March 27, 1951 J. B. WADE 2,546,532

TANGENTIAL ANGLE GAUGE

Filed Sept. 17, 1945 2 Sheets-Sheet 1

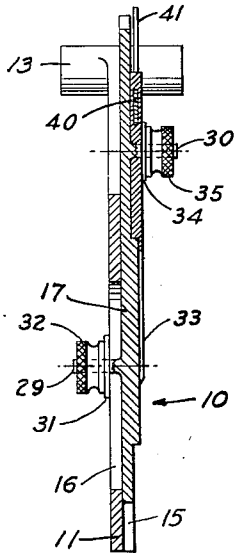

FIG. 2

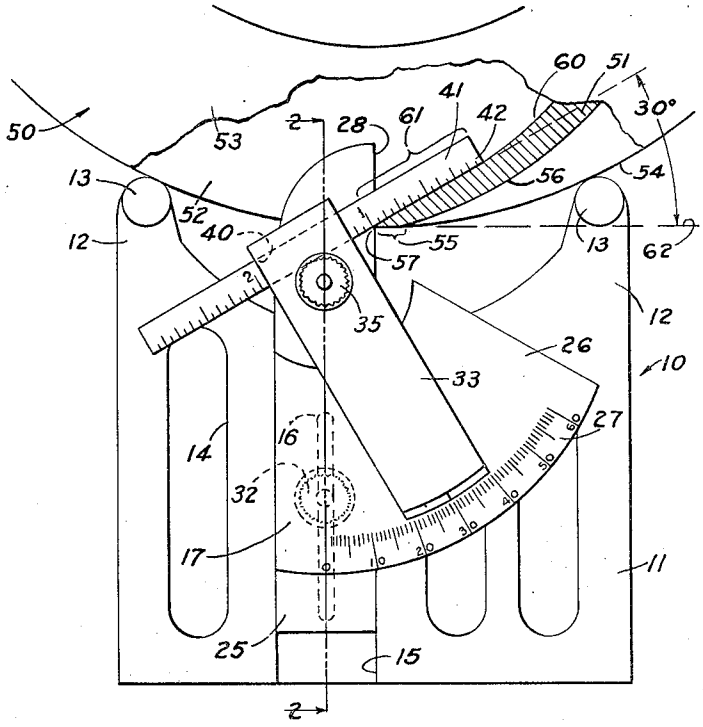

FIG. 1

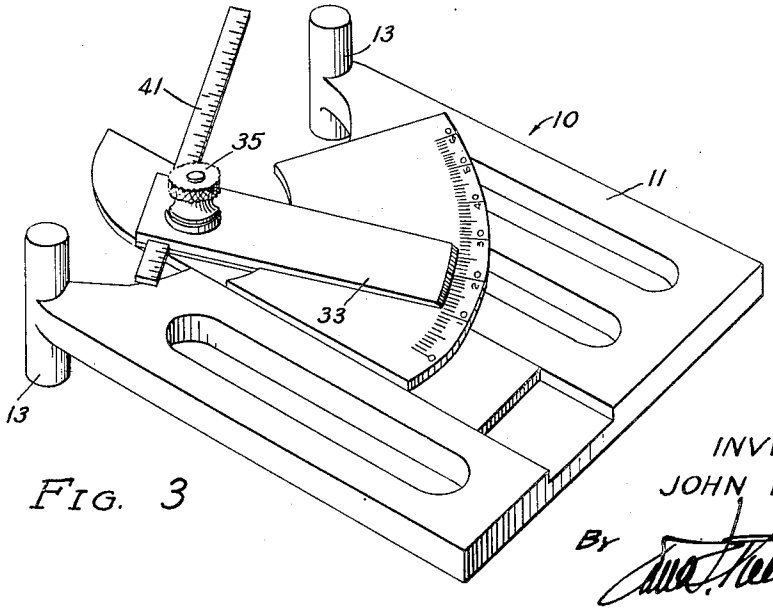

FIG. 3

INVENTOR:
JOHN B. WADE
By
ATTORNEY

March 27, 1951 J. B. WADE 2,546,532

TANGENTIAL ANGLE GAUGE

Filed Sept. 17, 1945 2 Sheets-Sheet 2

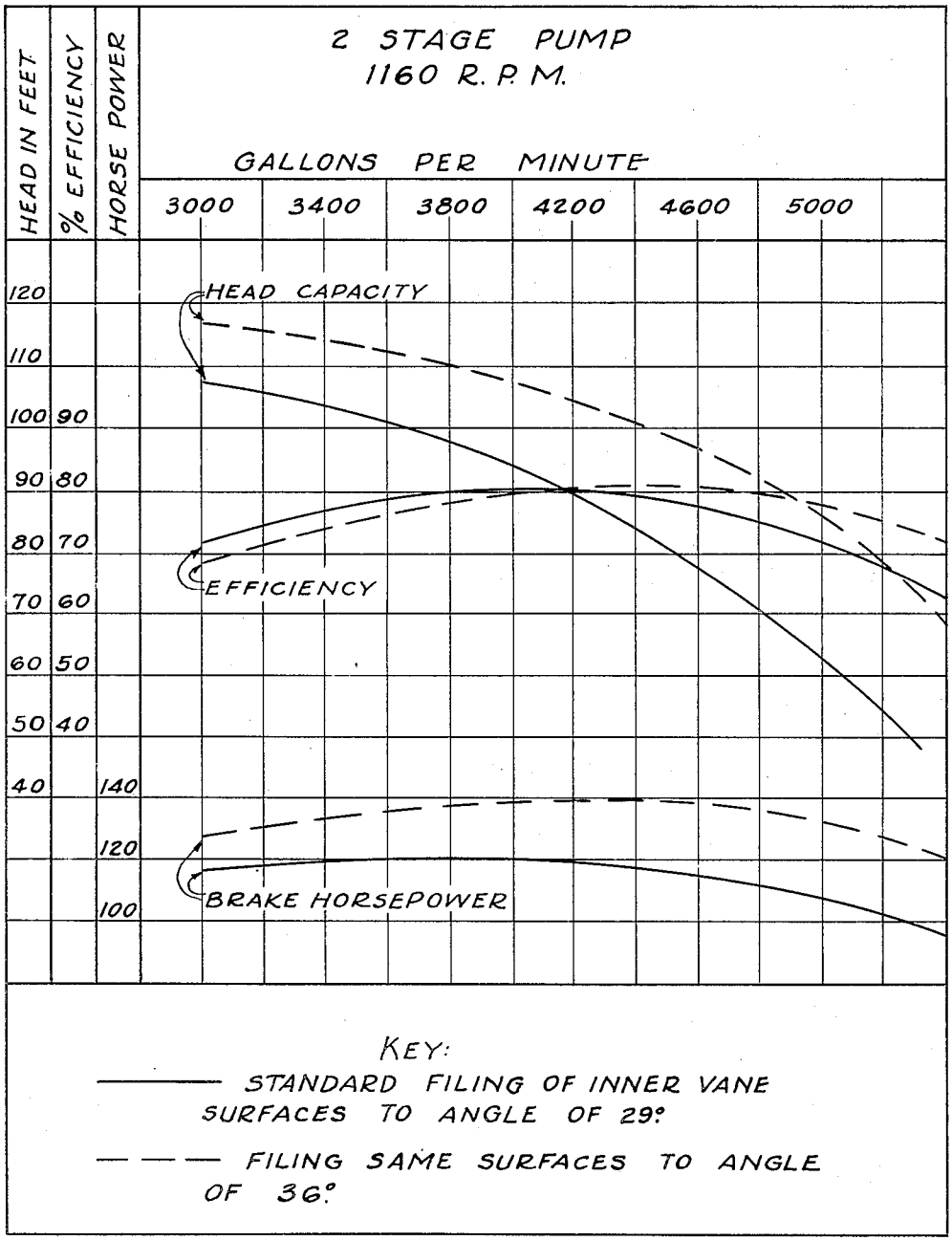

FIG. 4

INVENTOR:
JOHN B. WADE
BY
ATTORNEY

Patented Mar. 27, 1951 2,546,532

UNITED STATES PATENT OFFICE

2,546,532

TANGENTIAL ANGLE GAUGE

John B. Wade, Arcadia, Calif., assignor to Food Machinery and Chemical Corporation, a corporation of Delaware

Application September 17, 1945, Serial No. 616,738

2 Claims. (Cl. 33—75)

1

This invention relates to the art of manufacturing rotary centrifugal impeller pumps and is especially useful in determining the performance of these pumps.

The performance of a centrifugal impeller pump varies with the size of the openings between the impeller vanes. Heretofore, adjustment in the performance of a pump with an impeller of a given size has been made by filing away the inner surfaces of the outermost portions of the impeller vanes. This filing was done so as to make the width of the finished edges of the vanes, which lie in the same cylindrical surface with the periphery of the impeller, uniform in width. I have found this far from satisfactory and undependable in the results attained.

It is an object of my invention to provide a method of and apparatus for adjusting the performance of a centrifugal impeller pump which will be dependable in results and relatively easy to perform.

The method of my invention comprehends the filing of the inner surfaces of end portions of the vanes of a centrifugal impeller pump so that each of the finished surfaces thus produced is of a definite length, lies at a given angle with a tangent to the periphery of the impeller at the trailing edge of the vane, and has its inner edge flush with the unfinished vane surface. I have found that when these finished surfaces are uniformly produced by these standards, the openings between the impeller vanes are uniform. Furthermore, I have found that the performance of the pump may be predicted when these particular surfaces of the vanes are uniformly produced in this manner.

One of the problems in performing the method of my invention was to find a means of readily and accurately measuring the angles and the lengths of the finished inner surfaces of the impeller vanes to permit these to be formed uniformly on all the vanes.

It is accordingly another object of my invention to provide a gauge by which said angles and the lengths of said finished surfaces may be readily measured.

The manner of accomplishing the foregoing objects, as well as further objects and advantages, will be made manifest in the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a plan view of a preferred embodiment of the gauge of my invention illustrating the use of this in performing my method.

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1.

2

Fig. 3 is a perspective view of the gauge of my invention.

Fig. 4 is a chart graphically illustrating changes in performance characteristics produced in a pump by the method of my invention.

Referring specifically to the drawings, the gauge 10 of my invention is shown therein as including a base 11 which comprises a flat plate shaped, as shown in Fig. 1, to provide legs 12 terminating in cylindrical feet 13 which extend above and below the base 11. The base 11 may be lightened by the formation of slots 14 therein. The base also has a wide shallow channel 15 in the bottom of which is formed a slot 16. The channel 15 is formed at right angles to a plane containing the axes of the two feet 13 and provides a slideway for a protractor 17.

This protractor is formed by uniting a slide plate 25 with a degree scale plate 26, the latter having an arcuate degree scale 27 provided thereon. The slide plate 25 has a straight edge 28 which bisects the distance between the axes of the feet 13 no matter what the adjusted position of the protractor 17 on the base 11 may be. The slide plate 25 is provided with two stud screws 29 and 30, the first of which extends downwardly through the slot 16 to receive a washer 31 and nut 32 for securing the protractor 17 in a desired adjusted position in the channel 15. Pivotally mounted on the stud screw 30 is an indicator arm 33 and this arm is adapted to be secured in any particular position by a washer 34 and nut 35 on the screw 30. The arm 33 has a hole 40 extending transversely through its forward end, this hole being rectangular in shape and slideably receiving a vane engaging member 41 having a distance measuring scale 42 provided thereon.

Operation

As already stated, the principal object of the method of my invention is to provide a way of precisely determining the performance of a centrifugal impeller pump by an operation performed upon the impeller thereof.

Fig. 1 illustrates the gauge 10 of my invention associated with a pump impeller 50 as when performing the method of my invention. This impeller has a series of spirally disposed vanes 51 disposed between and cast integral with lower and upper walls 52 and 53. In manufacturing the impeller 50, the periphery 54 thereof is machined so that an area 55 of the outer surface 56 of each vane 51 is finished and lies in the same cylindrical surface as the finished periphery 54 of the impeller 50. The trailing edge 57 of the vane 51 is thus seen to lie in the cylindrical sur-

face of the periphery 54. Each vane 51 is seen to have an inner surface 60 which is entirely unfinished up to the time that the impeller 50 is processed by the method of my invention.

The method of my invention involves finishing a portion of the inner surface 60 such as the portion 61 indicated in Fig. 1 so that the finished surface 61 will be of a certain length and will lie at a certain angle with respect to a tangent 62 to the periphery 54 at the trailing edge 57.

As already implied, an impeller 50 of a given diameter and design may be given any of a wide variety of performances by the method of my invention. Furthermore, the performance of the pump incorporating this impeller may be exactly predetermined by this method. The character of the finished surfaces 61 which are necessary to produce each of a variety of performances for each impeller 50 of a given diameter and design have been worked out experimentally. To employ the process of my invention on the impeller 50 therefore, recourse is had to tables thus experimentally determined and this impeller is processed in accordance with my method so that each of the vanes 51 thereof is provided with a finished surface 61 of the necessary characteristics to produce the desired performance in the pump employing this impeller.

The surfaces 61 may be dressed by hand filing or by any of the machining methods which are suitable for this purpose. The results of this work on each vane 51 are checked by applying the gauge 10 as shown in Fig. 1. The nut 32 is loosened and the protractor 17 slid inwardly so that when applying this gauge with the feet 13 contacting the periphery 54 of the impeller 50, the member 41 will lie inside of the vane 51 and will not interfere with the straight edge 28 being brought into engagement with the trailing edge 57 of the vane 51. The screw 35 having previously been tightened so as to set the arm 33 to measure the desired angle on the scale 27, the protractor 17 is now slid outwardly until the member 41 contacts the surface 61. If it makes a line contact with this surface and the latter is of the requisite length as indicated by the distance scale 42 on the member 41, the surface 61 has been properly finished to give the desired results and the method is thereupon repeated with the other vanes 51 until surfaces 61 of the proper angle and length are provided on all of these vanes.

These surfaces 61 of course must be so formed that the inner edge of each of these surfaces is flush with the adjacent unfinished portion of the surface 60.

While the method of my invention preferably utilizes a modification in the character of the inner surfaces of the impeller vanes adjacent the trailing edges thereof for determining the performance of a pump embodying said impeller, a similar determination of performance may be accomplished by this method by precisely finishing outer surfaces of said vanes located just inwardly from and adjacent to the periphery of the impeller.

It is to be understood that in some instances the finished surfaces provided in accordance with my method on tip portions of the vanes 51 may be flat as shown in Fig. 1 or they may be slightly curved. In such cases the rule 41 may have a straight edge as shown in Figs. 1 and 3 in which case it would contact a concave curved finished inner surface on the vane 51 so as to measure the angle of the chord of this surface with a tangent drawn to the impeller at the trailing edge of said vane. Such a curved surface, of course, would have to be of a given depth and character of curvature to produce predictable results.

The gauge 10 of my invention is also adapted to have a rule, similar to the rule 41, and which is provided with convex or concave curved surfaces along one or both of the longitudinal edges thereof which are adapted to act as a template to assist in accomplishing the desired shape of the finished curved surface required to be produced on the vanes 51 in order that the impeller 50, when placed in operation, will produce the desired performance characteristics.

The chart of Fig. 4 illustrates how a pump provided by my method with certain vane surfaces lying at angles of 29° with tangents to the trailing edges of the vanes will have one set of performance characteristics as indicated by the full line graphs.

The broken line graphs plot the performance characteristics of the same pump after the vanes have been altered by my method to give these inner terminal surfaces angled 36° from trailing edge tangents.

Angles in between 29° and 36° produce performance graphs somewhere in between the broken and full line graphs of Fig. 4.

The great advantage of my method is that by it a prescription can be written for exactly the degree of alteration of the impeller needed to cause the pump with that impeller to possess the desired performance characteristics.

I claim:

1. A gauge comprising: a flat plate; a pair of legs extending therefrom; feet on the ends of said legs adapted for contacting the periphery of a circular body, there being a free space between said feet to accommodate said body when so contacted; a side slideably mounted on said plate for projecting a relatively short distance therefrom between said legs said slide providing a straight edge which is normal to and bisects a line joining corresponding points on said feet; means for setting said slide in a selected position in its sliding relation with said base plate; a protractor scale on said slide; an indicator arm pivotally mounted on said slide on the axis of said scale, said axis being disposed toward the end of said slide which is adapted to slideably project between said legs; means for retaining said indicator in any desired setting with reference to said slide in which said indicator indicates a selected angle on said scale; and a rectilinear member slideably mounted on said indicator at right angles to the latter, so that said member is adapted to be extended from said indicator across the periphery of said circular body to lie flush against a face on said body to measure, by the position of said indicator on said scale, the angle said face makes with a tangent to the periphery of said body at the point where said periphery is crossed by said straight edge.

2. A combination as in claim 1 in which said rectilinear member comprises a rule by which the length of said face may be measured at the same time the angle thereof aforesaid is measured.

JOHN B. WADE.

(References on following page)

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
50,275	Rogers	Oct. 3, 1865
185,330	Marshall	Jan. 2, 1877
199,425	Ericson	Jan. 22, 1878
798,695	Oehrle	Sept. 5, 1905
1,384,221	Wall et al.	July 12, 1921
1,516,288	Godfrey	Nov. 18, 1924
2,003,626	Bozzer	June 4, 1935
2,163,531	Wettstein	June 20, 1939
2,446,561	Streets	Aug. 10, 1948

FOREIGN PATENTS

Number	Country	Date
384,040	Germany	Mar. 27, 1923