Nov. 3, 1931. H. W. JACOBSON ET AL 1,830,659

SPLINE HOBBING APPARATUS

Filed June 1, 1927 3 Sheets-Sheet 1

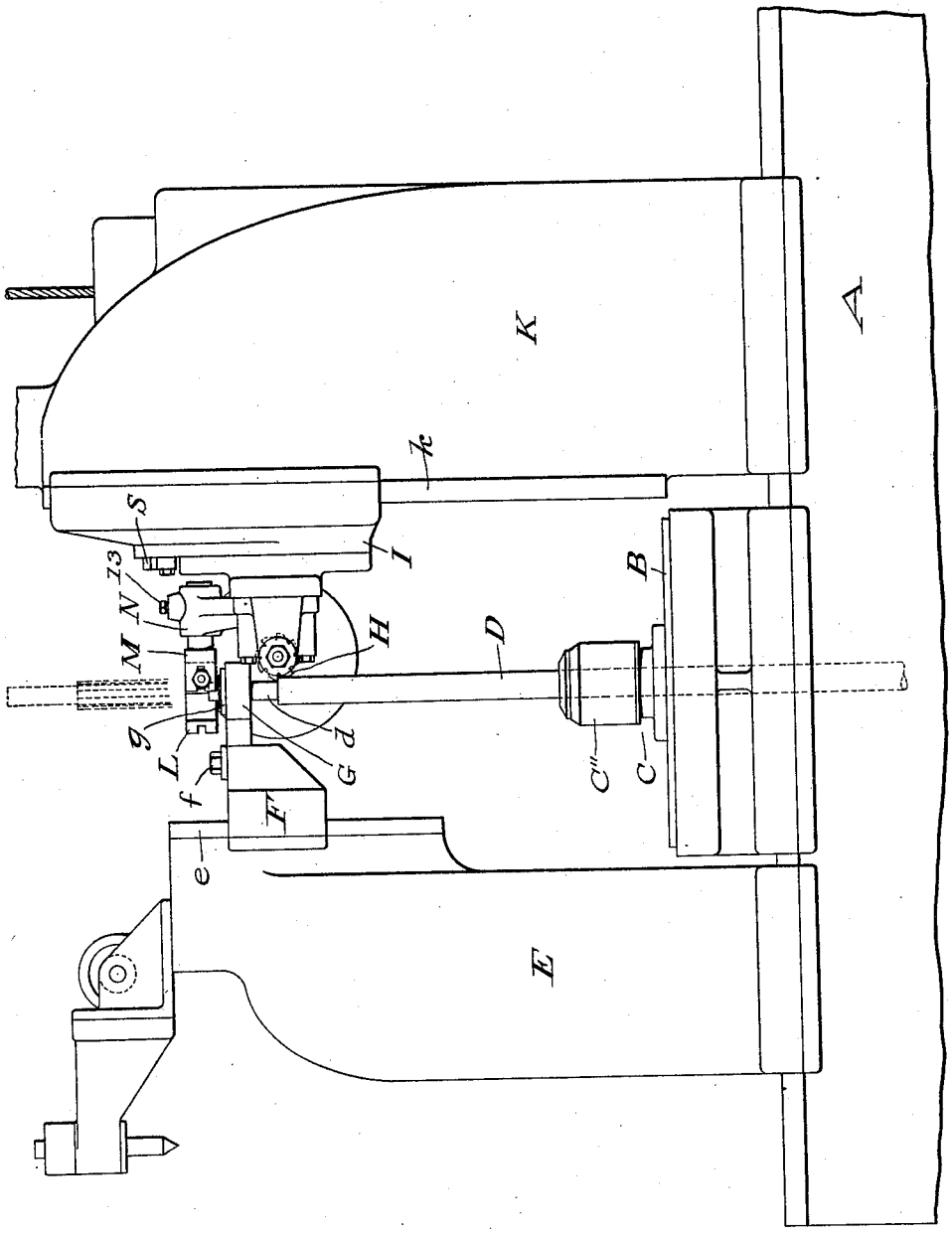


Fig. 1.

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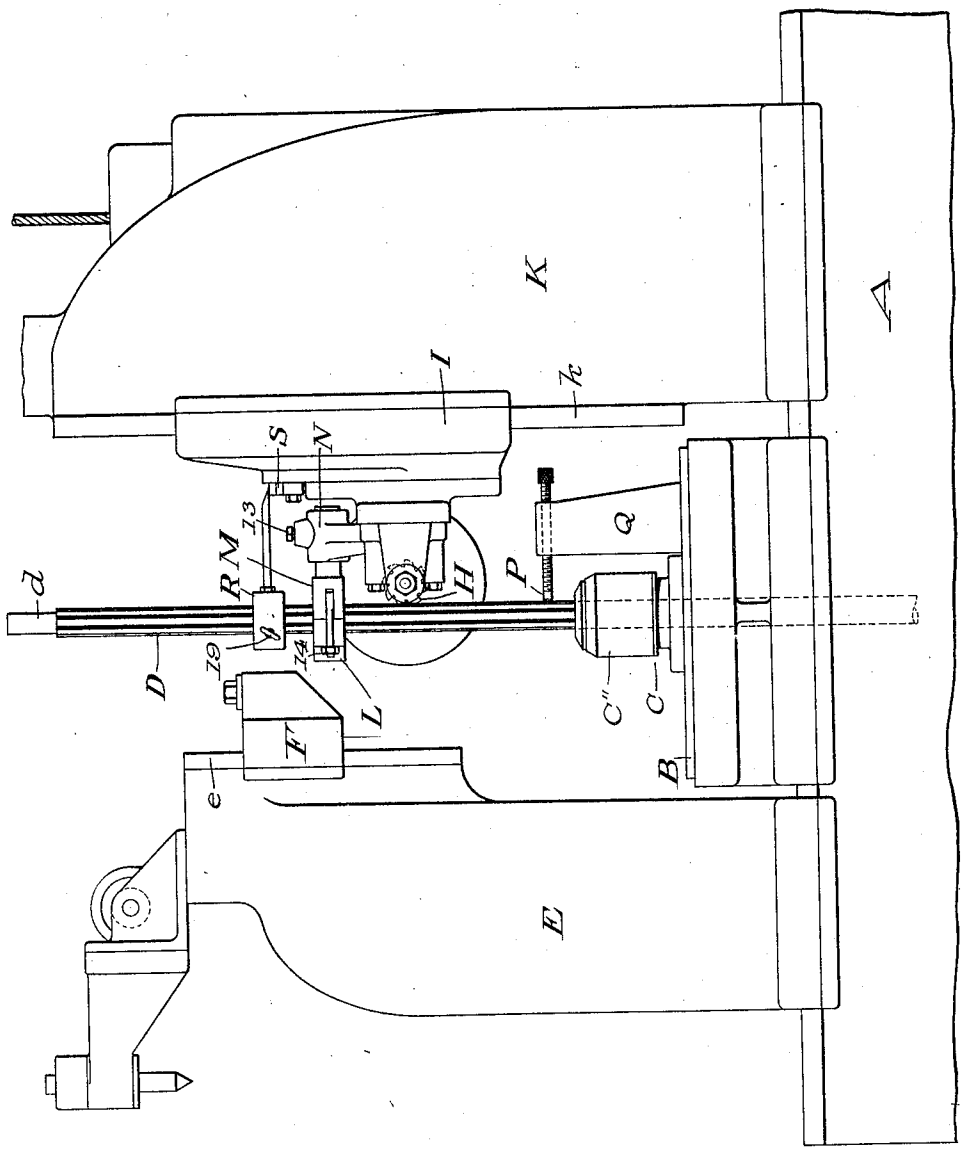


Fig. 2.

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Fig. 7.

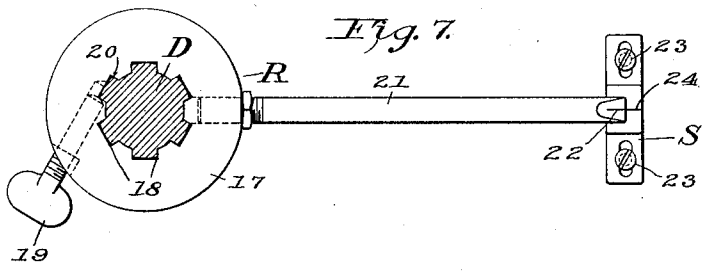


Fig. 6.

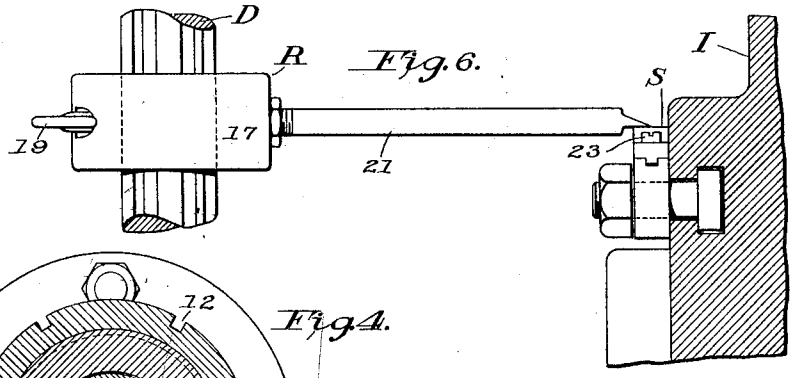


Fig. 4.

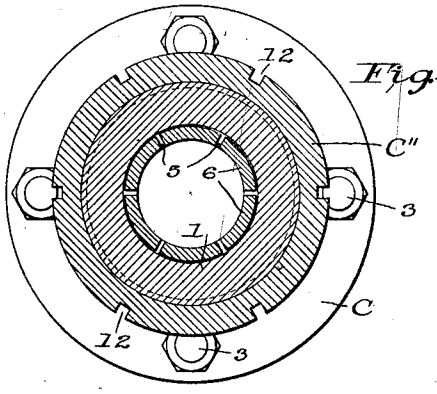


Fig. 5.

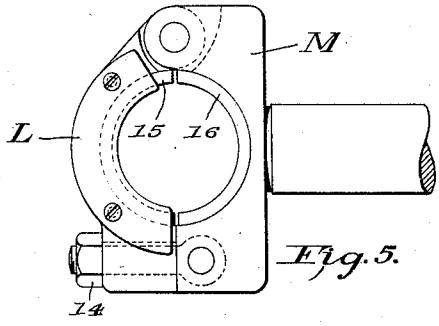
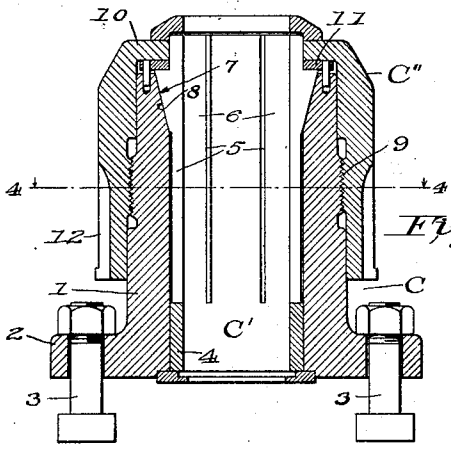


Fig. 3.



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UNITED STATES PATENT OFFICE

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SPLINE HOBBING APPARATUS

Application filed June 1, 1927. Serial No. 195,650.

In a co-pending sole application filed May 6, 1927, Serial No. 189,354, there is set forth a method for generating multi-splined shafts which is well adapted to be performed with the aidance of various convenient devices. The herein described joint invention represents our composite effort to render available instrumentalities especially suitable for use in carrying out an analogous method of operation.

Our aim has been so to contrive the fixtures that they will be co-operatively compatible with the successive steps and manipulations constituting a method of generating multi-splines, and so that they may admit of being handled with much facility, and so that they may also contribute to the ready attainment of a high order of precision.

Multi-splined shafts have, as all know, gone widely into usage and every effort has been and is being, bent by the various makers thereof to improve the methods and means for producing them. Our researches have indicated, of all the ways in which they may be made, a generation by the action of a hob best satisfies the requirements of production, cost and quality.

We have, accordingly, sought to provide a conventional gear hobbing machine (which otherwise cannot well do this work) with equipment peculiarly adapting it for the commercial production of elongated high grade multi-splined shafts. To spline by hobbing a short length or a short shaft, is one thing; but to hob a long shaft is quite another thing; that is to say by utilizing a conventional machine in which the traverse of the hob carrier is comparatively short. Consequently, such an elongated operation must be performed in successive sections or steps. This means that the shaft must be released, advanced and re-clamped as many times as will yield the aggregate length.

This necessity creates a difficulty; to wit, the problem of maintaining absolute alignment throughout the tandem sections. Any appreciable off-set at the junctions will impair or prohibit the free-sliding of the shift-element which is intended to be mounted on that shaft in close interfitting relation with its spline grooves.

With that problem this invention is, among other objectives, also concerned. It proposes the use of a clutch (preferably a collet) for grasping the shaft successively at intermediate stations for driving it. With that collet, it combined means adapted to be clamped to engage the shaft positively preparatory to each disengagement of it by the collet; all for the purpose of enabling the relation between the hob and the spline grooves previously cut thereby to be precisely established so as to be exactly ensured at the time the collect is again tightened on the shaft which has been freed and shifted longitudinally preparatory to hobbing the next section. This is in the nature of a specialized precision indexing means. This indexing means is caused to grip the shaft near the collet. After the shaft has been released by the collet, the shaft and free collet being then relatively shifted, this means (which will now be located distant from the collet) will nevertheless enable the collet to be again closed on the shaft in exactly the identical angular relation thereto that existed previous to its release. This ensures the utmost uniformity from one end to the other of the sectionally-formed spline grooves; to wit, by preserving the relationship between the hob and the shaft throughout the aggregate cycles of operation.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 diagrammatically depicts a hobbing machine embodying this invention; the parts being arranged preparatory to starting the splining of an elongated shaft. Fig.

2 is a diagrammatic elevation of the same machine illustrating the indexing of a partially finished shaft preparatory to finish-splining the additional section thereof. Fig. 3 is a detail representing in vertical section a collet suitable for grasping and rotating the shaft. Fig. 4 is a section through line 4—4 of Fig. 3. Fig. 5 is a plan of a follower suitable for maintaining the shaft against deflection under the action of the hob. Fig. 6 is a fragmentary side elevation showing an indexing fixture for establishing and reproducing the identical relation between the hob and the spline grooves, this fixture being used especially during the so-called finishing operations. Fig. 7 is a plan of the arrangement shown by Fig. 6.

It will be noted that the drawings depict a hobber of the vertical type. The motive of that is two-fold; first, to avoid the deflections and strains tending to cause deflection existing in all locally-supported horizontal shaft, and second, to economize valuable factory floor space otherwise pre-empted by any elongated horizontal shaft.

Referring to Figs. 1 and 2, A denotes the bed of a hobbing machine which supports a rotatable table B carrying a suitable shaft-gripping chuck preferably in the nature of a collet C such as has been illustrated by Figs. 3 and 4. The collet C, the turn table B, and the bed A are so formed as to provide for the reception of an elongated vertical shaft and, to that end, the floor or ground on which the bed A rests may be provided with a vertical hole or well sufficiently deep to receive a considerable portion of the full length of the longest shaft that will need to be splined.

To prevent side sway of the upper portions of the shaft (indicated by D) which would otherwise be free, it is proposed to provide means in the nature of a pilot. This pilot is carried by a standard E and its distance from the collet C may be regulated by means of a slide block F which may be adjustably secured to the guideway *e* presented by the standard E which normally rests securely on the bed A. To accommodate different sizes of shafts, and different journals at the ends of said shaft, the pilot means is preferably made interchangeable. That is to say, G indicates a pilot element proper which is detachably secured to the block F by means of a bolt *f* and this pilot G is apertured to carry a pilot bushing *g* adapted snugly to interfit with the journal end *d* of the shaft D; thereby bracing the extremity of the shaft preparatory to cutting splines therein.

It may here be explained that, after cutting the first section of the shaft, it is desirable to use a pilot element such as G for bracing the shaft at the start of the down stroke of the hob and the pilot element, in that case, will be adapted to journal the body portion of the shaft closely by virtue of providing a hole sufficiently large to receive it snugly.

The cutting of the splines is performed by the action of a hob H which is appropriately journaled and carried by a head I which in turn is vertically slidable on ways *k* of a stanchion K which rests securely on the bed A. The drawings being diagrammatic will be readily understood by those skilled in the art to represent elements conventionally used in a hobbing machine; to wit, the usual transmission system for simultaneously rotating the turntable and the hob; for feeding the hob-head downwardly to the end of its available stroke; and returning it to the upper end of the stroke: These details, for the sake of clearness, are therefore omitted from the drawings as not being necessary to a comprehension of the features of this invention.

The collet C comprises a tubular body portion indicated by 1 on Fig. 3 having a base 2 adapting it, by means of bolts such as 3, to be secured concentrically to the axis of the turn table B. This member operates as a means for receiving the collet element proper which is indicated by C′ and comprises a tubular shank 4 having a number of longitudinal splits 5 to form a series of resilient fingers 6. Near their outer ends, these fingers provide inclines 7 which co-operate with a conical seat 8 in the member 1 so that, when the collet proper C′ is forced downwardly, the fingers will be pressed to grip the shaft passing through the bore of the collet proper. This closing is accomplished by means of a closer C″ which is screw threaded at 9 to the body 1 and has an overhanging rim 10 operative upon a non-rotatable thrust ring 11, and provided with suitable side slots 12 to admit of being turned by a spanner wrench. The utility of the thrust ring 11 is to prevent any rotation of the collet closer C″ from being communicated to the collet proper C′. This enables great precision in indexing to be attained inasmuch as there is no tendency towards angular displacement upon the reclamping of the shaft.

Upon clamping the shaft in the collet with the parts in the position indicated by Fig. 1, the cutting of the splines may be begun; the follower indicated by Fig. 5 being assumed to be opened and set back so as to clear the pilot element G. As soon as the follower M (which is held by a set screw in the bracket N affixed to the head I) has been brought into horizontal coincidence with the body portion of the shaft D, it is slipped towards the shaft and turned until its main half section snugly contacts with the shaft and the set screw 13 is then tightened. The half cap L is, at this time, swung around the shaft and retained by means of a draw bolt 14; the parts being provided with suitable semi-circular bush-

ings 15 and 16 to insure a snug yet free turning fit.

The cutting operation is then proceeded with during the down feed of the hob-head I; and the shaft is roughed out by a cyclic operation through the adding of this instrumentality in the manner detailed in the copending application of Hugo W. Jacobson herein referred to.

It is during the finish-cutting of the splined shafts that the indexing instrumentality assumes its greatest importance. Fig. 2 represents a part of the finishing operation. The shaft is inserted in the collet. To align its roughed out grooves with the finishing hob so that the latter may take finished cuts of each side wall of each groove, a preliminary alignment is obtained by means of a setting finger P mounted in a standard Q which is adapted to rest on and interfit with one of the radial T-slots conventionally provided by the turn table B. This is done when the shaft is in the lowermost position and before the hob has entered any of the grooves. The hob-head is then fed downwardly sufficiently to enable the hob to take a short finish cut and to cause the follower to pass the pilot (as explained in connection with Fig. 1) and the first section of the finished cut is then pursued with the follower riding behind the hob and journaled against side sway.

At the end of the first down feed, the angular relation of the hob to the shaft is precisely established. This is done by the fixture shown by Figs. 6 and 7. This indexing fixture (indicated generally by R) comprises a ring 17 having a hole fluted in general correspondence with the splines of the shaft as indicated by 18. A thumb screw 19 extends in a tangential direction to one of the flutes, the object being to enable the thumb screw to press against the side wall of one of the splines of the shaft and urge it securely against a corresponding flute 20 of the ring 17. This establishes definite angular relation between the indexing device R and the splines of the shaft. This index device is provided with an elongated finger 21 having at its extremity an index line 22 which, by means of an element S adjustable on the head I, may be caused to coincide with a corresponding line 24. The screws 23, being now tightened, will fix this relationship. The index device may now be removed. The hob head may be elevated and the shaft unclamped. The shaft may then be elevated; the index device restored and clamped to the shaft and turned if necessary to bring the lines 22 and 24 into coincidence. The collet is now tightened with perfect assurance that the relationship between the hob and the spline grooves has not suffered alteration. The finish-splining of the next section may now be carried out; and so on cyclically until a sufficient length of the shaft has been splined.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention, and therefor, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, we claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of United States:—

1. A multi-spline hobber combining a rotatable collet; a shiftable hob-support; a rotatable hob adapted to generate splines in a shaft carried by said collet; and an indexing member adapted positively to engage said shaft to establish definitely the relation of its splines with said hob and to enable said collet to be unclamped and then reclamped with said relation exactly reproduced.

2. A multi-spline hobber combining a rotatable collet; a shiftable hob-support; a rotatable hob adapted to generate splines in a shaft carried by said collet; and an indexing member adapted positively to interfit with splines cut in said shaft to establish definitely the relation of its splines with said hob and to enable said collet to be unclamped and then reclamped to expose an additional length of the shaft to the action of the hob with said relation exactly maintained.

3. A multi-spline hobber combining a rotatable collet; a shiftable hob-support; a rotatable hob adapted to generate splines in a shaft carried by said collet; and a detachable indexing member adapted positively to be affixed to said shaft to establish definitely the relation of its splines with said hob; said member being adapted to be then removed to enable said collet to be unclamped and said shaft and hob shifted; and said member being adapted again to be affixed to said shaft to enable it to be reclamped with said relation exactly reproduced.

4. A multi-spline hobber combining a rotatable collet; a shiftable hob-support; a rotatable hob adapted to generate splines in a shaft carried by said collet; an indexing member adapted positively to engage said shaft to establish definitely the relation of its splines with said hob and to enable said collet to be unclamped and then reclamped with said relation exactly reproduced; and a follower having a displaceable cap for circumscribing said shaft.

5. A multi-spline hobber combining an erect rotatable collet adapted to rotate a shaft and to hold it against axial movement; an upright stanchion; a hob-head feedable vertically therealong; a hob journaled on said head, said hob and collet being adapted to be simultaneously rotated; a standard; and a displaceable pilot supported by said standard and adapted to engage said shaft at the side of said hob remote from said collet or co-axially journaling the shaft grasped by said collet.

6. A multi-spline hobber combining an erect collet adapted to rotate a shaft and to hold it against axial movement; an upright stanchion; a hob-head feedable vertically therealong; a hob journaled on said head, said hob and collet being adapted to be simultaneously rotated; a standard; a displaceable pilot supported by said standard for co-axially journaling the free end of the shaft, grasped by the collet, said pilot forming a bearing for said shaft at the side of said hob remote from said collet during the initial portion of the hobbing operation; and a shaft-embracing follower carried by said feedable hob-head and adapted, after the initial portion of the hobbing operation has been completed, to be placed around and form a movable bearing for the shaft at the side of the hob remote from the collet during the remainder of the hobbing operation.

7. A multi-spline hobber combining an erect collet adapted to rotate a shaft and to hold it against axial movement; an upright stanchion; a hob-head feedable vertically therealong; a hob journaled on said head, said hob and collet being adapted to be simultaneously rotated; a standard; a displaceable pilot supported by said standard for co-axially journaling a shaft grasped by the collet; and a follower carried by said feedable hob-head and comprising a main half section, a cap-section hinged thereto, semi-circular bushings carried by said sections, and means to hold said sections together with said bushings engaging said shaft.

8. A multi-spline hobber combining a rotatable work-holder adapted to rotate a work-piece and hold it against axial movement; a support; a hob-head feedable on said support parallel to the axis of said work-piece; a hob journaled on said head, said hob and collet being adapted to be rotated simultaneously; and a journal for said work-piece supported by and movable with said hob-head during a feeding movement of said hob-head.

9. In a spline hobbing machine adapted to perform roughing and finishing cuts, a rotatable turn-table; a work-holder carried thereby and adapted to rotate a work-piece and hold it against axial movement; a stanchion; a hob-head feedable on said stanchion parallel to the axis of said work-piece and adapted selectively to carry roughing and finishing hobs, said hobs and work-holder being adapted to be rotated simultaneously; and means carried by said turn-table to engage one of the rough-cut splines thereby to position said splines relative to a finishing hob for a finishing operation.

10. In a multi-spline hobbing machine adapted selectively to perform roughing and finishing cuts; a rotatable work-holder adapted to rotate a work-piece and hold it against axial movement; a stanchion; a hob-head feedable on said stanchion parallel to the axis of said work-piece and adapted to carry roughing and finishing hobs, said hobs and work-holder being adapted to be simultaneously rotated; a follower carried by said hob-head and affording a movable bearing for said work-piece adjacent the hob; and a setting device adapted to engage one of the rough-cut splines thereby to position said splines relative to a finishing hob for a finishing operation.

In witness whereof, we have hereunto subscribed our names.

HUGO W. JACOBSON.
RAOUL A. DEMEILLERS.