Jan. 25, 1944. O. RINGNEL 2,340,080

SKI CONSTRUCTION

Filed June 21, 1941 2 Sheets-Sheet 1

Fig. 1.

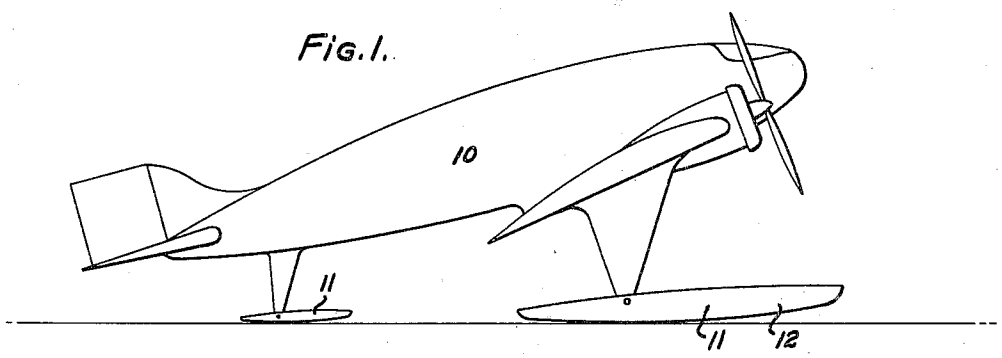


Fig. 2.

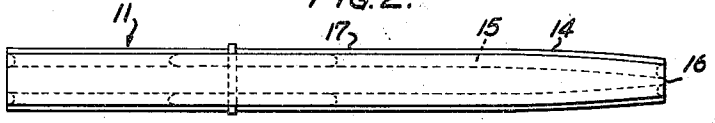


Fig. 3.

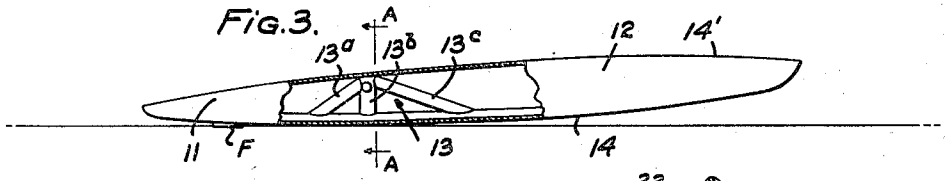


Fig. 4.

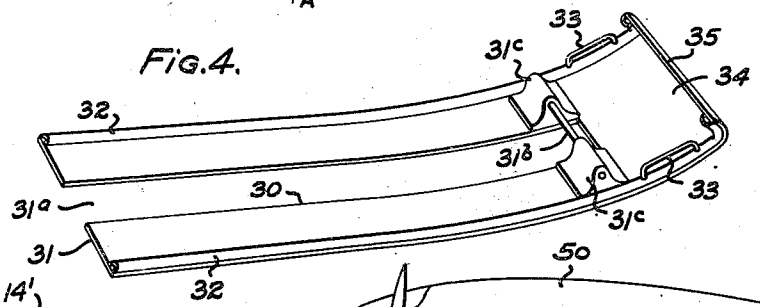
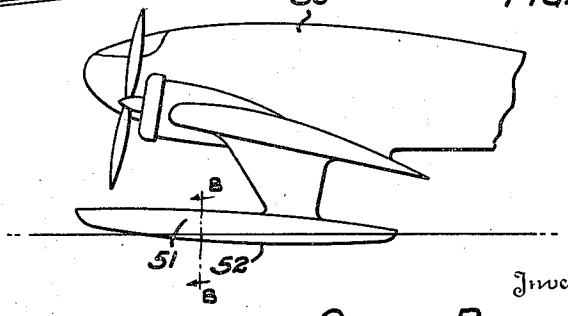


Fig. 5.



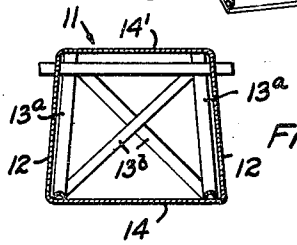


Fig. 3a.

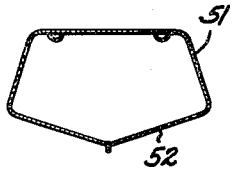


Fig. 5a.

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SKI CONSTRUCTION

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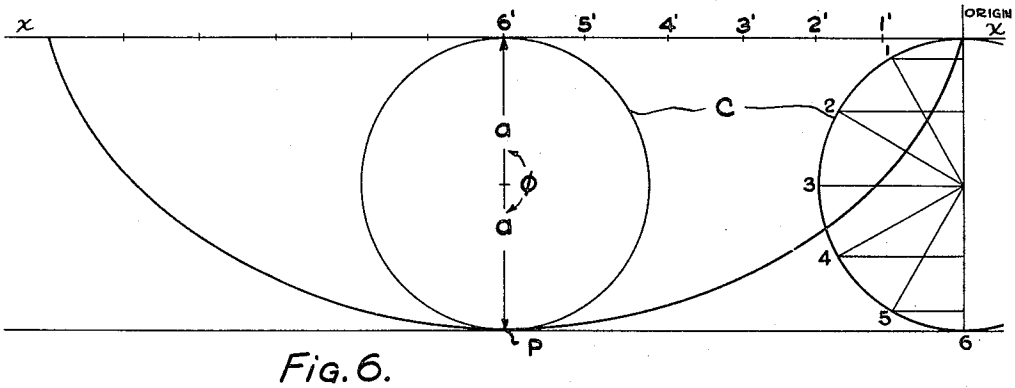


Fig. 6.

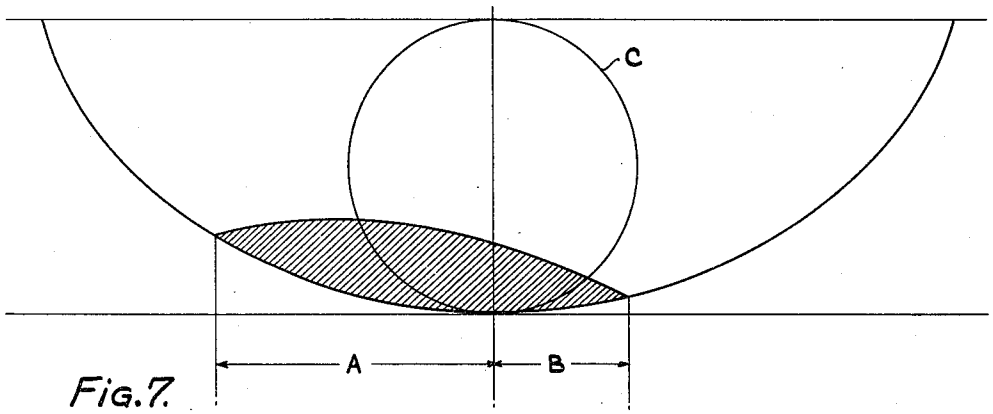


Fig. 7.

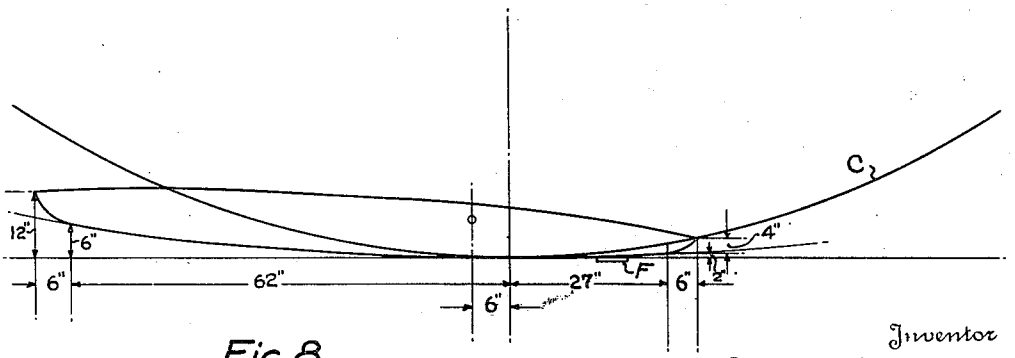


Fig. 8.

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UNITED STATES PATENT OFFICE

2,340,080

SKI CONSTRUCTION

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Application June 21, 1941, Serial No. 399,173

8 Claims. (Cl. 244—108)

This invention relates to devices adapted to dynamically contact a fluid or surface such as snow or both during an interval including contact with snow or a liquid in a first phase and a gas in a second phase.

More particularly, the invention relates to the bottom surface construction of skis and it is intended for the purpose of this specification that the term "ski" be generic to airplane runners, sled runners, the bottom of toboggans, airplane pontoons, hydroplane pontoons and pontoons generally adapted to be involved dynamically with a liquid surface.

Prior to the instant invention, airplanes, sleds, toboggans, seaplanes and the like have been equipped with skis, the bottom surfaces of which have been more or less flat for contact with a surface such as snow or water, the forward portion of said skis being generally turned up at the front to facilitate steering or landing. These prior constructions, however, have not involved any coordinated relation of the axially spaced surface portions of the bottom of the ski whereby the efficiency of same in its dynamic phase will be materially enhanced. In other words, the prior art skis were simply designed to effect surface contact along the main body of the bottom portion of the ski and for facilitating either "landing" or steering by the provision of an upturned portion at the front.

In accordance with the instant invention, it is proposed to use a curve for the outer surface of skis which is a "brachystochrone" or "brachystochronic" in nature. Such a curve may be defined by the following inherent property thus: a "brachystochrone" or a curve that is "brachystochronic" in nature passes through a beginning and end point and has a locus along which a dense particle travels the fastest; i. e., if the end point is lower than the beginning point, a body following along such curve will arrive sooner at the end point than by following any other curve or straight line. Further, in accordance with the instant invention, it is proposed that the curve of the skis take the form of a cycloid, this curve when applied to skis being a "brachystochrone" or "brachystochronic" in nature. Accordingly, skis in accordance with the instant invention, will force the snow or other particles in which they glide to take the quickest and easiest path and as a consequence there will be a minimum of "ploughing" such as will detract from the efficiency of the sliding movement of the ski and applicant has found that he can double his pay load by changing from conventional skis to skis which are "brachystochronic" in nature. As will be more apparent from the remainder of this specification and the drawings, the particles which are forced down by the ski travel in accordance with the law of simple harmonic motion with a characteristic slow start developing into rapid motion and then gradually diminishing in speed until the particles come to rest.

It is an object of the instant invention to provide a ski having a bottom surface of a contour whereby the various portions thereof along the longitudinal axis of same will be coordinated in a manner to increase the efficiency of the ski in its dynamic phase.

It is a further object of the instant invention to provide a relatively simple ski having a bottom surface contour of a high efficiency while the ski is in its dynamic phase and which ski construction retains a conventionally upturned forward portion and a generally centrally located portion adapted to contact the surface upon which the ski is riding.

It is still a further object of the instant invention to provide a ski having a specially designed bottom contour of critically high efficiency, both in a first dynamic phase when in contact with snow or a liquid surface, and in a second dynamic phase when moving through a gas, said contour being capable of effecting additional "lift" in said first dynamic phase, so as to obtain maximum "lift" reaction from pushing down on the medium involved in said first phase.

Other objects and the nature and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side elevational view of an airplane equipped with skis in accordance with the instant invention;

Fig. 2 is a top view of a ski in accordance with the invention;

Fig. 3 is a side elevation of the ski shown in Fig. 2;

Fig. 3*a* is a transverse section taken along line A—A of Fig. 3 and looking in the direction of the arrows;

Fig. 4 is a view in perspective of a toboggan in accordance with the invention; and,

Fig. 5 is a fragmentary view of an elevation of an airplane equipped with a floating ski of the pontoon type. Fig. 5*a* is a transverse section taken along the line B—B of Fig. 5, and looking in the direction of the arrows;

Fig. 6 shows a cycloid or "brachystocchrone" of

the character to be adapted to the surface of a ski and schematically illustrating the movement of a particle on the surface thereof in accordance with the law of simple harmonic motion;

Fig. 7 is a schematic lay-out of the surface of a ski in accordance with the invention; and,

Fig. 8 is similar to Fig. 7, but more specific as to dimensions.

Referring to Figs. 1, 2 and 3, the airplane 10 is provided with skis 11 having an outer covering 12 and an inner frame structure 13 comprising angularly disposed tubes. Each ski 11 comprises a specially curved base sheet 14 reinforced at the sides by a pair of split tubes 15 running longitudinally of the base and adjacent the side edges thereof. The split tubes may be spot welded to the base 14. The front 16 of the base 14 may be of less width than the central portion 17 and the split tubes 15 may follow the inwardly curving contour of the sides of the base 14 adjacent the front end 16 of the ski 11. The inner frame structure 13 formed by the tubes involves a pair of triangular braced truss-like formations, each of which may be welded at their base to the upper side of one of the split tubes 15 and at their apex to the horizontal cross bar 18. Each of the triangular truss-like formations may comprise the tubes 13*a* and 13*c* as best shown in Fig. 3. These truss-like formations are braced by tubes 13*b* as shown in Fig. 3*a*. The connections between the various tubes and split tubes of the ski inner frame structure and reinforcing members for the base sheet of the ski may be formed by welding or in any other suitable manner. A top or outer surface 14' of the outer covering 12 may also be formed of sheet metal or other suitable material and the top curve may be substantially the same as the bottom curve, differing only at the front and rear portions as will later be described. A fin F to prevent skidding may be secured to the bottom of the ski structure as shown in Fig. 3.

The toboggan 30 illustrated in Fig. 4 comprises a base sheet 31 and a pair of split tubes 32 adjacent the side edges of the base sheet 31 and extending generally longitudinally thereof. A pair of handles 33 may extend upwardly from the upper sides of the split tubes 32 adjacent the forward portion 34 of the toboggan 30. The said forward portion includes a nose 35 of generally U-section though the surface contour of the lower portion of the base sheet 31 is a curve of the same "mathematical family" as the curve of the base sheet 14 of the ski 11. The base sheet 31 may be formed with a longitudinally extending opening 31*a* to provide for a motorized caterpillar tread extending therethrough which may be associated with a rotor mounted on shaft 31*b* journaled in bearing supports 31*c* secured to the base 31. The curvature of the bottom of the toboggan acts to tend to lift the toboggan load over the snow while the weight of the caterpillar mechanism acts to retain "friction-push" contact with the snow.

Referring to Fig. 5, the airplane 50 is provided with a floating ski 51 of the pontoon type, the bottom surface 52 of which is of the same "mathematical family" as the contour of the bottom surfaces of the base sheets 14 and 31 respectively.

The skis 11, 30 and 51 have bottom surfaces and skis 11 and 51 have top surfaces of the same "mathematical family" which have been found to have exceptionally high dynamic efficiency in or on the fluid or snow phase for which they were designed and they have been found to have particularly high efficiency when specially designed for a succession of phases such as from snow to a gaseous phase. The surfaces are formed by a curve of the following expression or mathematical formula expressed in parametric form:

$$x \text{ equals } a\,(\phi - \sin\phi)$$
$$y \text{ equals } a\,(1 - \cos\phi)$$

where a equals the radius of the generating circle and ϕ equals the angle formed by the radii passing through the point of contact P of the generating circle C (see Fig. 6) which rolls along the line X—X (without slipping) and vertically through the line X—X.

The curve generated, Fig. 6, by the circle C is a cycloid and in accordance with the instant invention is used for the bottom surfaces of the skis or pontoons or toboggans and the top surfaces of the skis and pontoons referred to. As a curved surface of this nature is passed over or through a medium such as snow or liquid or gas, an ideal efficiency of dynamic contact is effected because the particles through which or over which the ski is passed are displaced in a manner such that the said particles tend to move in accordance with the laws of simple harmonic motion. At the right of Fig. 6, the generating circle is divided into equal angles corresponding to equal intervals of time. The projections of the radii forming the angles on the vertical are depicted to illustrate that the distances from the line X—X to the point where the said radii cut the vertical do not change at a constant rate but rather increase slowly at the beginning to a maximum rate and then gradually decrease. This gradual increase and decrease of the projections correspond to the curvature of the cycloid so that if the cycloid were moved through a displaceable medium at a constant rate (corresponding to the constant rate of turning of the generating circle), then the particles of the displaceable medium would move with simple harmonic motion.

For practical purposes, the top curve of the skis in accordance with the instant invention may be similar to the bottom curve as depicted in Fig. 7 wherein the cross hatched portion schematically depicts a ski in accordance with the instant invention.

It has been found in practice, that airplane skis adapted to be used in snow may take the form illustrated in Fig. 8 wherein the majority of the ski measured from the forward end corresponds to that portion of the cycloid which is on one side of its axis of symmetry with the remaining or lesser portion of the ski extending on the opposite side of the axis of symmetry. In Fig. 7 the distance from the forward part of the ski to the axis of symmetry has been denoted by the reference letter A and the distance from the axis of symmetry to the rear portion of the ski has been denoted by the reference letter B. In Fig. 8, the ratio of A to B is as 62'' is to 27'' when the total length of the ski is 101''. As a practical matter, in order to facilitate steering and general handling of the plane, the tips of the ski may depart from a true cycloid and may be spiral shaped or the curvature of the bottom sides of the tips may be defined as "cycloidal" in nature with the radius of the generating circle decreasing in accordance with the logarithmic decrament as shown in the drawings. In Fig. 8, the length of the tips which depart from the true cycloid are approximately 6''. It is to be understood that the ratio of A to B given in Fig. 8 is merely illus-

trative and the invention is not to be limited to this ratio as other ratios may be used depending upon the characteristics desired and the medium over or in which the skis are to be used and the characteristics of the body or vehicle associated with the skis. The fin in Fig. 8 may be ½" in height and about 6" long. This fin is located about 14" from the rear end of the ski, and is knife-like in section. It functions in a similar manner to the small fin conventionally found on the bottom of power racing boats.

Wherever curvature is generated either by rolling a wheel on a fixed line, or circle, or by unwinding from a fixed center a thread into a tangent line, the ratio of length-speed to (spin) rolling-rate (in 2 pi r's or degrees thereof) is of extreme importance if nuclear-spin-rate to speed-of-light c is fixed because this creates what is called existence of rate-form of energy called mass, atom or molecule. Further no molecule exists without its field (c^3) and no field exists without its center (of whorl-rate) and a field is an energy frequency.

It will be obvious to those skilled in the art that various changes may be made in this device without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. A ski having a lower profile formed substantially in accordance with the following formula expressed in parametric terms:

$$x \text{ equals } a\ (\phi - \sin\phi)$$
$$y \text{ equals } a\ (1 - \cos\phi)$$

2. The structure recited in claim 1, the profile of the upper surface of said ski being substantially the same as the lower surface but inverted.

3. A ski having a profile of cycloidal nature with the forward portion of said ski formed in accordance with that portion of a cycloid which extends on one side of the axis of symmetry of such cycloid and the rear portion of said ski formed in accordance with that portion of the cycloid which extends on the opposite side of said axis of symmetry, the forward portion of said ski being continuous with said rear portion and with the forward portion being longer than the rear portion.

4. A ski formed with upper and lower cycloidal profiles, the lower profile at the ends thereof being formed in the shape of a spiral tangent to the cycloid of the lower surface, the ratio of the axial dimension of the spiral shaped ends to the axial dimension of the ski being approximately as 6 is to 101.

5. A ski having upper and lower profiles of cycloidal and inverted cycloidal characteristics, the forward portion of said ski extending to a greater dimension from the axis of symmetry of the cycloid forming the profiles than the dimension from the axis of symmetry to the rearmost portion of said ski, the lower profile of said ski being formed with spirals at the ends which are tangent to the cycloid forming the major portion of the lower profile of said ski.

6. A ski having upper and lower profiles of cycloidal and inverted cycloidal characteristics, the forward portion of said ski extending to a greater dimension from the axis of symmetry of the cycloid forming the profiles than the dimension from the axis of symmetry to the rearmost portion of said ski, the lower profile of said ski being formed with spirals at the ends which are tangent to the cycloid forming the major portion of the lower profile of said ski, the ratio of the axial dimension of the forward portion to the axial dimension of the rear portion being approximately as 62 is to 27.

7. A ski in accordance with claim 3, the ratio of the axial dimension of the forward portion to the axial dimension of the rear portion being approximately as 62 is to 27.

8. A ski having a lower profile and an upper profile each of which has a major portion in the form of a brachystochrone as defined by the specification, whereby when the ski is moved through a displaceable medium the particles of said medium will be forced aside and caused to move substantially in accordance with simple, harmonic motion.

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