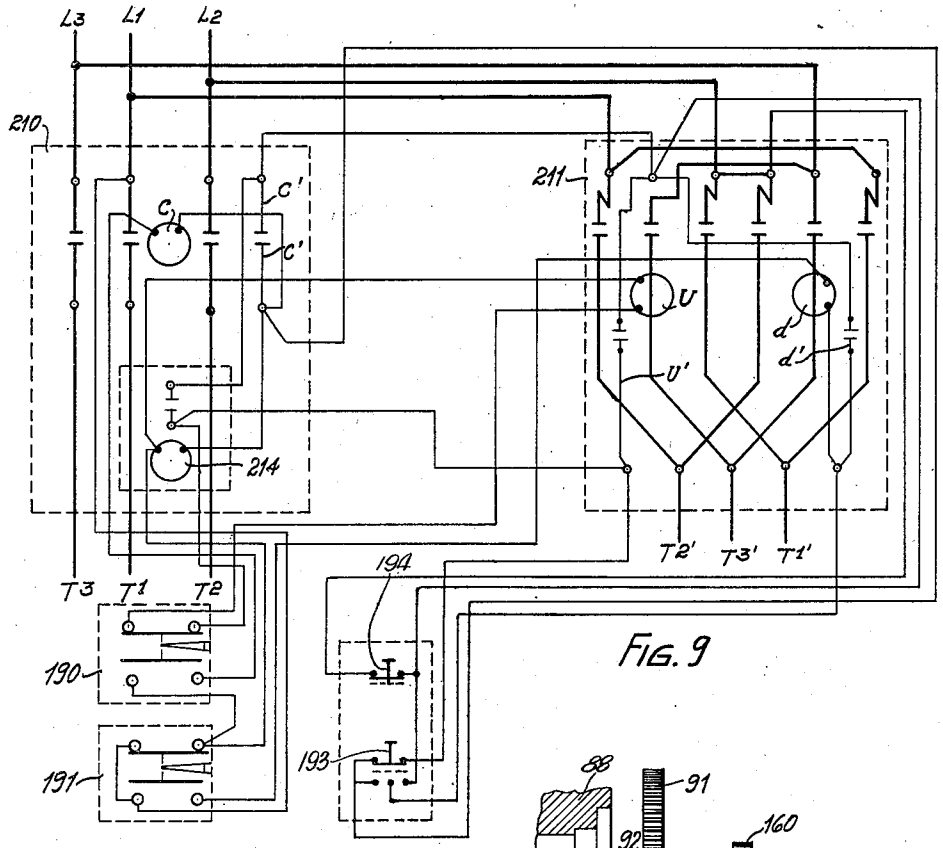


FIG. 9

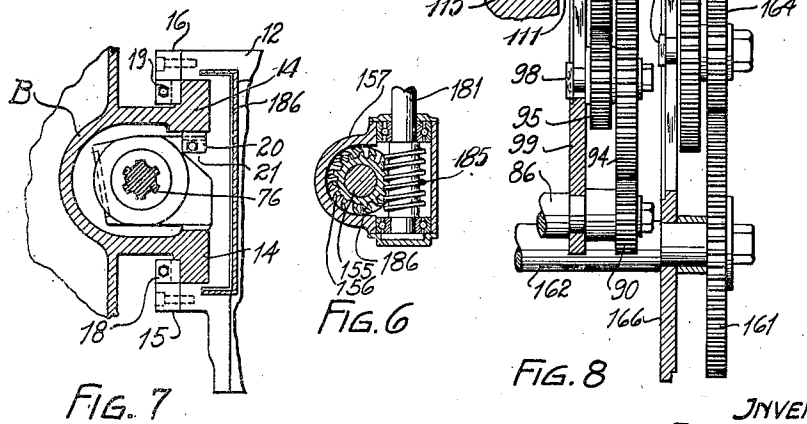


FIG. 7

FIG. 6

FIG. 8

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Patented Feb. 18, 1941 2,231,866

UNITED STATES PATENT OFFICE

2,231,866

HOBBING MACHINE

Frank H. Adams, Cleveland Heights, Ohio, assignor to The Cleveland Hobbing Machine Company, Cleveland, Ohio, a corporation of Ohio

Application June 5, 1934, Serial No. 729,118

12 Claims. (Cl. 90—4)

The present invention relates to machine tools and more particularly to gear cutting machines, especially those commonly called hobbing machines. Heretofore in the art numerous machines have been designed and employed for cutting gears by means of the hobbing principle as well as other principles, but all of these machines have been subject to certain defects and are inadequate to meet the requirements of present day production methods, either as to simplicity of design, rigidity of construction, accuracy of the work produced, or as to floor space required, etc.

An object of the present invention is the provision of a novel machine tool, and more particularly a hobbing machine, which will require a minimum amount of floor space, be simple in design, rigid in construction, and produce accurate work at a high speed with a minimum amount of maintenance and lost time.

The invention resides in certain novel features and details of construction and combination 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:

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

Fig. 2 is a section through approximately the center of the machine with portions in elevation.

Fig. 3 is a section approximately on the line 3—3 of Fig. 2 with portions in elevation.

Fig. 4 is a section on the line 4—4 of Fig. 2 with portions in elevation.

Fig. 5 is a section approximately on the line 5—5 of Fig. 3.

Fig. 6 is a section on the line 6—6 of Fig. 2.

Fig. 7 is a section on the line 7—7 of Fig. 2.

Fig. 8 is a developed view of the change gearing shown in Figs. 2, 3 and 5, and

Fig. 9 is a wiring diagram of the electric circuit of the machine.

Similar reference characters designate corresponding parts throughout the several views of the drawings.

Referring to the drawings, it will be observed that the machine illustrated is of generally vertical construction, thus enabling the floor space required by the machine to be kept down to a minimum. The bed of the machine, designated in general by the reference character A, which also serves as a sump for the cutting fluid, etc., is made rectangular, permitting a number of machines to be readily gauged close together, synchronized and taken care of by a single operator. The frame of the machine, designated in general by the reference character B is of heavy channel construction, providing maximum rigidity with minimum weight, and is bolted or otherwise securely fixed to the bed A.

The work head, designated in general by the reference character C, comprises a work head frame 12 slidably supported on vertically spaced ways 13 and 14 formed on the frame B at the top and bottom thereof, respectively. The work head C is held in engagement with the lower ways 14 by members 15 and 16, see Figs. 3 and 7, bolted or otherwise secured to the rear side of the work head frame 12 and projecting to the rear of the overhanging portions of the ways 14. Adjustable tapered gibs 18 and 19 interposed between the members 15 and 16 and the ways 14 are provided for taking up the wear, etc. An adjustable gib 20 supported by a rib 21 on the rear of the work head frame 12 and interposed between the rib 21 and the right-hand way 14 prevents any side movement of the work head on the ways 14. The upper part of the work head C is maintained in engagement with the ways 13 in a manner similar to that just described with reference to the lower ways 14. Members 22 and 23 bolted to the rear side of the frame 12 extend behind overhanging parts of the ways 13. Tapered gibs interposed between the members 22 and 23 and the ways 13, and a tapered gib 26 interposed between a rib similar to the rib 21 and the right-hand way are provided for taking up wear, etc., and preventing any play or lost motion between the work head and the frame B. The construction just described provides a rigid support for the work, free from vibration, chatter, etc.

A work spindle 30 rotatably supported in the frame member 12 of the work head C by antifriction bearings 31 and 32, see Fig. 2, is provided with a chuck 34 which, together with a tail center 35, supports the work blank W. The tail center 35 is secured in a member 36 adjustably supported in a semi-circular channel formed in the tail stock 37 slidably supported on the ways 38 and 39 formed integral with the work head frame 12. The member 36 is secured in the channel by a bolt 41 projecting through an enlarged aperture in the member 36 and threaded into the tail stock 37. The member 36 and in turn the tail center 35 is adjusted with reference to the tail stock by means of tapered gibs 42 positioned between the member 36 and the tail stock and moved

relative to the tail stock by bolts 43 threaded into the latter. Members 44 and 45 bolted to the rear side of the tail stock 37 and projecting to the rear of the overhanging parts of the ways 38 and 39 retain the tail stock in position on the ways. The tail stock 37 is moved along the ways 38 and 39 through the medium of a rack 49 secured to the work head frame 12, and a pinion 52, formed on a member 53, in mesh therewith, and clamped in any desired position by means of a single operating lever 55. The operating lever 55 is pivotally connected to one end of the member 53, and is rotatable about an axis parallel with the ways 38 and 39 to clamp and unclamp the tail stock 37 in position, and about an axis normal thereto to move the tail stock along the ways.

The work spindle 30 is driven at a predetermined speed by an electric motor 60 supported on an adjustable platform 61, in a recess in the frame B, through the medium of the following mechanism. The main drive shaft 64 of the machine is operatively connected to the motor 60 by a flexible drive connection designated in general by the reference character 65, and adjusted by raising or lowering the motor 60 by means of the platform 61. The rear end of the main drive shaft 64 is rotatably supported in a boss 68 formed integral with the frame B by anti-friction bearings 69, and the front end of the shaft is supported in member 70 fixed to the frame B, through the medium of a bevel gear 71 splined thereto, the hub of which is rotatably supported in an aperture 72 in the member 70 by anti-friction bearings 73.

The bevel gear 71 is continuously in mesh with a bevel gear 75 fixed to the upper end of a vertically positioned spline shaft 76 rotatably supported in the member 70 by anti-friction bearings 77. The lower end of the spline shaft 76 extends into an oil recess 78 in the work head frame 12 and has a splined connection with a bevel gear 80 provided with an elongated hub 81, rotatably supported in a rearwardly extending portion 82 of the work head frame by anti-friction bearings 83. Bevel gear 80 is in mesh with a bevel gear 85 fixed to the rear end of a horizontal shaft 86, rotatably supported in the work head frame 12 by anti-friction bearings 87. The front end of the shaft 86 is rotatably supported in a partition 88 in the work head frame by anti-friction bearings 89, and carries a gear 90 fixed thereto.

The gear 90 is operatively connected to a gear 91 fixed to a horizontal shaft 92, through change gears 94 and 95 in mesh with gears 90 and 91, respectively. The change gears 94 and 95 are rotatably supported on a stud shaft 98 adjustably supported in one of a plurality of T-slots in a bracket 99. The bracket 99 is rotatably supported coaxial with the shaft 86 and is secured in any adjusted position by a nut 100 threaded onto a stud bolt 101 projecting through an arcuate slot 102 in the bracket 99. The shaft 92 is operatively connected to the work spindle 30 through a worm and worm wheel 104 and 105, respectively, the former of which is fixed to the shaft 92 and the latter to the spindle 30.

In order to provide means for taking up wear and lost motion between the worm 104 and worm wheel 105 the shaft 92 is rotatably supported in a sleeve member 108 rotatably supported in the frame of the work head eccentric with reference to the axis of the shaft 92. The reduced rear end 109 of the member 108 is rotatably supported in a recess 110 in the work head frame 12, and the front end is provided with a flange 111 rotatably supported in the partition 88. The member 108 is rotated in a manner to move the worm 104 into the worm wheel 105 by a member 114 threaded into an aperture in the partition 88, and provided with a reduced end portion which abuts a flat surface on the flange 111. The member 108 is secured in any adjusted position by cap screws 115 projecting through arcuate slots 116 in the flange 111, and having threaded engagement with the partition 88.

The tool head, designated in general by the reference character D, comprises a member 120 slidably supported on horizontal ways 121 formed integral with the frame B intermediate the vertically spaced ways 13 and 14, and a member 122 rotatably supported by the member 120 coaxial with the main drive shaft 64. A tool spindle 125 rotatably supported in the member 122 by anti-friction bearings is driven from the main drive shaft 64 through miter gears 128 and 129, the former of which is provided with an elongated hub splined to the front end of the main drive shaft 64 and rotatably supported in a rearwardly extending boss 130 formed integral with the member 122. Miter gear 129 is fixed to one end of a stud shaft 134 rotatably supported in the member 122, the upper end of which carries a spiral pinion 135 in mesh with a spiral gear 136 fixed to the tool spindle 125.

A hob arbor 138 secured at its upper end to the tool spindle 125, is rotatably supported in a bracket 139 bolted to the member 122. The upper end of the tool spindle 125 carries a flywheel 140 fixed thereto. The member 122 is rotatably supported by the member 120 by the engagement of the boss 130 in a cylindrical aperture in the front wall of member 120. Bolts 141, the heads of which engage in a circular T-slot 142, secure the member 122 in any adjusted position. The construction just described permits the axis of the hob to be adjusted about the axis of the main drive shaft 64 which is normal to the axis of the work spindle. A vernier scale 143 permits the hob to be accurately and quickly set at any desired angle.

Movement of the tool head D along the ways 121 to move the hob towards or from the work, is effected by rotation of a shaft 145 rotatably supported in the frame B and provided with a worm 146 fixed thereto in mesh with a rack 147 secured to the underside of the member 120. The shaft 145 is provided with a square end to facilitate turning the same and a graduated dial to facilitate setting of the hob. The tool head may be clamped to the way 121 in any adjusted position by bolts 148 if desired. The member 120 has a telescopic connection with the boss-like member 70, which prevents the entrance of chips, etc., into the interior of the tool head, while permitting movement thereof along the ways 121.

The work head C is moved along the vertical ways 13 and 14 to advance the work past the tool through the medium of a lead screw 155, rotatably supported in the work head B, and having threaded engagement with a nut 156 rotatably supported in a bracket 157 bolted or otherwise secured to the base A. Thrust bearings 158 and 159 which take the entire load of the work head are interposed between the lead screw 155 and the work head frame 12, and the nut 156 and the bracket 157, respectively. The lead screw 155 is driven in predetermined timed relation to the rotation of the work and tool spindle, to raise

the work head B at the desired feed rate, from a gear 160 fixed to the extreme outer end of the shaft 92. The gear 160 is operatively connected to a gear 161 fixed to the front end of a horizontal shaft 162 through the medium of change gears 163 and 164 in mesh with the gears 160 and 161, respectively, and rotatably supported on a stud shaft 165 adjustably secured in an elongated slot in a bracket 166. The bracket 166 is rotatably supported coaxial with the shaft 162 and is adapted to be secured in any adjusted position by means of a nut 167 threaded onto a bolt 168 secured to the partition 88, and projecting through an arcuate slot 169 in said bracket. The bracket 166 is also supported by blocks 170 and 171 carried by the frame 12 and provided with grooves within which the outer circular edge of the bracket 166 engages. The shaft 162 which is rotatably supported in the frame 12 and the partition 88 by anti-friction bearings carries a worm 177 fixed thereto, in mesh with a worm wheel 178 fixed to the upper end of the lead screw 155.

A rapid transverse movement is imparted to the work head B to quickly bring the work up to the cutter, or to quickly return the work head to its starting position by rapidly rotating the nut 156 by means of a reversible motor 180 supported by the bed A within the frame B. A shaft 181, rotatably supported in suitable bearings in the bracket 157, is connected to the armature shaft 182 of the motor 180 by a coupling 183, and has fixed thereto a worm 185 in mesh with a worm wheel 186 formed about the circumference of the nut 156. The worm 185 and worm wheel 186 are of the self-locking type and prevent rotative movement of the nut 156 with reference to the lead screw 155 while the motor 180 is at rest during the feeding movement.

The work head frame 12 is divided into two compartments by the partition 88, both of which compartments are adapted to be filled with oil to the level indicated in Fig. 2 for the lubrication of the various parts housed within the compartments. All the gears etc., in the work head are enclosed within the frame 12, which prevents the entrance of chips and dirt, etc. A telescopic guard 186 prevents the entrance of chips, etc. to the ways 14. Cutting fluid is supplied to the tool by a pump 187 driven from the motor 60 through a flexible drive connection 188. Since the motor 60 is energized only during the cutting operation the cutting fluid is supplied merely as needed. The pump 187, like the motor 60, is supported on an adjustable base in a recess in the frame B.

The motors 60 and 180 preferably are three phase alternating current motors and the motor 180 is reversible. A wiring diagram of the machine is shown in Fig. 9. The motors are controlled by upper and lower limit switches 190 and 191, respectively, and the start-stop push button switch 192, both the start and stop buttons 193 and 194, respectively, of which are provided with ferrules 195 and 196, respectively, which limit the movement thereof. Both the limit switches and the start-stop push button switch are well known in the art and per se do not form a part of the present invention and may be of any conventional construction. The start button 193 is normally in the out position, i. e., the position shown in the wiring diagram, but may be set in the neutral position shown in dotted lines by the ferrule 195, and the stop button 194 which is normally closed may be set in the open position by the ferrule 196. The limit switches 190 and 191 are operated and controlled by adjustable stops 200, 201 and 202, carried by the work head C. The stop 200 engages the arms 203 and 204 of a bell crank lever on the limit switch 190 to actuate the same, and the stops 201 and 202 engage the arms 205 and 206 of a bell crank lever on the limit switch 191 to actuate said switch.

The motor 60 is connected to and from the supply lines L^1, L^2, L^3 through the medium of a solenoid operated circuit breaker panel 210, the operating solenoid and holding-in circuit of which are indicated as *c* and *c'*, respectively. The motor 180 is connected to and from the supply lines through the reversible circuit breaker panel 211, the operating solenoids and their respective holding-in circuits of which are designated as *u*, *u'* and *d*, *d'*. The reference character *u* designates the solenoid which closes the circuit to the motor 180 to operate the same in a direction to raise the work head C, and the solenoid which closes the circuit to motor 180 to lower the work head is designated by the reference character *d*. The leads to the motor 60 are designated as T^1, T^2, T^3, and to the motor 180 as $T^{1'}$, $T^{2'}$, $T^{3'}$. A contact relay is designated at 214. The panels 210 and 211 are enclosed in the head of the frame A behind the covers 215 on opposite sides of the frame.

A precision gauge designated in general by the reference character G is provided for accurately positioning the hob head with reference to the work. The gauge G is of conventional construction and is adjustably supported by a post 220 threaded into the frame B. The movable part of the gauge abuts a post 222 bolted or otherwise secured to the hob head D.

The operation of the machine is as follows: With the machine at rest and a work head in the lower position, the electrical circuit is as shown in the wiring diagram. Assuming that a work blank has been secured in position between the work spindle chuck 34 and the tail center 35 the start button 193 is pressed by the operator, closing the circuit to the contact relay 214 which, in turn, closes the circuit to the solenoid *u*, energizing the motor 180 to quickly raise the work head and bring the work up to the tool. Upon release of the start button 193 the circuit relay 214 is closed through the holding-in circuit *u'* which is now energized. Thereafter the relay 214 maintains its own circuit. The stop 200 is so positioned that it engages the upstanding arm 203 of the limit switch 190 and moves the contact arm to its lower position, see Fig. 9, just prior to the engagement of the work with the hob, opening the circuit to solenoid *u* and closing the circuit to solenoid *c*, through the contacts of relay 214, stopping the motor 180 and starting the motor 60. The holding-in circuit *c'* maintains the circuit to the motor 60 until the work has traveled past the hob and the cutting operation has been completed, at which time the stop 202 engages the arm 205 and trips the limit switch 191, opening the circuit to the motor 60 and resetting the circuit to the solenoid *d* so that the motor 180 will be energized to quickly lower the work head C when the start button 193 is again pressed.

The work head C remains at rest in the up position until the finished blank has been removed, after which the start button is pressed by the operator to lower the work head. As the work head C moves down, the stop 200 engages the arm 204 and returns the limit switch 190 to its initial or starting position without interrupt-

ing the circuit to the motor 180. As
head C approaches its lower limit or
the stop 201 engages the lever 206, ret
limit switch 191 to its starting or int
and interrupting the circuit to the
After a new blank has been positi
work head, the cycle or operati
Stationary pins 217 fixed to the
12 limit the movement of the
201 and 202 so that it is imp
head C to be accidentally m
etc. The machine may b
during an operation by
button 194, after which
started by pressing th
If desired, the stop
an open position by
which event the
movement of the
struction is part
repairs on the
193 can likew
turning the
head C wi
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line

motor, and means controlled by the movement of said member for closing the circuit to the first mentioned motor and opening the circuit to the second mentioned motor automatically at a predetermined point in the movement of said member relative to said frame.

6. A metal working machine of the character described comprising a frame, a member slidably supported by said frame, a lead screw and a cooperating nut for moving said member relative to said frame, an electric motor for simultaneously rotating said spindle and for producing relative rotation between said lead screw and said nut, a second electric motor for producing relative rotation between said lead screw and said nut at another speed, means for closing the circuit to the second mentioned motor, and means controlled by the movement of said member for automatically closing the circuit to the first mentioned motor and opening the circuit to the second mentioned motor at a predetermined point in the movement of said member relative to said frame.

7. A metal working machine of the character described comprising a frame, a member slidably supported by said frame, a spindle rotatably supported by said member, a lead screw and a cooperating nut for moving said member relative to said frame, an electric motor for simultaneously rotating said spindle and producing relative rotation between said lead screw and said nut, a second electric motor for producing rotation between said lead screw and said nut at a different speed, means for closing the circuit to the second mentioned motor, and means controlled by the movement of said member for closing the circuit to the first mentioned motor and opening the circuit to the second mentioned motor automatically at a predetermined point in the movement of said member relative to said frame.

8. A metal working machine of the character described comprising a frame, a work head slidably supported by said frame, a tool head slidably supported by said frame, a spindle rotatably supported by one of said heads, a lead screw and a cooperating nut for producing relative movement between said heads, an electric motor for simultaneously rotating said spindle and producing relative rotation between said lead screw and said nut, a second electric motor for producing relative rotation between said lead screw and said nut, means for closing the circuit to the second mentioned electric motor, and means controlled by the movement of one of said heads for automatically closing the circuit to the first mentioned electric motor and opening the circuit to the second mentioned electric motor at a predetermined point in the movement of said heads relative to each other.

9. A metal working machine of the character described comprising a frame, a work head slidably supported by said frame, a tool head slidably supported by said frame, spindles rotatably supported by said heads, a lead screw and a cooperating nut for producing relative movement between said heads, an electric motor for simultaneously rotating said spindles and producing relative rotation between said lead screw and said nut, a second electric motor for producing relative rotation between said lead screw and said nut, means for closing the circuit to the second mentioned electric motor, and means controlled by the movement of one of said heads for automatically closing the circuit to the first mentioned electric motor and opening the circuit to the second mentioned electric motor at a predetermined point in the movement of said heads relative to each other.

10. A hobbing machine of the character described comprising a frame provided with a plurality of vertically spaced guideways and a horizontal guideway therebetween, a work head slidably supported by said vertically spaced guideways, a tool head slidably supported by said horizontal guideway, a vertical work spindle rotatably supported by said work head, a tool spindle rotatably supported by said tool head, a lead screw and a cooperating nut for moving said work head along said vertical guideway, an electric motor for simultaneously rotating said spindles and producing relative rotation between said lead screw and said nut, a second electric motor for producing relative rotation between said lead screw and said nut, means for closing the circuit to the second mentioned electric motor controlled by the movement of said work head, and means for automatically closing the circuit to the first mentioned electric motor and opening the circuit to the second mentioned electric motor at a predetermined point in the cycle of movement of said work head relative to said frame.

11. A hobbing machine comprising a frame, a member slidably supported by said frame, a spindle rotatably supported in said member, a lead screw and a cooperating nut for moving said member relative to said frame, an electric motor for rotating said spindle and for producing relative rotation between said lead screw and nut, a second electric motor for producing relative rotation between said lead screw and nut at a higher speed, means for closing the circuit to the second mentioned motor, and means controlled in accordance with the movement of said member for automatically closing the circuit to the first mentioned motor and opening the circuit to the second mentioned motor at a predetermined point in the movement of the member.

12. In a machine of the character described, the combination of a frame, cooperating tool and work spindles rotatably carried by said frame means comprising a lead screw and a cooperat ing nut for producing relative movement betwee said spindles, an electric motor for simultaneous rotating said spindles and for producing relati rotation between said lead screw and its coop ating nut at one speed, a second electric mo for producing relative rotation between said screw and its cooperating nut at another sp means for closing the circuit to the second-r tioned motor, and means automatically actu in timed relation to the relative movemen tween said spindles for closing the circuit other of said motors.

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