Jan. 16, 1951 T. F. CARLIN 2,537,967

HOBBING MACHINE

Filed Sept. 22, 1944 3 Sheets-Sheet 1

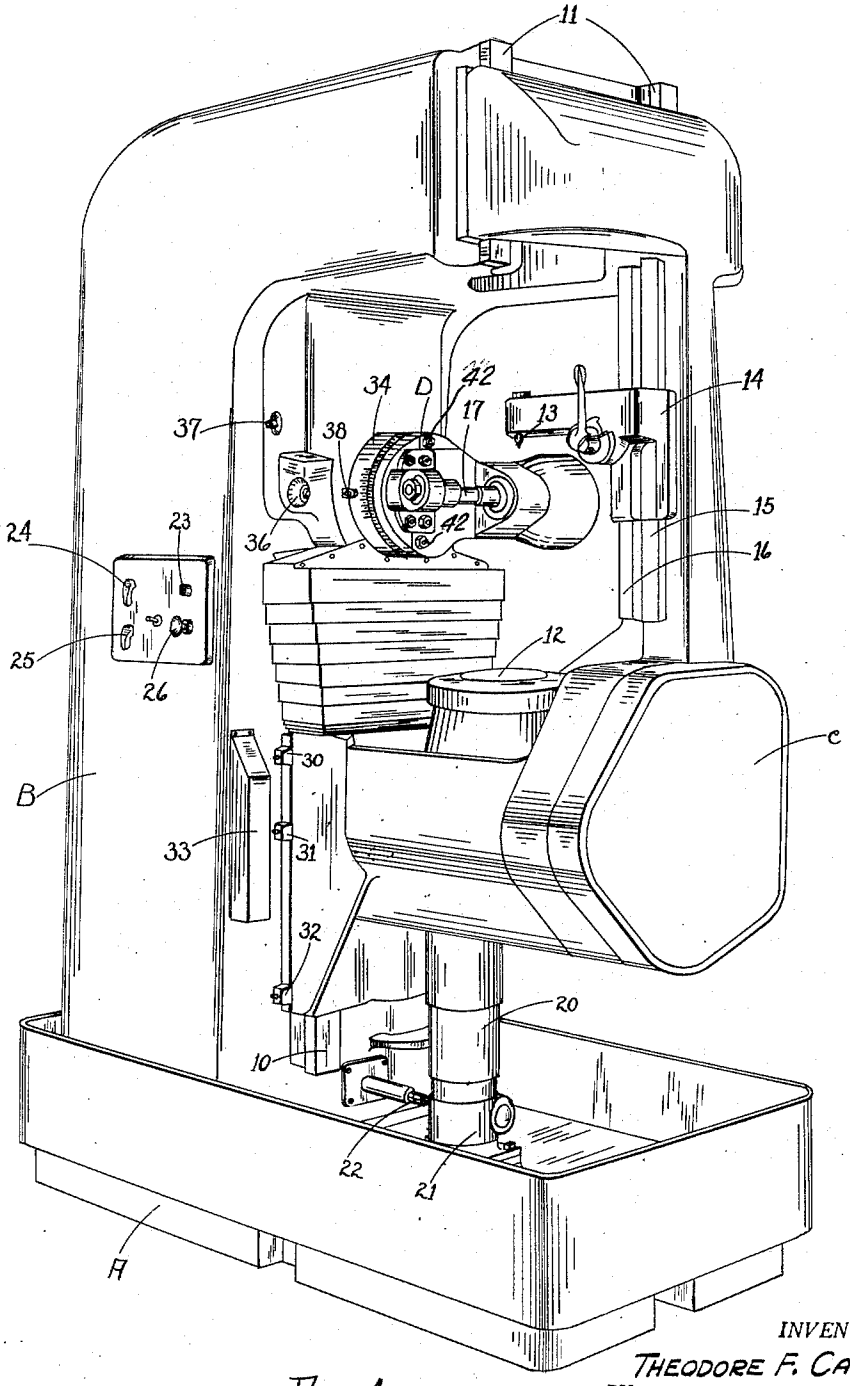


Fig. 1

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HOBBING MACHINE

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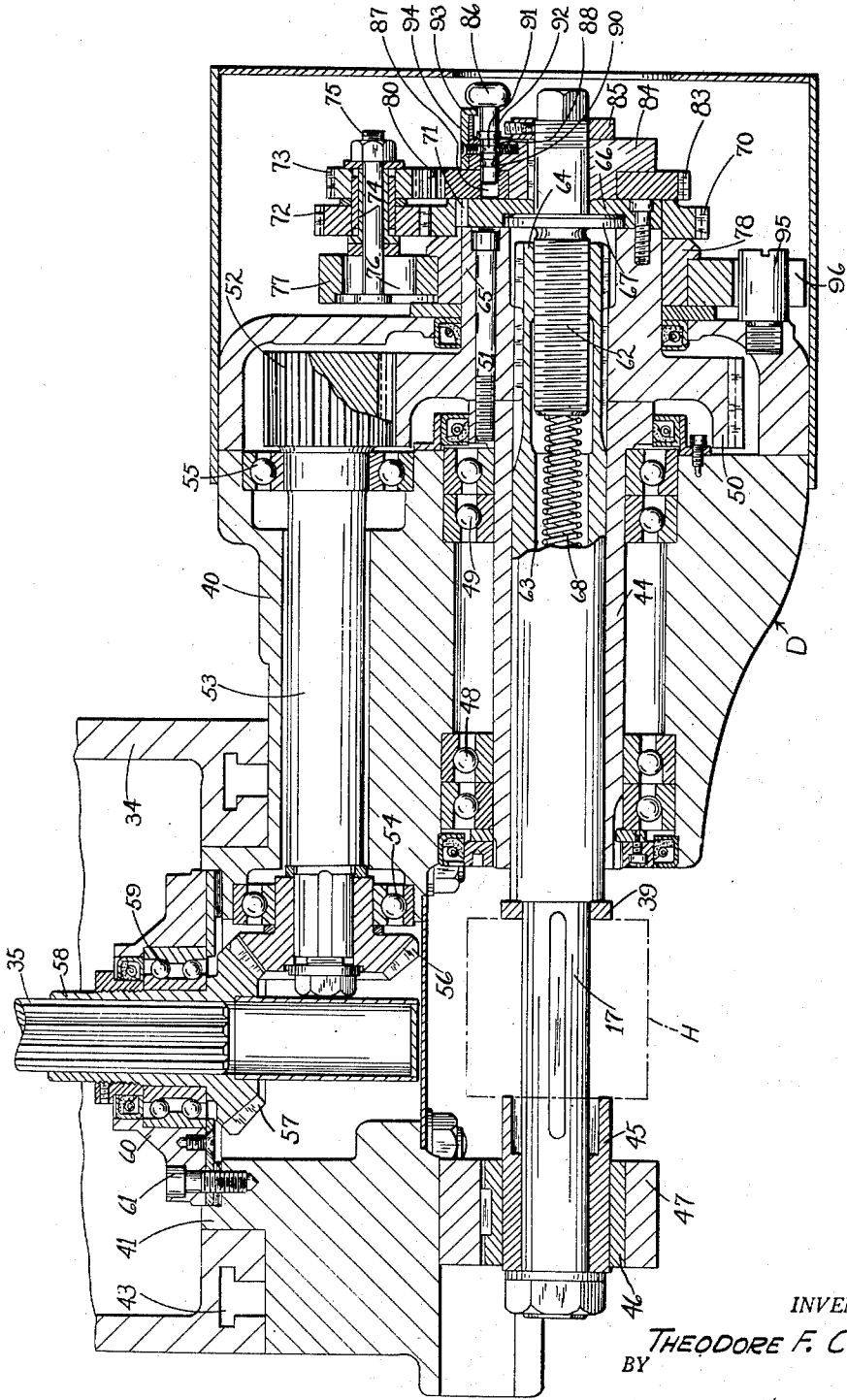


Fig. 2

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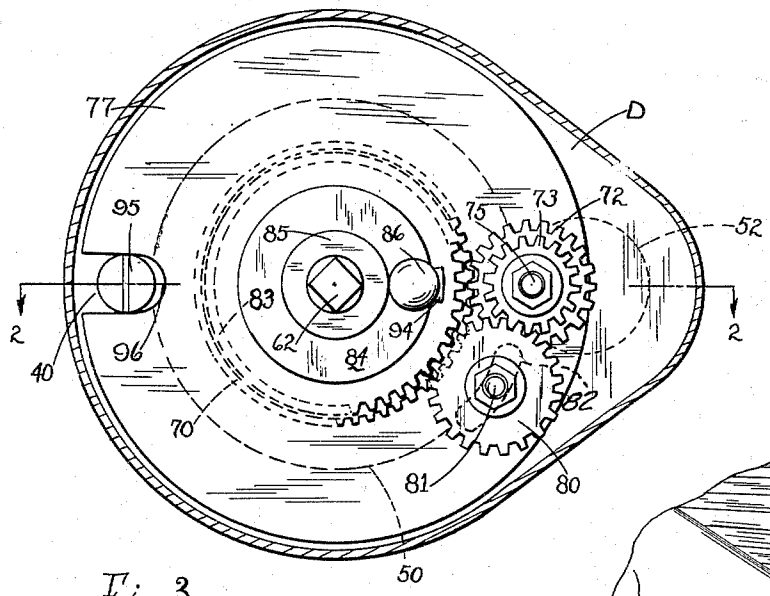


Fig. 3

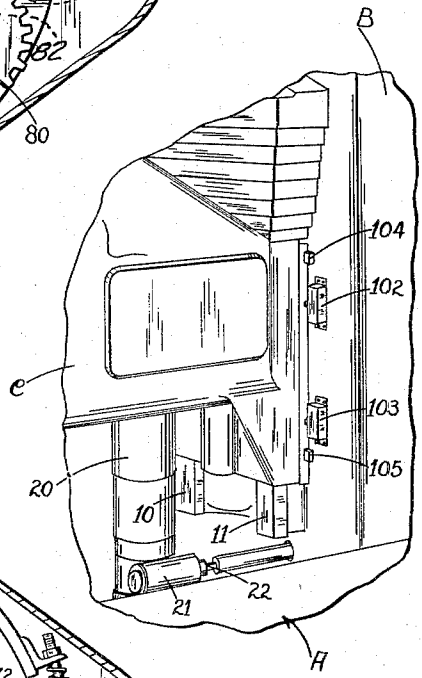


Fig. 5

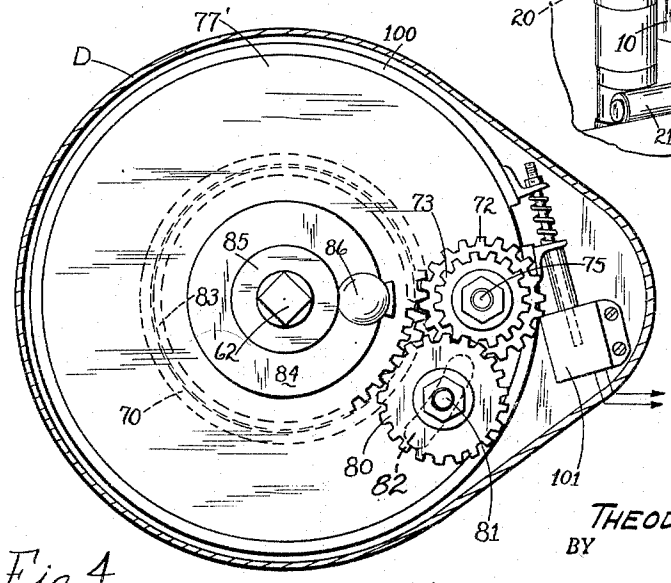


Fig. 4

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UNITED STATES PATENT OFFICE

2,537,967

HOBBING MACHINE

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Application September 22, 1944, Serial No. 555,246

18 Claims. (Cl. 90—4)

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The present invention relates to hobbing machines and, more particularly, to hobbing machines of the axial feed type as distinguished from tangential feed type hobbing machines.

In the operation of hobbing machines of the axial feed type, it has heretofore been customary to periodically advance the hob, that is move the hob tangentially of the work spindle after a number of blanks have been cut so as to bring a new section of the hob into cutting position. This practice does not make full use of the hob since the portions thereof intermediate successive settings performed very little, if any, cutting; in other words, the wear, etc., incident to the cutting operation being performed is not uniformly distributed over the usable or effective length of the hob.

The principal object of the present invention is the provision of a novel and improved hobbing machine or hob head comprising means for continuously advancing the hob or moving it tangentially of the work during the operation of the machine in such a manner that the hob is advanced an amount equal to its usable or effective length once during some relatively long predetermined period, such as a work day, a half day, or the like. At the end of each period the hob is replaced, if necessary, and the direction of advance reversed or the mechanism returned to its original position and the cycle repeated. Alternatively, the hob may be intermittently advanced a very small amount between the cutting operations.

Another object of the invention is the provision of a novel and improved hobbing machine of the axial feed type comprising means for continuously advancing the hob or moving the same axially at a very slow rate during operation of the machine, which means will be simple in construction, positive, reliable and accurate in operation, and preferably includes mechanism for readily disconnecting the same when its use is not desired.

The invention resides in certain constructions and combinations and arrangements of parts and further objects and advantages will be apparent from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification, in which similar reference characters designate corresponding parts, and in which

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

Fig. 2 is a sectional view, with portions in elevation, through the center line of the hob head and approximately on the line 2—2 of Fig. 3;

Fig. 3 is an end view of the hob head shown in Fig. 2, with the cover broken away;

Fig. 4 is a view similar to Fig. 3 but showing a modified construction; and

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Fig. 5 is a fragmentary perspective view of the right-hand side of the machine of Fig. 4.

Although the invention is susceptible of various modifications and alternative constructions, it is herein shown and described as embodied in a hobbing machine similar to that shown in United States Patent No. 2,307,428, issued January 5, 1943, except that the shape of the machine is slightly different, some of the electrical control devices have been relocated, and the hob head is carried by a member slidably supported in a cylindrical aperture in the vertical column or frame rather than being supported on horizontal ways.

Generally speaking, the machine is of vertical construction and comprises a base A, a vertical column or gooseneck B supported upon the base A, a work head C vertically movable upon vertically spaced pairs of ways 10, 11 on the column B, and a tool or hob head D carried by a cylindrical member slidably supported in a horizontal cylindrical aperture in the column B and adjustable therein towards and from the work head. The work which may be a gear blank, a shaft to be splined, or the like, is adapted to be rotatably supported in the work head C by a chuck or some other suitable means, not shown, attached to the upper end of the work spindle 12 and a tail center 13 carried by a tail slide 14 supported for vertical movement towards and from the work spindle upon ways 15, 16 formed on the work head. The hob spindle or arbor 17 is rotatably supported in the hob head D in a manner hereinafter more specifically described and during operation of the machine is rotated in timed relation to the rotation of the work spindle 12 by a cut motor located in the lower part of the column B and operatively connected to the respective spindles in a manner similar to that disclosed in the aforesaid patent.

The work head C is adapted to be reciprocated along the vertically spaced pairs of ways 10, 11 to cause a work blank carried by the work head to be moved axially past a hob fixed to the hob arbor and to return the work head to its initial position by a cooperating lead screw and nut connected to the work head C and the base A, respectively. The lead screw is located within the chip guard 20 and is driven at a relatively slow speed in timed relation to the rotation of the hob and work spindles from the work spindle drive. The nut is rotatably supported in a housing 21 bolted to the base A and is adapted to be rotated at a relatively high speed through the medium of a self-locking worm and worm wheel drive by a high speed reversible traverse motor located within the column B and connected thereto by the shaft 22.

The control circuits for the respective motors, and the cycle of operations of the machine are

preferably similar to those disclosed in the aforesaid patent and will not be herein described in detail. Suffice it to say that after a suitable blank has been positioned in the work head C, the start push button switch 23 is depressed, whereupon the traverse motor is operated to move the work head vertically at a rapid traverse rate to bring the blank to cutting position with respect to the hob. At this point in the cycle, the traverse motor is automatically stopped and the cut motor started, thus continuing the movement of the work head but at a relatively slow feed rate. The feed movement continues until the blank is cut, whereupon the cut motor is automatically stopped. After the work has been removed from the work head, the work head is returned to its original position by again depressing the start push button switch to actuate the traverse motor in the opposite direction. The direction in which the cycle of operation is performed depends upon the setting of the selector controller switches 24, 25. The machine can be stopped at any time during its cycle of operations by depressing the stop push button switch 26. The length of travel of the rapid traverse approach movement, the feed movement, etc., is controlled by the adjustable stops 30, 31 and 32 carried by the work head C and adapted to actuate limit switches within the housing 33.

The cylindrical member 34 which carries the hob head D is slidably supported in the column B concentrically with respect to the main drive shaft 35 of the machine and is adapted to be moved longitudinally therein to adjust the hob towards and from the work spindle by a screw 36. The member 34 is adapted to be clamped in any adjusted position by clamp mechanism actuated by a clamp screw 37 and is prevented from rotating in the cylindrical aperture by a key 38. The hob head D comprises a hob head housing 40 having a cylindrical portion 41 projecting into a cylindrical aperture in the front end of the member 34 and through the medium of which the housing 40 and in turn the hob head D are rotatably connected to the front end of the member 34 concentric with the axis of the shaft 35. The hob head D is adapted to be secured in any desired angular position by bolts 42, the heads of which engage within a circular T-groove 43 in the front face of the member 34.

The hob arbor 17 is slidably supported in a sleeve member 44 and through the medium of a sleeve 45 on the left-hand end thereof as viewed in Fig. 2, in a bushing 46 of an outboard support, designated generally as 47. The hob H, the outline of which is shown in Fig. 2, is keyed to the arbor 17 and interposed between the sleeve 45 and a hob spacing washer 39, the right-hand side of which abuts a shoulder formed on the arbor by a change in its diameter. The sleeve 44 is rotatably supported in the hob head housing 40 by anti-friction bearings 48, 49 and both the hob arbor 17 and the sleeve 44 are driven by a hob arbor gear 50 splined to the right-hand end of the arbor 17 and connected to an external flange on the right-hand end of the sleeve 44 by machine screws 51. The gear 50 is continuously in mesh with a hob head drive pinion 52 formed on the right-hand end of a shaft 53 rotatably supported in the housing 40 by anti-friction bearings 54, 55. The left-hand end of the shaft 53 is provided with a bevel gear 56 keyed thereto and continuously in mesh with a bevel drive gear 57 having an elongated hub 58, through the medium of which the gear is rotatably supported by anti-friction bearings 59 in a bearing cap or member 60 connected by screws 61 to the rear end of the cylindrical housing 40. The gear 57 is splined to the front end of the main drive shaft 35 of the machine so as to permit adjustment of the hob head towards and from the work spindle.

The sleeve 44 and the gear 50 fixed thereto are held against axial movement relative to the housing 40 by the bearings 48, 49 and the hob arbor is adapted to be reciprocated therein by a threaded shaft or hob arbor screw 62 extending into an aperture 63 in the right-hand end of the hob arbor, the end portion 64 of which aperture is threaded to engage the threads of the screw 62. The screw 62 is rotatably secured to the hub 65 of the gear 50 which projects to the right beyond the housing 40 and by a cap member 66 bolted to the end of the hub 65 and forming therewith a groove within which a flange 67 on the screw is confined. A spring 68 interposed between the end of the screw 62 and the bottom of the aperture 63 provides means for eliminating lost motion between the cooperating threads of the screw 62 and the hob arbor.

The hob arbor 17 and the screw 62 are operatively connected by mechanism which produces a relatively slow relative rotation therebetween upon rotation of the hob arbor. As shown, this mechanism comprises an epicyclic gear train comprising a gear 70 keyed to the member 66 by a key 71 and continuously in mesh with the larger of two relatively fixed gears 72, 73 keyed to a sleeve 74 rotatably supported on the shank of a bolt 75, the head of which engages within a radially elongated T-slot 76 in a disk-like member 77 rotatably supported on a flanged sleeve 78 interposed therebetween and the hub 65 of the gear 50. The gear 73 is continuously in mesh with a gear 80 rotatably supported on a bolt 81, the head of which is located within an arcuate-shaped T-slot 82 in the member 77 for adjustment towards and from the bolt 75. The gear 80 is continuously in mesh with a gear 83 rotatably supported coaxially with the hob arbor 17 by a member 84 keyed to the screw 62 adjacent to its right-hand end and held thereon by a nut 85.

The gear 83 is adapted to be selectively connected to the member 84 or disconnected therefrom by a pull pin 86 slidably supported in a suitable aperture in the member 84. The right-hand end of the pull pin is enlarged to form a hand grasp and the left-hand end adapted to be selectively engaged within an aperture 87 in the gear 83 for the purpose of locking the gear 83 to the member 84 or permit relative rotation between the members. The pull pin 86 is adapted to be yieldably retained in either its projected or retracted position by a spring-pressed pawl 88 engageable within suitable grooves 90, 91 in the shank of the pin. A flange 92 on the shank of the pull pin and engageable in one position of the pin with the end of the member 84 and in the other position of the pin with an inwardly projecting flange 93 on a member 94 fixed to the exterior of the member 84 limits the movement of the pull pin. The construction and operation of the epicyclic gear train are such that when the member 77 is free to rotate on the member 78 about the axis of the hob arbor 17, no relative rotation takes place between the hob arbor and the screw 62 upon rotation of the gear 50 with the result that the hob is not advanced unless the member 77 is held against ro-

tation. Obviously this may be accomplished in any suitable manner. As shown in the embodiment illustrated in Figs. 1 to 3, rotation of the member 77 and in turn the gear cluster or assembly comprising the gears 72 and 73 about the axis of rotation of the hob arbor is prevented by an anchor stud 95 threaded into the housing 40 and comprising a head projecting into a slot 96 in the exterior of the member 77. The epicyclic gearing is rendered inoperative to advance the hob arbor upon removal of the anchor stud 95.

As an illustration of the type of hob advance contemplated by the present invention, the gears 70, 72, 73, 80 and 83 of the embodiment shown have eighty, twenty-nine, twenty-five, thirty-two and sixty-nine teeth, respectively, with the result that the screw 62 is rotated approximately one revolution relative to the hob arbor for each two thousand revolutions of the hob arbor and since the screw 62 has ten threads per inch, the hob is advanced one-tenth of an inch for each two thousand revolutions thereof. After the hob has been advanced an amount equal to its usable length, the direction of axial movement thereof can be reversed, if desired, by inserting an idler gear in the epicyclic gear train, or it can be returned to its initial position by manually withdrawing the pull pin 86 and turning the screw 62 by hand. After the hob arbor has been returned to its starting position, the pull pin is reengaged in the aperture 87 in the gear 83 and the device is conditioned to start a new cycle of operations. As will be well understood by those skilled in the art to which the invention relates when the hob is continuously advanced during the cutting operation, the hob advance movement must be taken into consideration in determining the gear ratios to be employed between the hob and work spindles.

As previously suggested, means other than that described above may be employed for selectively holding the member 77 stationary or permitting it to rotate and an alternative construction is shown in Figs. 4 and 5 wherein the member 77', similar to the member 77 of the embodiment shown in Figs. 1 to 3, is adapted to be held stationary by a solenoid-operated brake 100, the solenoid 101 of which is periodically energized to engage the brake and advance the hob a small amount in timed relation to the reciprocation of the work head and during an interval when the work is out of engagement with the hob. The solenoid 101 is connected in series circuit to a source of electric current with two normally open switches 102, 103 connected in parallel with each other, which switches are adapted to be intermittently closed for a short period of time while the cut motor is operating but while the hob is out of engagement with the work by elongated members 104, 105, respectively, adjustably connected to the lower right-hand side of the work head C. The two switches 102, 103 are used because the machine shown can be operated with the work head in either the "up" or "down" position at the beginning of the cycle of operations. The connections to the electrical switches 102, 103 are made through the selector controller switch 24 in such a manner that the correct switch is operatively connected in the circuit automatically with the selection of the cycle desired. The members 104, 105 can be so located that the hob is advanced either just before the cutting operation starts or immediately at the end thereof.

From the foregoing description of the preferred

embodiments of the invention, it will be apparent that the objects heretofore enumerated and others have been accomplished and that there has been provided a novel hob head and hobbing machine wherein the hob is advanced during operation of the machine at a comparatively slow rate either continuously or intermittently, as desired.

The preferred embodiments of the invention have been shown and described with considerable detail but it is to be understood that the invention is not limited to the particular construction shown and it is my intention to hereby cover all adaptations, modifications and uses thereof which come within the practice of those skilled in the art to which the invention relates and within the spirit and scope of the appended claims.

Having thus described my invention, what I claim is:

1. In a hob head, the combination of a rotatable and axially movable hob arbor, means for rotating said hob arbor, a member rotatably supported coaxially with respect to said hob arbor, means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member, a gear train operatively connected to said hob arbor and to said member and comprising two relatively fixed gears supported for rotation about an axis offset from the axis of rotation of said hob arbor for producing a slow relative rotation between said hob arbor and said member upon rotation of said hob arbor, and means for disconnecting said gear train.

2. In a hob head, the combination of a housing, a hob arbor, bearing means carried by said housing to journal said hob arbor in said housing for rotation and axial movement relative thereto, drive means within said housing for rotating said hob arbor, a member rotatably supported in said housing and restrained from axial movement with respect thereto, means operatively connecting said hob arbor and said member for slowly moving said hob arbor axially relative to said bearing means upon relative rotation between said hob arbor and said member, and a gear train operatively connected to said drive means and to said member adapted for producing a slow relative rotation between said hob arbor and said member upon rotation of said hob arbor.

3. In a hob head, the combination of: a rotatable and axially movable hob arbor; means for rotating said hob arbor; a member rotatably supported coaxially with respect to said hob arbor; means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member; and a gear train operatively connected to said hob arbor and to said member adapted for producing a slow relative rotation between said hob arbor and said member upon rotation of said hob arbor; said gear train comprising a gear concentric with said hob arbor and rotatable therewith, a gear concentric with said hob arbor and rotatable with said member, and gearing connecting said gears.

4. In a hob head, the combination of: a rotatable and axially movable hob arbor; means for rotating said hob arbor; a member rotatably supported coaxially with respect to said hob arbor; means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member; a gear train operatively connected to said hob and to said member for producing a

slow relative rotation between said hob arbor and said member upon rotation of said hob arbor; said gear train comprising a gear concentric with said hob arbor and rotatable therewith, a gear concentric with said hob arbor and rotatable with said member, and gearing connecting said gears; and means for rendering said gear train ineffective to produce said slow relative rotation between said hob arbor and said member.

5. In a hob head, the combination of a rotatable and axially movable hob arbor, means for rotating said hob arbor, a member rotatably supported coaxially with respect to said hob arbor, means for operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member, a second member rotatably supported coaxially with said hob arbor, means for selectively holding said second member stationary, a gear train operatively connected to said hob arbor and to said first-mentioned member and comprising gearing supported by said second member for rotation about an axis offset from the axis of rotation of said hob arbor for producing a slow relative rotation between said hob arbor and said first-named member upon rotation of said hob arbor.

6. In a hob head, the combination of: a rotatable and axially movable hob arbor; means for rotating said hob arbor; a member rotatably supported coaxially with respect to said hob arbor for moving said hob arbor axially upon relative rotation between said hob arbor and said member; a second member rotatably supported coaxially with respect to said hob arbor; means for selectively holding said second member stationary; and a gear train operatively connected to said hob arbor and to said first-named member for producing a slow relative rotation between said hob arbor and said first-named member upon rotation of said hob arbor, said gear train comprising a gear concentric with said hob arbor and rotatable therewith, a gear concentric with said hob arbor and rotatable with said first-named member, and gearing carried by said second member connecting said gears.

7. In a hobbing machine, the combination of a rotatable and axially movable hob arbor, a rotatable work support, means for rotating said hob arbor and said work support, means for producing a relative movement between said hob arbor and said work support axially of the axis of rotation of said work support, a member rotatably supported coaxially with respect to said hob arbor, means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member, a second member rotatably supported coaxially with respect to said hob arbor, means controlled by the relative movement between said hob arbor and said work support axially of the axis of rotation of said work support for intermittently holding said second member stationary, and a gear train comprising gearing carried by said second member for rotation about an axis offset from the axis of rotation of said hob arbor for producing a slow relative rotation between said hob arbor and said first-named member upon rotation of said hob arbor.

8. In a hobbing machine, the combination of a rotatable and axially movable hob arbor, a rotatable work support, means for simultaneously rotating said hob arbor and said work support in predetermined timed relation during the hobbing operation, means for producing a relative movement between said hob arbor and said work support axially of the axis of rotation of said work support during the hobbing operation and in predetermined timed relation to the rotation of said hob arbor and said work support, a member associated with said hob arbor and supported for rotation relative thereto, means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member, and gearing means interconnecting said member and the driving means for the arbor to produce a slow relative rotation between said hob arbor and said member during the hobbing operation and in predetermined timed relation to the rotation of said hob arbor.

9. In a hobbing machine, the combination of a rotatable and axially movable hob arbor, a rotatable work support, means for rotating said hob arbor and said work support in predetermined timed relation during the hobbing operation, means for producing a relative movement between said hob arbor and said work support axially of the axis of rotation of said work support during the hobbing operation and in predetermined timed relation to the rotation of said hob arbor and said work support, a member rotatably supported coaxially with respect to said hob arbor, means operatively connecting said hob arbor and said member for moving said hob arbor axially upon relative rotation between said hob arbor and said member, a second member rotatably supported coaxially with respect to said hob arbor, means for selectively holding said second member stationary, and a gear train operatively connected to said hob arbor and to said first-named member and comprising gearing carried by said second member for rotation about an axis offset from the axis of rotation of said hob arbor for producing a slow relative rotation between said hob arbor and said first-named member.

10. In a hobbing machine, the combination of a rotatable work support, a hob head, a rotable hob arbor journaled in said head for rotation and axial movement relative thereto, means for rotating said support and arbor in timed relation to each other and for producing relative linear movement between said support and arbor in a direction parallel with the axis of rotation of the work support, a rotatable member journalled in said head and restrained from axial movement with respect thereto, gearing within said head driven by said first-mentioned means for producing a slow relative rotation between said arbor and said member, and means including cooperating threaded parts operatively interconnecting said arbor and member whereby said arbor is slowly moved axially relative to said head in response to relative rotation between said arbor and member.

11. In a hobbing machine, the combination of an angularly adjustable housing, a hob arbor, bearing means carried by said housing to journal said hob arbor in said housing for rotation and axial movement relative thereto, a rotatable work support, means for simultaneously rotating said hob arbor and said work support in predetermined timed relation during the hobbing operation, means for producing a relative feed movement between said hob arbor and said work support axially of the axis of rotation of said work support during the hobbing operation and in predetermined timed relation to the rotation of said hob arbor and said work support, a member rotatably supported in said housing and re-

strained from axial movement with respect thereto, gearing means operatively connecting said hob arbor and said member for effecting a slow relative rotation between said arbor and member, and means operatively interconnecting said arbor and member for moving said hob arbor axially relative to said bearing means upon relative rotation between said hob arbor and said member.

12. In a hob head, the combination of an angularly adjustable housing, a hob arbor supported by said housing for rotation and axial movement, drive means carried by said housing for rotating said hob arbor, cooperating threaded parts one fixed to and rotatable with said hob arbor and the other rotatable relative to said housing and restrained from axial movement relative thereto for producing axial movement of said hob arbor upon relative rotation between said parts, and gearing means operatively connected to said drive means and the other of said threaded parts for producing a slow relative rotation between said threaded parts.

13. In a hob head, the combination of a housing, a hob arbor supported by said housing for rotation and axial movement, drive means including a driven member concentric with said hob arbor for rotating said hob arbor, cooperating threaded parts operatively connected to said hob arbor for moving said hob arbor axially relative to said housing, one of said threaded parts being connected for rotation with said arbor and the other of said parts being supported for rotation relative to said arbor, means rotatably interconnecting said housing with one of said threaded parts in a manner preventing axial movement thereof, and gearing means operatively connected to said driven member and that threaded part which is rotatable relative to said arbor for producing a slow relative rotation between said threaded parts.

14. In a hob head, the combination of an angularly adjustable housing, a hob spindle assembly including a rotatable member and a coaxial hob arbor supported for axial movement within said member, drive means carried by said housing for rotating said hob spindle assembly, cooperating threaded parts for producing axial movement of said hob arbor relative to said member upon relative rotation between said threaded parts, one of said threaded parts being operatively connected to said hob arbor, and a gear train operatively connecting said member to the other of said threaded parts for producing a slow relative rotation between said threaded parts.

15. In a hob head, the combination of a housing, a hob spindle assembly including a rotatable member and a hob arbor supported for axial movement within said member, drive means carried by said housing for rotating said hob spindle assembly, cooperating threaded parts one operatively connected to said member and the other fixed to and rotatable with said hob arbor for moving said hob arbor axially relative to said member, and means for operatively connecting said member and said first threaded member comprising a gear fixed to said member, a second gear fixed to said first-named threaded part and concentric with said first gear and said hob arbor, and gears operatively connected to said gears for producing a slow relative rotation between said threaded parts.

16. In a hob head, the combination of a housing, a hob spindle assembly including a rotatable member and a hob arbor supported for axial movement within said member, drive means carried by said housing for rotating said hob spindle assembly, cooperating threaded parts concentric with the axis of rotation of said hob arbor for producing a slow axial movement of said hob arbor relative to said member upon relative rotation between said threaded parts one of said threaded parts being fixed to and rotatable with said hob arbor, a gear fixed to said member, a second gear fixed to said second-mentioned threaded part, and gearing operatively connecting said gears whereby said second-mentioned threaded part is rotated relative to said first-mentioned threaded part upon rotation of said hob spindle assembly.

17. In a hob head, the combination of: a housing; a hob spindle assembly including a rotatable member, a hob arbor supported for axial movement within said member; cooperating threaded parts one fixed to and rotatable with said hob arbor; a gear fixed to said member; a second gear fixed to said threaded part other than the part fixed to said hob arbor; means for rotating said spindle assembly; and gear means for connecting said first two mentioned gears including a pair of gears rotatable about an axis fixed with respect to said housing.

18. In a hobbing machine, the combination of a rotatable work support, a housing pivotally supported for adjustment about an axis extending transversely of the axis of rotation of said work support, a hob arbor supported by said housing for rotation and axial movement, drive means for simultaneously rotating said hob arbor and said work support in predetermined timed relation, said drive means including gearing within said housing and connected to a shaft coaxial with the pivotal axis of said housing, means for producing simultaneously with the rotation of said hob arbor and said work support a relative feed movement between said hob arbor and said work support axially of the axis of rotation of said work support in predetermined timed relation to the rotation of said hob arbor and said work support, relatively rotatable threaded parts operatively connected to said hob arbor for moving said hob arbor axially, one of said threaded parts being connected for rotation with said arbor and the other of said parts being supported for rotation relative to said arbor, means rotatably interconnecting said housing with one of said threaded parts in a manner preventing axial movement thereof, and a gear train operatively connecting said gearing within said housing to that threaded part which is rotatable relative to said arbor for producing a slow relative rotation between said threaded parts in predetermined timed relation to the rotation of said hob arbor.

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