Nov. 19, 1929. R. I. BODENLOS 1,736,247

PITCHOMETER

Filed April 29, 1927 3 Sheets-Sheet 1

Fig. 1.

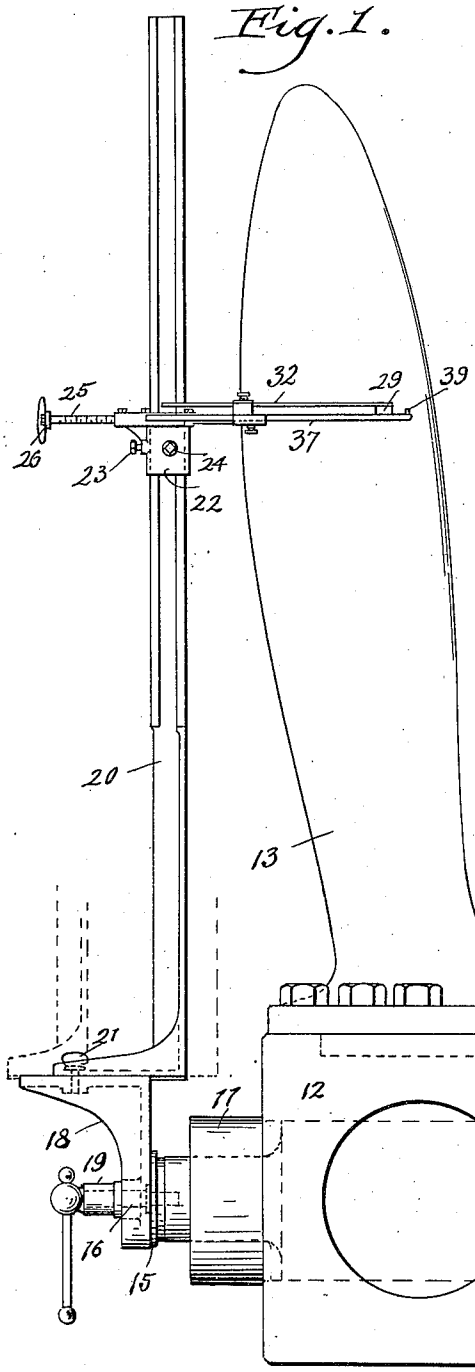
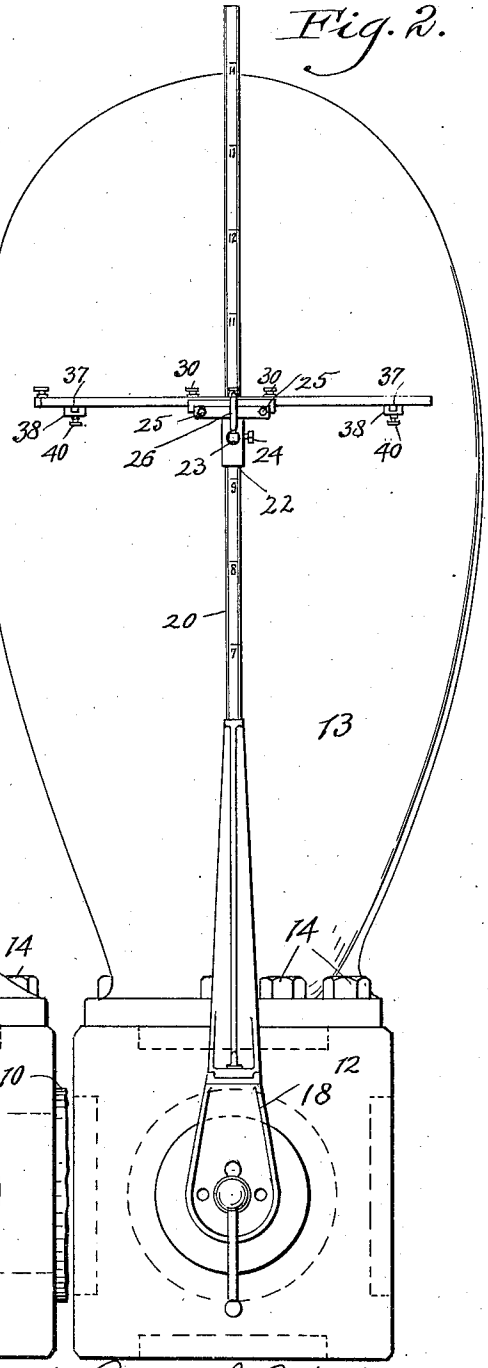


Fig. 2.



Inventor. Robert I. Bodenlos.

Knox Hudson & Kent attys

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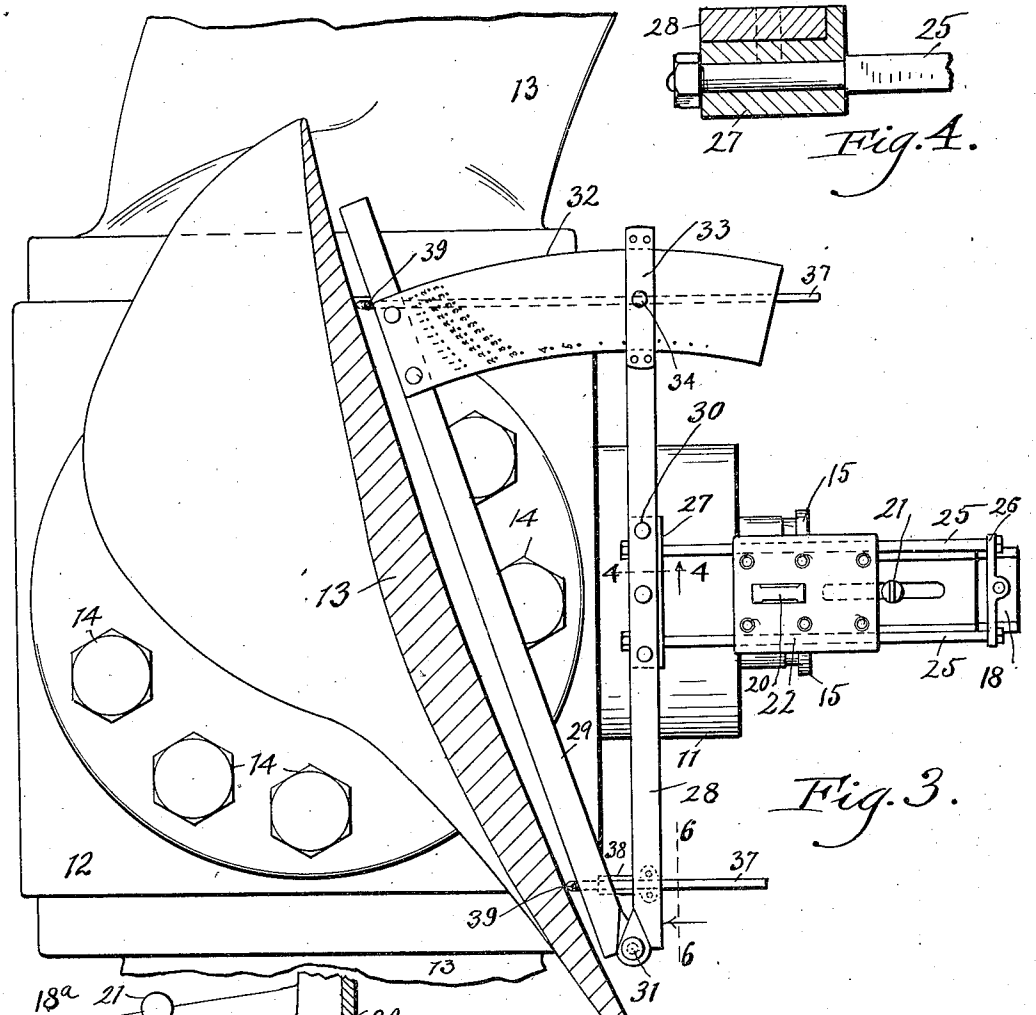


Fig. 3.

Fig. 4.

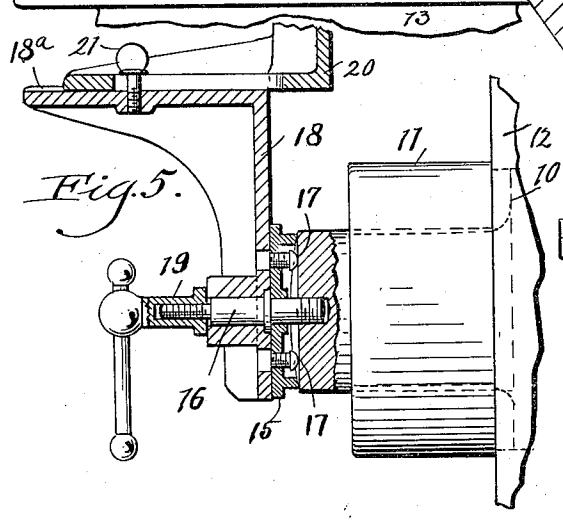


Fig. 5.

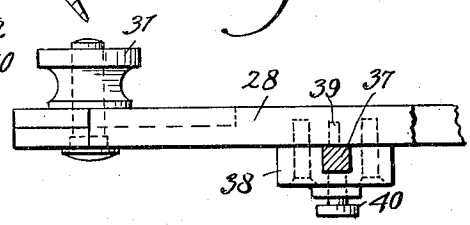


Fig. 6.

Inventor
Robert I. Bodenlos
Howson Hudson & Kent
attys

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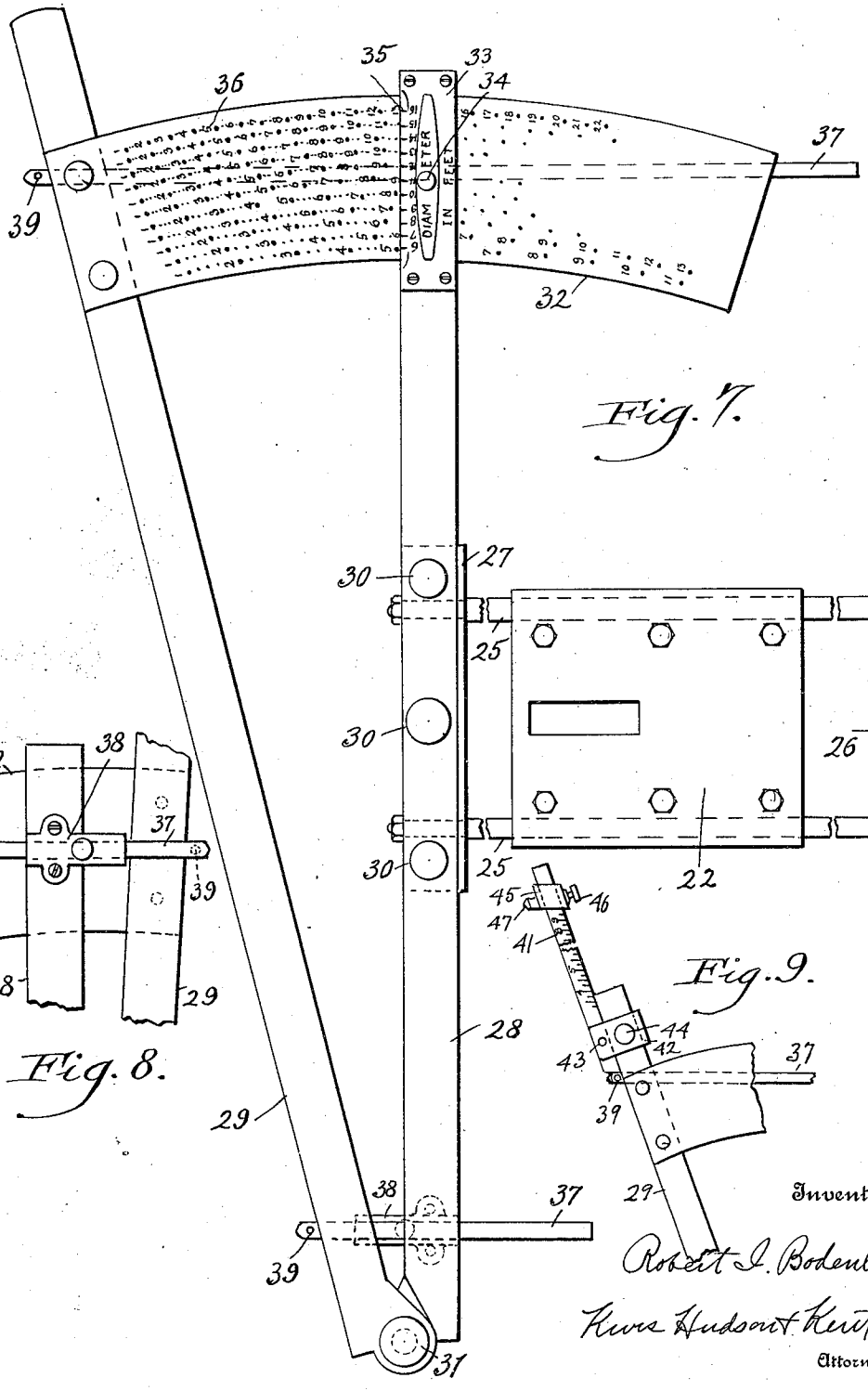


Fig. 7.

Fig. 8.

Fig. 9.

Inventor

Robert I. Bodenlos

Howe Hudson & Kent

Attorneys.

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UNITED STATES PATENT OFFICE

ROBERT I. BODENLOS, OF CLEVELAND, OHIO, ASSIGNOR TO THE AMERICAN SHIPBUILDING COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF NEW JERSEY

PITCHOMETER

Application filed April 29, 1927. Serial No. 187,559.

This invention relates to what may be termed a pitchometer adapted for use in correctly positioning the blades of a propeller either on the propeller hub applied to the shaft of the vessel or to a temporary support in the shop. The device has utility not only when the propeller is being assembled on the shaft of the vessel but also when a blade is being replaced. The device is useful also not only in bringing about the correct and uniform positioning of the different blades as to their pitch and fore and aft relationship, but in testing or checking the contour of a blade and in determining its pitch at different points in its length.

The object of the invention is to provide an improved instrument of the character stated and especially to provide a pitchometer which is accurate and is quickly and easily operated for any of the purposes stated above and which has adjustments necessary to adapt it for blades of various shapes and designs, and especially those which are not only more or less radial but also those which are inclined to the radial either laterally or in a fore and aft direction.

The invention may be briefly summarized as consisting in certain novel details of construction and combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In the accompanying sheets of drawings, Fig. 1 is a side view of the instrument applied to the end of a propeller shaft in association with the blade of a propeller; Fig. 2 is a face view of the same; Fig. 3 is an enlarged plan view of the instrument with the propeller blade in section; Fig. 4 is a detail sectional view substantially along the line 4—4 of Fig. 3; Fig. 5 is a view of the lower part of Fig. 1 on a slightly enlarged scale and with the major portion of the parts in section; Fig. 6 is a detail sectional view substantially along the line 6—6 of Fig. 3; Fig. 7 is an enlarged plan view of the top portion of the instrument; Fig. 8 is a fragmentary bottom view of a portion of the same; and Fig. 9 is a fragmentary plan view of a portion of the pitch board showing a slight modification or an attachment which may be employed.

Referring now to the drawings, 10 represents a propeller shaft on which is adapted to be secured by a nut 11 or otherwise the propeller composed of a hub 12 and blades 13. The hub 12 has flat faces to which the blades are adapted to be secured by bolts 14, the propeller illustrated having in this instance four blades. The inner end of each blade is flanged and the bolts 14 pass through slots in the flange thereby enabling the blade to be adjusted to the correct position on the hub.

The pitchometer constituting the subject matter of this application includes what may be termed a pitch board, the details of which will be described presently, and which is adapted to be maintained in a plane parallel to the axis of the propeller shaft 10 through the medium of an adjustable support detachably connected to the end of the propeller shaft at the center thereof, the said support being composed of the following parts and being attached to the shaft as will now be explained.

In the preferred embodiment, there is employed a washer or disk 15 which is fastened to the end of the shaft centrally thereof by a collared stud 16, the end of the shaft being provided with a centrally and axially disposed threaded opening adapted to accommodate the end of this stud. While the end of the shaft is always faced off square with the axis of the shaft, in the event the end should become at all battered I provide for the adjustment of this washer through the medium of adjusting screws 17 to bring it into exact parallelism with the end face of the hub.

The support further includes what may be termed a base 18 which also is supported by the collared stud 16 and is adapted to be clamped against the outer face of the washer 15 by a nut 19 or equivalent means. This base is substantially L-shaped inasmuch as it has a laterally projecting arm 18ª the top surface of which is at right angles to the face of the base which is clamped against washer 15.

Mounted on the arm 18ª of the base is a guide bar 20 having a foot portion which slidingly engages the arm 18ª, the latter being preferably provided with a groove forming a guideway which will enable the guide bar to be moved back and forth parallel to the axis of the shaft. The guide bar can be clamped in any position of adjustment by a thumbscrew 21 which in this instance extends through an elongated slot in the foot of the guide bar.

The guide bar is adapted to be positioned centrally of the blade, as best shown in Fig. 2, and to centralize it with reference to the blade, the base 18 will be turned on the collared stud 16 and will then be tightly clamped in position by turning the nut 19. This guide bar is graduated, as shown in Fig. 2, in increments of the diameter of the propeller in feet.

Movable along the guide bar 20 is a slide 22 which is adapted to be clamped in any desired position readily determined by the graduations, by thumbscrews 23 and 24, so as to enable the pitch board to be positioned at various points along the length of the blade corresponding to different points in the diameter of the propeller.

The slide 22 carries a second slide which is movable at right angles to the guide bar 20 or toward and from the blade when the parts are in the relative positions illustrated. This second slide comprises two parallel drag bars 25 which slide in two guide grooves formed in the upper part of the slide 22 on opposite sides of the guide bar. The outer ends of the drag bars are connected together by a cross piece 26 which the operator will generally grasp when he desires to move the drag bars and pitch board in or out. The inner ends of the drag bars are connected together by a pitch board carrier 27 to which the drag bars are tightly secured, as indicated in Fig. 4. In the preferred embodiment, the drag bars are preferably square rods at least one of which is graduated, preferably in inches. The pitch board, which is mounted on the carrier 27, comprises two bars 28 and 29, the former having its middle portion rigidly secured by thumbscrews 30 to the carrier, as illustrated in Figs. 3 and 7, and the second bar being pivoted to one end of bar 28 by suitable means, such as by a thumbnut 31. It will be seen that the bar 29 can be swung from a position of parallelism with bar 28 to any desired angle (within limits) with respect thereto.

At the opposite or free ends of the bars 28 and 29 there is provided on one of the bars a curved dial plate 32 and on the other a guide 33. In this instance, the dial plate 32 is secured to bar 29 near its free end and the guide 33 is on the upper side of bar 28. The dial plate 32 rests upon the top face of bar 28 and extends under guide 33, and it has its inner and outer edges curved on arcs of circles concentric with respect to the center of thumbscrew 31 so that, when bar 29 is moved relative to bar 28, the dial plate moves freely through the slot between guide 33 and the top face of bar 28. The parts can be clamped with the bars 28 and 29 at any given angular position by a thumbscrew 34 extending through the guide 33 and adapted to engage the dial plate. Additionally, the thumbnut 31 can be tightened to clamp the bars in any given angular relationship.

The guide 33 has along its inner edge numbered graduations 35 which indicate preferably in increments of feet the diameter of the propeller or wheel on which the pitch is to be set. That is to say, these numbered graduations correspond to the diameters of imaginary circles drawn on the blades of the wheel a foot apart with the shaft as the axis, and it may be here stated that the graduations on the guide bar 20 which, as already explained, is graduated in feet, correspond to the location of chords intersecting these imaginary circles.

The dial plate 32 also has numbered graduations indicated at 36. These graduations, which substantially cover the dial plate, are pitch graduations in feet and fractions thereof. These graduations and the numerals corresponding thereto are arranged in concentric arc-shaped rows, there being one row of graduations for each of the diameter graduations on the guide, the rows of pitch graduations being in line with the different diameter graduations of the guide. The pitch graduations are carefully laid out and stamped for the different diameters. In this instance, the diameter graduations on the guide 33 run from 6 to 16 and accordingly there are eleven rows of pitch graduations which run from 1 to a maximum of 22, but of course the range of the instrument, both as to diameter and pitch, may be varied as required.

Additionally, the pitch board includes two blade contactors 37 which are preferably in the form of rods square in cross section. These bars are parallel to each other and are carried by the bar 28 on opposite sides of the center of bar 28, and, therefore, on opposite sides of the center of guide bar 20 and of the center of the blade when the guide bar is positioned centrally with respect to the blade, as illustrated in Fig. 2 of the drawings. While these blade contactors or rods 37 are carried by bar 28 of the pitch board, they are slidable with respect thereto, being supported by guides 38 (see Figs. 6 and 8) which are secured on the lower side of bar 28. The forward ends of the rods which are adapted to engage the propeller blade are pointed, as indicated in the drawings, and a short distance back from the extreme points these rods have upstanding pins 39

which are adapted to engage the front edge of the swinging bar 29 of the pitch board. When the bars 28 and 29 are set to the proper angle, the pins 39 of rods 37 are brought up against the front edge of the bar 29 and then the rods may be clamped in position by thumbscrews 40, best shown in Figs. 2, 6 and 8.

The pitchometer is used as follows:

Assuming that the threaded hole is provided in the center of the shaft, the washer is placed against the end of the shaft, then adjusted (if necessary) so as to bring it into parallelism with the end face of the hub and is then tightened by means of the collared stud. Then the base 18 is slipped onto the end of the stud and tightened slightly and the guide bar 20 is placed on the base and tightened up, and when the guide bar is positioned centrally with respect to the blade, the base may be tightened on the stud. The position of the guide bar on the base will depend generally on the design of the wheel and especially on the fore and aft position of blades on the propeller hub.

The pitch board and slide 22 are moved along the guide bar to a position with reference to the blade where the pitch is to be set (usually about one foot from the top edge of the blade) and then slide 22 is tightened on the guide bar. The pitch board is then adjusted by adjusting the angle between the bars 29 and 28 until the proper pitch designation (the pitch being known) registers with the diameter graduation on the guide 33 corresponding to the diameter at which the pitch board is set on the guide rod and then the parts of the pitch board are clamped together.

The pitch board is then moved toward the propeller blade until the graduations on the drag rods show about two inches, after which the rods 37 are moved back until the pins 39 engage the front edge of bar 29 of the pitch board and the rods are then clamped in position by the thumbscrews 40. Then the pitch board is pushed by means of the drag rods until the point of one of the rods 37 touches the blade. The blade is then moved to meet the point of the other rod 37 and this is continued until the points of both rods engage the face of the propeller blade equal distances on opposite sides of the center line thereof, the blade while being shifted being maintained centrally with respect to the guide bar 20. The blade is now set for the right pitch at the desired diameter which, for purposes of description, may be assumed to be twelve feet. At this point, it is important to note the graduation mark on the drag rods which, for convenience, will be assumed to be about four inches, this being of importance in setting the other blades and particularly for the purpose of assuring uniformity or approximate uniformity in the fore and aft positions of the different blades.

To find the accuracy of the blade and to prove up the propeller, the pitch board may be lowered on the guide bar to eleven foot diameter and then to ten foot diameter, then to nine foot diameter, etc., the above procedure being followed at each diameter. If there is a variation of the pitch on the different diameters of the blades, the middle point should be taken and the difference split up about two feet from the top of the blade (or more on wheels of larger diameter).

The propeller is then turned until the next blade comes in position before the pitch board and the same procedure as above is followed, but in setting the different blades, the position of the guide bar on the base 18 must not be changed.

When the second, third and fourth blades are set, care should be exercised that when the blades are correctly positioned for pitch, the drag rod should occupy the same position in the slide 22 (as shown by the graduations) as with the first blade on the same diameter. A small amount of variation will do no harm but if the difference exceeds a certain amount, the blade should be brought to the correct fore and aft position either by placing shims or thin washers over the propeller studs 14 or by taking the blade off the hub and refacing the same correspondingly. If this procedure is not followed, the propeller is unbalanced and will vibrate at a certain speed but by placing the blades in the correct fore and aft position as well as in the same pitch, the disadvantages just mentioned are eliminated.

By means of my improved pitchometer used in the manner explained above, the blades of the propeller can be set to the same pitch and to the same fore and aft position and this proper and uniform setting of the blades (assuming that the propeller is properly designed) will insure smooth running, minimize vibration and will result in greater efficiency in propulsion and a saving of fuel.

I have above described my improved pitchometer applied to a propeller shaft and have explained the preferred method of using the instrument in properly positioning the blades on a propeller hub when applied to the shaft, but I wish it to be understood that the instrument has utility also in testing and setting the blades with reference to a test block in the shop wherein the propeller is being constructed. When the instrument is used under these circumstances, the blades can be positioned on the block the same as on the propeller hub and when thus correctly positioned, they can be marked so that they may be later applied to the propeller hub on the shaft and set properly by the use of markings applied as the result of the original testing and setting in the shop. Under these cir-

cumstances, the test block will have an opening to receive the collared stud 16, which opening is so positioned that it will correspond to the axis of the shaft which is to carry the propeller.

The construction above described can be used effectively for a great variety of shapes and sizes of blades, but if the blade is unusually wide, the distance between the points of the contactor rods 37 may not be sufficient to give results with the desired degree of accuracy and certainty. Accordingly, I may use an attachment such as indicated in Fig. 9 which, in effect, increases the distance between the points which contact with the blade. This consists of two extensions 41 which are adapted to be placed against the forward edge of bar 29 so as to extend outwardly beyond the ends thereof, which extensions are adapted to be supported on the bar with their inner ends engaging the ends of the contactor rods 37 in the manner indicated in Fig. 9 where one of these extensions is shown. These extensions may be slidably supported by fittings 42 and may be secured thereto by thumbscrews 43 and the fittings themselves may be secured to the bar 29 by thumbscrews 44. These extensions 41, which are preferably graduated, as shown, to indicate distances from the center of the contactor rods 37, are provided with slides 45 which may be set on the extensions at any desired point and secured thereto by thumbscrews 46, each being provided with a point 47 adapted to engage the blade.

While I have described the preferred construction and have explained the preferred way of using the instrument, I do not desire to be confined to the precise details or arrangements shown, but aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention as defined in the appended claims.

Having thus described my invention what I claim is:

1. A pitch board comprising two pivotally connected angularly adjustable members, means for holding one of said members rigid and in definite position with respect to the axis of the propeller, and a pair of adjustable blade contactors carried by said fixed member.

2. A pitch board comprising two relatively movable pivoted bars, means for holding one of said bars in fixed position with reference to the axis of the propeller, and a pair of blade contactors slidably supported by said last mentioned bar.

3. A pitch board for use in setting propeller blades, comprising two relatively adjustable members, means connected to one of said members for supporting the board in a plane parallel to the axis of the propeller at predetermined distances therefrom, and slidable blade contactors connected to said last mentioned member of the board.

4. A pitch board for use in setting the blades of a propeller, comprising a bar, means connected to substantially the middle thereof for holding the same in fixed position in a plane parallel with the axis of the propeller and at varying distances therefrom, a second bar pivoted to the first bar, and a pair of adjustable blade contactors carried by the first bar on opposite sides of the center thereof.

5. A pitch board for use in setting the blades of a propeller, comprising two pivoted bars, means attached to substantially the middle of one bar for supporting it in definite relation to the axis of the propeller, blade contactors carried by said bar on opposite sides of the center thereof, a second bar pivoted to the first mentioned bar and adapted to be adjusted angularly with respect thereto, said two bars having cooperating members graduated respectively in terms of pitch and diameter.

6. In a device for setting the blades of a propeller, a pitch board, means for supporting it in a plane parallel with the axis of the propeller and at predetermined distances therefrom, means by which the board may be moved toward and from the propeller blade, said board being composed of a relatively fixed member, a movable member angularly adjustable with reference thereto and a pair of blade contactors adjustably supported by the fixed member and adapted to engage the blade on opposite sides of the center line thereof and at substantially equal distances therefrom.

7. In a device for setting the blades of a propeller, a pitch board, means for supporting it in a plane parallel with the axis of the propeller and at predetermined distances therefrom, said board being composed of a relatively fixed member, an angularly adjustable member pivoted thereto, a pair of blade contactors adjustably supported by the fixed member and adapted to engage the blade on opposite sides of and equidistant from the center line thereof, and two cooperating parts carried by said members, respectively, one graduated in terms of diameter and the other in terms of pitch at varying diameters.

8. In a device for use in setting the blades of a propeller, a pitch board having angularly adjustable members and blade contacting means, and means for supporting the board in a plane parallel with the axis of the propeller and centrally with respect to the blade, the said supporting means including two parts, one adapted to be secured in fixed position with reference to the axis of the propeller shaft, and the other part carrying the pitch board and bodily adjustable on the first part in a fore and aft direction.

9. In a device for positioning the blades of a propeller, a pitch board including two

pivoted parts adapted to be relatively adjusted in accordance with the pitch at a given diameter, a support for the board on which the latter may be adjusted toward and from the blade in a plane parallel with the axis of the propeller and toward and from said axis, said support including a part adapted to be secured to the shaft in definite relation to the propelling axis and another part slidable thereon in a fore and aft direction.

10. In a device for use in setting the blades of a propeller, a pitch board, means for supporting said pitch board in a plane parallel with the axis of the propeller at predetermined distances therefrom and for moving the same toward and from the propeller blade in a fore and aft direction, said pitch board comprising a relatively fixed member, a member angularly adjustable with reference to said fixed member, a pair of blade contactors independently adjustably supported by the fixed member and adapted to engage the blade on opposite sides of the center line thereof and at substantially equal distances therefrom, and means for positioning the blade engaging ends of said contactors a fixed distance away from the forward edge of said second named member in its various positions of angular adjustment.

11. In a device for use in setting the blades of a propeller, a pitch board, means for supporting said pitch board in a plane parallel with the axis of the propeller at predetermined distances therefrom and for moving the same toward and from the propeller blade in a fore and aft direction, said pitch board comprising a relative fixed member, a movable member pivoted at its end to one end of said fixed member whereby it is angularly adjustable with reference thereto, a pair of blade contactors independently adjustably supported by the fixed member and adapted to engage the blade on opposite sides of the center line thereof at substantially equal distances therefrom, and means for positioning the blade engaging ends of said contactors a fixed distance away from the forward edge of said member in its various positions of angular adjustment.

12. In a device for use in setting the blades of a propeller, a pitch board, means for supporting said pitch board in a plane parallel with the axis of the propeller at predetermined distances therefrom and for moving the same toward and from the propeller blade in a fore and aft direction, said pitch board comprising a relatively fixed member having a graduated portion adjacent one of its ends, a movable member pivoted to the opposite end of the fixed member from that upon which is arranged the graduated portion and having a graduated portion adjacent its free end cooperating with the graduated portion upon the fixed member, said graduated portions being graduated, respectively, one in terms of pitch and the other in terms of diameter, a pair of blade contactors independently and adjustably supported by the fixed member and adapted to engage the blade on opposite sides of the center line thereof and at substantially equal distances therefrom, and means to position the blade engaging ends of said contactors a fixed distance away from the forward edge of said member in the various positions to which it is moved.

In testimony whereof, I hereunto affix my signature.

ROBERT I. BODENLOS.