

Once collected within the pools of the reservoirs, both logs and lumber would be floated from them, *through the reservoir dams*, at periodic seasons, by means of substantial contrivances, which any skilful engineer charged with these works will know how to plan, construct, and operate with entire success.

That the lumber will only be passed down at *stated periods*, forms no objection: since, with unobstructed streams, it is only *occasionally*, and at very *uncertain* times, that it can now be run at all.

There are *five* very important objections to the "system of locks and dams on the Ohio River," which Mr. Roberts has studiously, if not wisely, declined to meet; any one of the first four of these is fatal to the slackwater plan, and when we consider that it is proposed to carry it out under the direction of *a corporation*, the fifth is fatal too, to wit:

1. The augmentation of freshets by slack-water pools.
2. The increased obstruction from ice.
3. The damages to town and country property.
4. The expense of maintenance.
5. The tolls necessary to be charged for maintenance alone, if not for interest, and corporate profits.

And we may add that not the least of the legitimate objections to Mr. Roberts' "system of locks and dams on the Ohio River," is, that it is proposed to carry it out by means of *an incorporated body*, which is even now soliciting from the Congress of the United States, a grant of land ostensibly to effect this so-called improvement, but really using the popular name of the Ohio River to cover *a mere land speculation*.

A speculation like some of those now in progress in the north-west, based upon railroad schemes in the wilderness, the operators in which, do not hesitate to avow to each other, "*that they care nothing about the railroads, it is the Government lands they are after!*"

So it is to be apprehended, that a grant of Government lands to the Ohio River Corporation will end, not in an improvement of the Ohio River, *but in the loss of the lands to the Country.*

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*A simple method of finding the Helicoidal Surface of a Screw Propeller, and the Practical Development of such Surface upon a Plane.* By JAMES H. WARNER, Eng. Corps., U. S. N.

From a great variety of fantastic designs, the screw propeller has been so far improved that we may with propriety consider a uniform, or *true* screw, the rule, and all other forms an exception.

Griffith's screw is perhaps the only important deviation from ordinary practice that has other than an ideal existence, and his screw is made uniform for a given pitch, whilst the blades are movable to a certain extent in order to increase or diminish the pitch. But this form is limited to cases where the screw can be easily dismounted by hoisting it out of position, a system of arrangement almost exclusively confined to auxiliary steam vessels for naval service.

Aside from the importance of ascertaining the best form and dimension, there are other points connected with the design and construction of a screw, which claim the attention of the mechanical engineer, and the object of this paper is to furnish a simple suggestion with reference to the helical surface of a screw, and the development of such surface upon a plane.

The operation here described is but an adaptation of the centrobaric principle, or the "Guldinus" properties of bodies, as stated in the following proposition :

"If any straight or curved line, or plane surface bounded by curved lines, revolve about an axis situated in the same plane with the lines or surfaces, the surface or solid thus generated will be respectively equal to a surface or solid whose base is equal to the given line or surface, and whose height is equal to the arc described by the centre of quantity of the generating line or surface."

Let  $BD$ , fig. 2, Plate III, be a circle, of which  $BE$  is the radius. Now, then, if the line  $BE$  revolve about the point  $E$ , the extremity will describe the circumference whilst the line itself will describe the area of the circle. From the principles of mechanics, we know the centre of gravity of a straight line lies in its centre ; then bisecting the line  $BE$  gives the point  $a$ , which with the radius  $aE$  describes the circumference  $ab$ . Hence from the above proposition, the area of this circle is equal to a rectangle of which the line  $BE$  is the base, and the circumference  $ab$  the height; or in other words, the area of a circle is equal to the product of the radius  $BE$ , into the distance traversed by its centre of gravity.

Applying this to the screw, let  $BD$  be the circumference, and  $BE$  the radius, which, in this connexion, may be called the *generatrix*; whilst the point  $B$  describes the circumference, the line  $BE$  moves in the direction of its axis a distance equal to the pitch, generating a twisted or helical instead of a plane surface, and the development of the path traced by the point  $B$  is the hypotenuse of a right angled triangle (fig. 2), of which the circumference  $BD$  is the base, and the pitch  $AB$  the perpendicular. In like manner the helical path of the point  $a$  is the hypotenuse of a similar triangle of which the circumference  $ab$  is the base, and the pitch a perpendicular, whence the area of one thread for one convolution is equal to a rectangle, the base of which is the radius, and whose height is equal to the hypotenuse  $AI$ . That is to say, multiply the radius of the screw by the development of its centre of gravity or the hypotenuse  $AI$ , for the whole of the area thread, and this product again multiplied by the mean fraction of pitch used gives the area of such fractional part. This product includes the whole surface from axis to periphery, consequently, to obtain the effective area that portion within the hub must be deducted. Referring to fig. 2,

$AB$  = Pitch of screw.

$BD$  = Circumference of do.

$AD$  = Development of exterior helix.

$AC$  = " " of hub.

$AI$  = Helical path of centre of gravity of radius of screw.

$A2$  = " " " hub.

$R$  = Radius of screw.  $R'$  = Radius of hub.

$F$  = Mean fraction of pitch.

$$\text{Then } \sqrt{A B^2 + B I^2} = A I.$$

$$\text{and } \sqrt{A B^2 + B 2^2} = A 2.$$

Whence

$$(R \times A I) - (R^1 \times A 2) = \text{area of thread for one convolution.}$$

or

$$(R \times A I) - (R^1 \times A 2) \times F = \text{effective area for any fractional part.}$$

Applying to this the screw of the U. S. Steam Frigate, "*Minnesota*," having the following dimensions:—

Diameter,	.	.	17 feet 4 inches.
Pitch,	.	.	23 "
Length,	.	.	3 " 6 "
Diameter of hub,	.	.	2 " (mean.)
Number of blades,	.	.	2

We have,

$$A B = 23 \text{ feet.}$$

$$B 2 = 3.1416 \text{ feet.}$$

$$B D = 54.44 "$$

$$B C = 6.283 "$$

$$A D = 59.09 "$$

$$B I = 27.22 "$$

$$A C = 23.84 "$$

$$R = 8.66 "$$

$$R^1 = 1 \text{ foot.}$$

$$F = \frac{3.5}{2.3} \times 2 = .3042$$

$$A I = \sqrt{23^2 + 27.22^2} = 35.64.$$

$$A 2 = \sqrt{23^2 + 3.1416^2} = 22.2.$$

Whence,

$$(8.66 \times 35.64) - (1 \times 22.2) = 286.6 \text{ square feet area for one full thread.}$$

or

$$(8.66 \times 35.64) - (1 \times 22.2) \times .3042 = 87.188 \text{ sq. feet area of two blades.}$$

This operation admits of similar application when the pitch expands radially or in the direction of its axis, and with either an *oblique* or *curved* generatrix.

The development of one blade of the screw cited in the preceding example is shown in fig. 3. The angle of this blade at periphery is  $22^\circ 54' 10''$ , increasing gradually from thence to the axis or  $90^\circ$ , at the hub it is  $74^\circ 43' 14''$ .

If a cylinder be cut at any other than a right angle with its axis, the section will present an elliptic or rather an oval figure, consequently, if we observe the exterior helix of a screw from a point perpendicular to its direction, the curve of the extremity of the blade will be similar to that of the transverse side of a cylindrical section cut at a corresponding angle, and the same would result for any other point, lying in a line perpendicular to the axis passing through the centre of the blade, the curve changing with the angle.

The diameter of this screw is 17.33 feet, and the angle at periphery,  $22^\circ 54' 10''$ ; hence, to obtain a curve of the blade at this point, we have simply to describe that of a cylindrical section cut at this angle, of which the perpendicular line through the centre of the blade, or the radius, is the minor axis, and the diagonal cutting the sides of the cylinder the major axis.

The radius is 8 feet 8 inches, which I have divided into 8 spaces of 1 foot each, and one of 8 inches, and have drawn the curved helices, 1, 2, 3, 4, 5, &c., corresponding to the sections of cylinders, 2, 4, 6, 8, 10, &c., feet diameter.

The length of the helices were calculated by the formula,

$$\sqrt{2\pi r^2 + \text{Pitch}^2} \times \frac{\text{length}}{\text{pitch}}.$$

These lengths measured upon the curves give the points 1, 2, 3, 4, 5, &c., through which the line is traced, indicating the shape of the developed blade. The horizontal dotted lines represent the respective semi-major axes and the vertical dotted lines the radii or semi-minor axes.

I have arranged the calculations from which the diagram was drawn in the following tabular form, and which, with the exception of column G, requires no further explanation.

Diam-eter.	Circum-ference.	Hypothe-nuse.	Angles.	Semi-axis (major.)	Semi-axis (minor.)	Radius of curve.	Helix.
A	B	C	D	E	F	G	H
	$A \times 3.1416$	$\sqrt{B^2 + 23^2}$	$\frac{B}{23} = \tan.$	$\frac{\text{Sec. D} \times B}{2}$	$\frac{A}{2}$		$C \times .1521$
feet.	feet.	feet.		feet.	feet.	feet.	feet.
2	6.283	23.84	74° 43' 14"	3.80	1	13.514	3.626
4	12.56	26.20	61° 21' 39"	4.17	2	8.854	4.000
6	18.84	29.74	50° 40' 38"	4.73	3	8.125	4.524
8	25.13	33.66	42° 27' 53"	5.42	4	7.375	5.119
10	31.41	38.48	36° 12' 46"	6.20	5	7.604	5.853
12	37.69	44.15	31° 23' 12"	7.02	6	8.166	6.715
14	43.98	49.63	27° 36' 26"	7.90	7	8.958	7.548
16	50.26	50.26	24° 35' 21"	8.74	8	9.625	8.406
17.33	54.44	59.09	22° 54' 10"	9.36	8.66	10.187	9.000

The radii of the curved helices were obtained by means of a subsidiary diagram similar to fig. 4., as follows:—Draw two lines  $jo$ ,  $jn$ , at any convenient angle, make  $jk$  and  $jm$  respectively equal to the semi-axis, then with the distance  $jk$  and  $jm$ , cut  $jn$  in  $l$  and  $n$ ; join  $l$  and  $m$ , and from the point  $n$  draw  $no$  parallel to  $lm$ , the distance  $jo$  will be the radius of a circular arc which will nearly coincide with an elliptic curve to a greater extent than the helix of the blade of an ordinary screw. This radius may be otherwise and perhaps more conveniently obtained, as follows:—join the extremity of the two axes by the diagonal  $af$ , fig. 3, upon which, from the point  $b$  of the rectangle  $abfc$ , let fall a perpendicular  $bh$  extended so as to intersect the vertical line  $ac$ , gives the point from which the curve is drawn.

Fig. 5, is simply a *working sketch* showing thickness of metal &c., and from which it is apparent that lines traced through the extremities of helices measured upon straight lines do not approximate to the true shape of the blade.

