

June 29, 1937.

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2,085,016

MACHINE FOR PRODUCING HELICOID SURFACES

Original Filed April 30, 1932 2 Sheets-Sheet 1

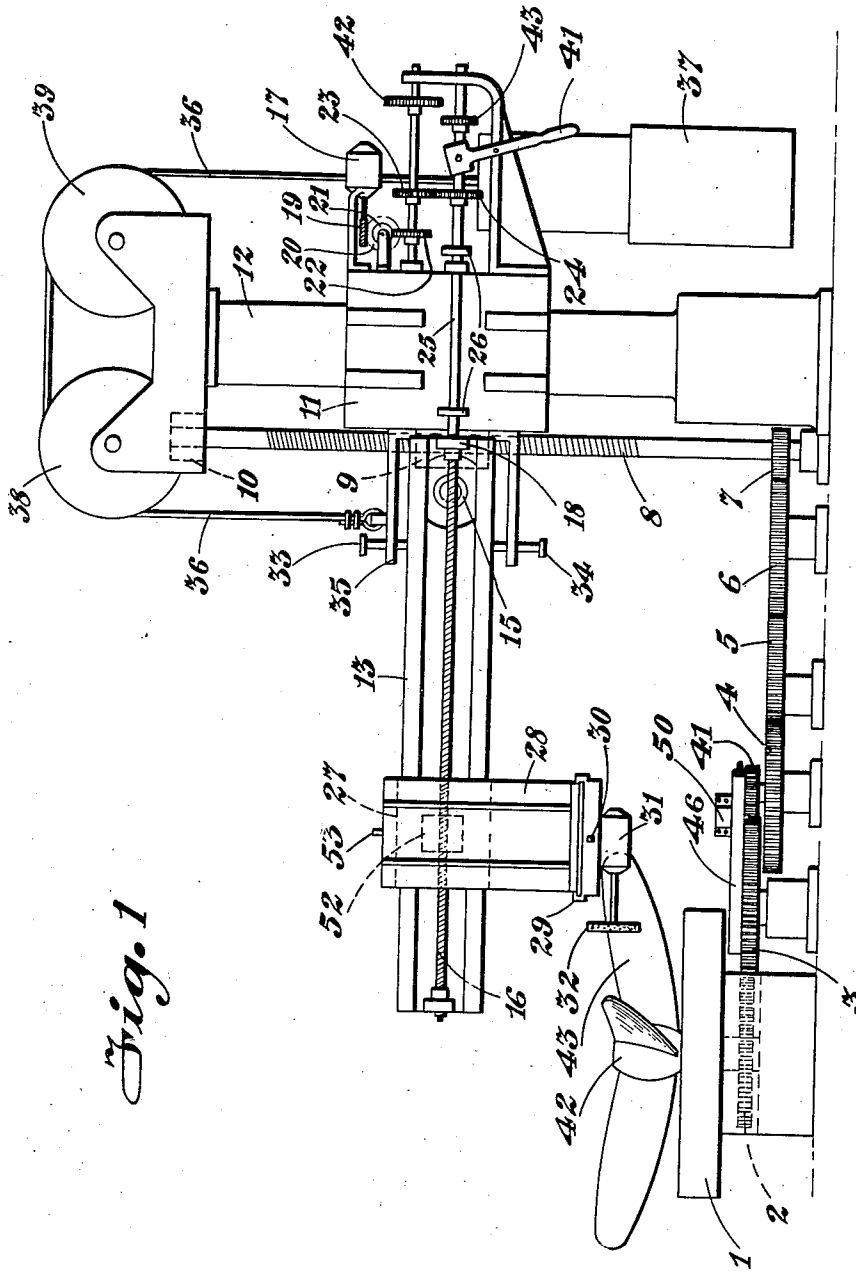


Fig. 1

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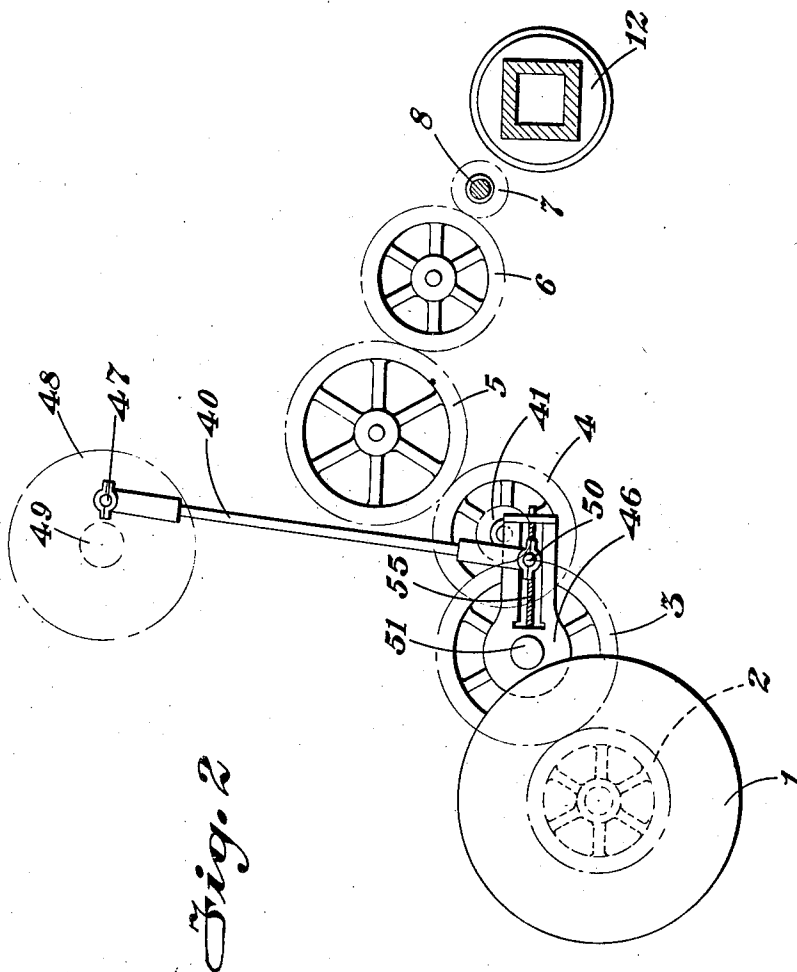
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MACHINE FOR PRODUCING HELICOID SURFACES

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4 Claims. (Cl. 51-46)

The present invention relates to a machine for finishing propeller blades and more particularly the invention relates to a machine for finishing the blades of a propeller useful on boats or the like.

It is well known in the art that the working surface of a propeller blade should be a helicoid. The object of the present invention is to provide a machine for finishing to perfect pitch the helicoidal surfaces of propeller blades. Another object of the invention is to provide such a machine of a simple structure. A further object of the invention is to provide a method and a means for generating true helicoids on the working surfaces of propeller blades. Still further objects and advantages attaching to the invention and to its use and operation will be apparent to those skilled in the art from the following particular description and from the appended claims.

The invention attains its objects by rotating the propeller about its axis through an arc of a circle, first in one direction and then in the reverse direction, while moving in a like manner a finishing or grinding tool, in operative relation to the helicoidal surface of one of the blades of said propeller, in a longitudinal direction at an angle to the plane of rotation of said propeller and while moving slowly said grinding tool from the root end to the tip end of said blade or vice versa. The rotating movements of said propeller and the movements of said grinding tool are perfectly synchronized by means of gears, the ratio between said gears determining the pitch of the propeller blade.

In the drawings accompanying and forming part of this specification an embodiment of my invention is shown in which,

Fig. 1 is a front elevational view of the new machine,

Fig. 2 is a top view of a power source connected to said machine.

Like numbers denote like parts in all the figures.

Referring to Fig. 1 of the drawings the new machine comprises a table 1 adapted for rotational movement and on which the propeller 42 to be worked on is mounted. A grinding wheel 32 bears against the face of the blade 43 of the propeller 42 mounted on said table 1. Said wheel 32 is adapted for longitudinal movements, these movements being controlled by screw thread 8. The movements of table 1 and screw thread 8 are perfectly synchronized by a series of gears 2, 3, 4, 5, 6 and 7. Gears 2, 3, 4, 5 and 6 are travel gears and gears 41 and 7 are magnifying gears. The ratio between table gear 2 and screw thread 8, which is determined by the ratio between gear 2 and gear 41, and the ratio between gear 4 and gear 7, determines the pitch of the propeller

blade. A table of gear ratios for blades of different pitches will be given hereinafter.

Said screw-thread 8 engages with a threaded block 9 rigidly attached to a hollow block member 11. Said member 11 is adapted for vertical movements on stationary column 12 through the medium of roller bearings (not shown for purposes of simplicity) provided at the top and bottom of each of the sides of said member 11. Support arm 13 extends from said member 11 over said table 1 and said arm 13 is adjustable through joint 15 and set screws 33, 34 in support plate 35 and, when desired, is set at an angle to the plane of said table 1. Said support plate 35 is attached to member 11 and has the cable 36 of the counter balance 37 attached thereto, said cable 36 being led over pulleys 38, 39 attached to said column 12.

Screw-thread 16 extends along the length of said arm 13, as shown, and said screw-thread 16 is driven by motor 17 through a series of gears 19, 20, 21, 22, 23, 24 and shaft 25, as shown. Said shaft 25 is provided with universal joints 26 to permit a change in position of said shaft 25 when said arm 13 is moved from its horizontal position. Carrier 27 slides along said arm 13 actuated by screw-thread 16 engaging with a screw-block 52 in said carrier 27. Angle arm 28 is attached to said carrier 27 and is adapted for vertical manual adjustment thereon by screw 53. Motor support part 29 is attached to angle arm 28 and is adapted for horizontal adjustment thereon by screw-thread 30. Motor 31, driving grinding wheel 32, is rigidly attached to said support part 29.

In Fig. 2 a driving mechanism for the machine is shown in which arm 46 on gear 3 is moved through an arc first in one direction and then in the reverse direction by the revolution of disc 48 about the center 49 thereof, the end 47 of shaft 40 being off-set from said center 49 and the end 50 of said shaft 40 being engaged with said arm 46 of gear 3. The magnitude of the arc through which table 1 and the arm 46 travels is governed by the distance of the end 50 from the center 51 of said gear 3, this distance may be changed as desired by means of screw-thread 55 in said arm 46 engaging with said end 50. The disc 48 is driven in a continuous rotary movement by means of a motor and a worm wheel reduction (not shown for purposes of simplicity).

The operation of the device is as follows:—

A propeller 42 is rigidly mounted on table 1 the center of said propeller 42 coinciding with the center of said table 1, as shown in Fig. 1. The blade 43 of said propeller 42 on which a helicoid is to be generated is situated at one end of its arc of rotation. Said grinding wheel 32 is then brought into position against the face of said blade 43, at the root end thereof, and at the

forward edge of said blade 43, by suitably adjusting parts 28 and 29. Power is applied to the driving mechanism of shaft 40, described heretofore which rotates said table 1 and the propeller 42 mounted thereon through an arc, first in one direction and then in the reverse direction, and which moves said grinding wheel 32 in a longitudinal direction in the same manner, both movements being simultaneous and synchronized, by means of the mechanism described heretofore and thus the grinding wheel 32 is moved across the face of said blade 43 from the forward edge to the back edge thereof and vice versa on successive movements of said table 1 and said wheel 32. Simultaneously with the movement of shaft 40 current is applied to said motors 17 and 31 and grinding wheel 32 is started into operation and travels slowly from the root end to the tip end of said blade the said grinding wheel 32 overlapping part of its path on each successive longitudinal movement thereof. The combined movements of these steps generates a true helicoid on the blade of the propeller subjected to the process. The succeeding blade of the propeller is then brought into the same position on said table 1 as that occupied by the original blade and grinding wheel 32 is returned to its original position at the root end of the blade of the propeller by reversing motor 17. The operation is then started anew and is repeated until a true helicoid is generated on each of the propeller blades in turn.

The ratio between table gear 2 and screw-thread 8 which depends upon the ratio between table gear 2 and gear 41 and the ratio between gear 4 and gear 7 determines the pitch of the propeller blade. I have demonstrated that these relationships should be in the following order for various pitches:—

40

45

50

55

60

65

70

Pitch	4-7	2-41	Ratio between gears located between 4 and 7
36°	27-9	108-36	1-1
37°	27-9	108-35	1-1
38°	27-9	108-34	1-1
39°	27-9	108-33	1-1
40°	27-9	108-32	1-1
41°	27-9	108-31	1-1
42°	27-9	108-30	1-1
43°	27-9	108-29	1-1
44°	27-9	108-28, 8/29	1-1
45°	27-9	108-28	1-1
46°	27-9	108-27	1-1
47°	27-9	108-26	1-1
48°	36-9	108-36	1-1
49°	36-9	108-35.5	1-1
50°	36-9	108-34.5	1-1
51°	36-9	108-34	1-1
52°	36-9	108-32	1-1
53°	36-9	108-30.3	1-1
54°	27-9	108-43	2-1
55°	27-9	108-41	2-1
56°	27-9	108-39.2	2-1
57°	27-9	108-37.6	2-1
58°	27-9	108-37.1	2-1
59°	27-9	108-36	2-1
60°	27-9	108-31	2-1
61°	36-9	108-36	2-1
62°	27-9	108-36	3-1
63°	36-9	108-29	2-1
64°	27-9	108-29/30	3-1
65°	36-9	108-36	3-1
66°	36-9	108-32.5/33	4-1
67°	36-9	108-26.25/40	4-1
68°	36-9	108-28.1/38	4-1
69°	36-9	108-36	4-1
70°	36-9	108-34	4-1
71°	36-9	108-32	4-1
72°	36-9	108-30	4-1
73°	36-9	108-28	4-1

The arm 13 is not, however, parallel to the generatrix of the helicoid. It will be obvious to

those skilled in the art that the point of contact between the grinding wheel 32 and the blade 43 of the propeller 42 is at a different part of said wheel 32 as it travels from the root end to the tip end of said blade 43. For example, if the distance from the root end to the tip end of said blade is divided into three equal parts a line connecting the contact point of said wheel 32 and the center of said wheel 32 is, for example, at an angle of 45° from the vertical at the first division line from the root end of the blade; at an angle of 35° at the second dividing line, and at an angle of 25° at the third dividing line. It will be understood, of course, that these angles are taken purely arbitrary and vary with blades of different pitches. The arm 13 must thus be at such angle with respect to the generatrix that the contact point on said wheel 32 follows the generatrix exactly when said wheel 32 travels from the root end to the tip end of the propeller blade, if the longitudinal motion thereof is eliminated.

The practical method of determining the angle of inclination of arm 13 is by tracing the generatrix on the blade of the propeller and adjusting said arm 13 at such angle that the contact point between the surface of the blade and wheel 32 follows exactly the generatrix. Arm 13 is set at the desired angle by adjusting set screws 33 and 34 to move said arm 13 on joint 15, universal joints 26 being provided to permit the movement of shaft 25 from its normal position.

Gear shift handle 41 is provided to disengage gear 24 with gear 23 and to engage gear 43 with gear 42 to increase the speed of travel of grinding wheel 32 from the root end to the tip end of the propeller blade when that is desired.

From what has been said above it will be apparent that the above described process and machine is adaptable for fashioning the pattern of a propeller or the like.

While I have shown and described and have pointed out in the annexed claims certain novel features of my invention it will be understood that various omissions, substitutions, modifications and changes in the several steps of the process and in the operation and in the form and details of the apparatus involved and in its use and operation may be made by those skilled in the art without departure from the broad spirit and scope of the invention.

I claim as my invention:

1. A machine for generating helicoids on propeller blades comprising a work support on which the hub of said propeller is axially mounted, means for rotating said work support and therewith the blade being worked upon first in one direction and then in the reverse direction through an arc of a circle, a guide-support mounted on a frame support offset from the axis of rotation of said work support, a grinding wheel mounted on said guide-support, means for driving said grinding wheel, means for oscillating said frame support and therewith said grinding wheel in a direction at an angle to the plane of rotation of said work support, the rotating movements of said work support and the oscillating movements of said wheel being synchronized by means of gears, the surface of said blade and said wheel being in operative contact on each successive movement thereof, means to move said wheel along said guide-support from the root end to the tip end of said blade, said wheel overlapping part of its path on said surface on each successive movement thereof, said

guide-support being at an angle to the generatrix of the helicoid being generated on the surface of said blade whereby the contact point between said wheel and said surface is maintained coincident with said generatrix.

2. A machine for generating helicoids comprising means for rotating the surface on which the helicoid is to be generated first in one direction and then in the reverse direction through an arc of a circle, means offset from the axis of rotation of said surface to oscillate a rotary cutting tool against said surface in a direction at an angle to the plane of rotation of said surface, said surface and said cutting tool being in operative contact on each successive movement thereof, means to synchronize the movements of said tool and said surface, means to drive said cutting tool and means mounted on said offset oscillating means to move and guide said tool along the length of the generatrix of the helicoid, said guide means being at an angle to said generatrix.

3. A machine for generating helicoids comprising means for rotating the surface on which the helicoid is to be generated first in one direction and then in the reverse direction through an arc of a circle, means offset from the axis of rotation of said surface to oscillate a rotary cutting tool against said surface in a direction at an angle to the plane of rotation of said surface, said surface and said cutting tool being in operative contact on each successive

movement thereof, means to synchronize the movements of said tool and said surface, means to drive said cutting tool and means mounted on said offset oscillating means to guide said tool along the length of the generatrix of the helicoid, said guide means being at an angle to said generatrix whereby the contact between said tool and said surface is maintained coincident with said generatrix.

4. A machine for generating helicoids comprising means for rotating the surface on which the helicoid is to be generated first in one direction and then in the reverse direction through an arc of a circle, means offset from the axis of rotation of said surface to oscillate a rotary cutting tool against said surface in a direction at an angle to the plane of rotation of said surface, said surface and said cutting tool being in operative contact on each successive movement thereof, means to synchronize the movements of said tool and said surface, the working part of said tool being of lesser width than the helicoid being generated on said surface, means to drive said rotary tool and means mounted on said offset oscillating means to guide said tool along the length of the generatrix of the helicoid, said guide means being at an angle to said generatrix whereby the contact between said tool and said surface is maintained coincident with said generatrix.

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