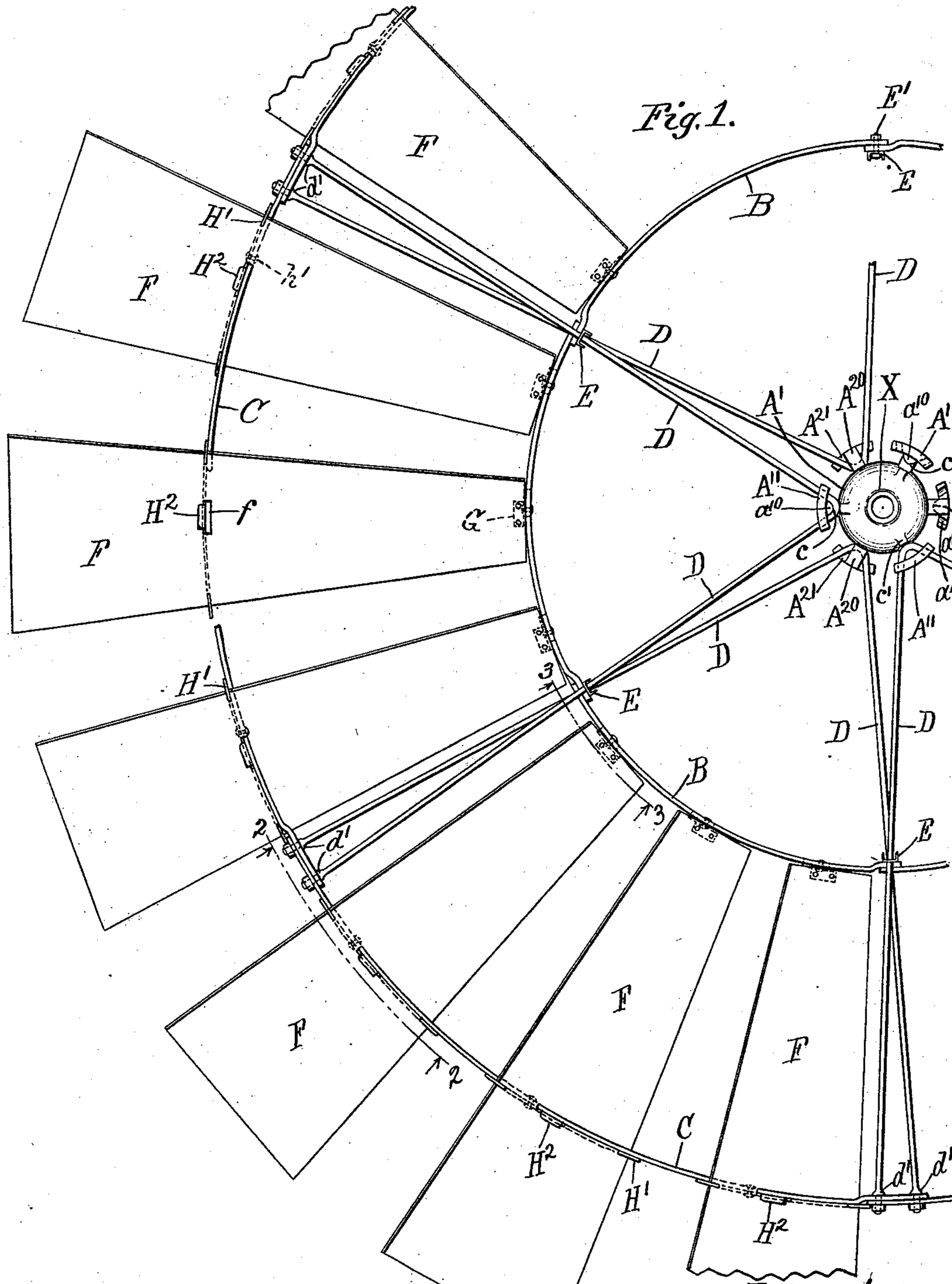
(No Model.) 2 Sheets—Sheet 1.

LA VERNE W. NOYES.

WIND WHEEL.

No. 523,842. Patented July 31, 1894.

Fig. 1.



Witnesses:
E. T. Wray.
Jno. Elliott.

Inventor.
LaVerne W. Noyes
by Burton and Burton
his attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 6.

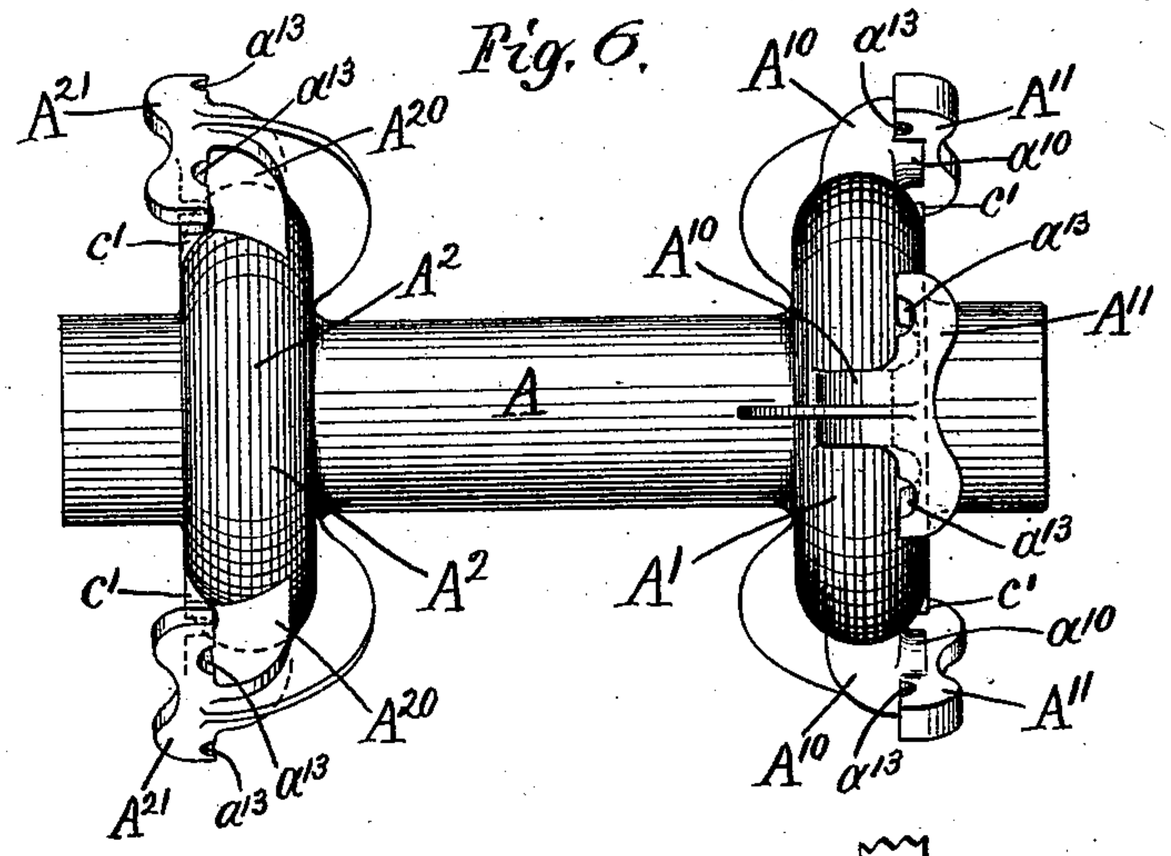


Fig. 7.

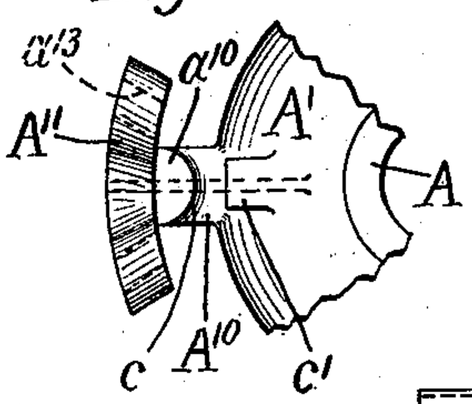


Fig. 3.

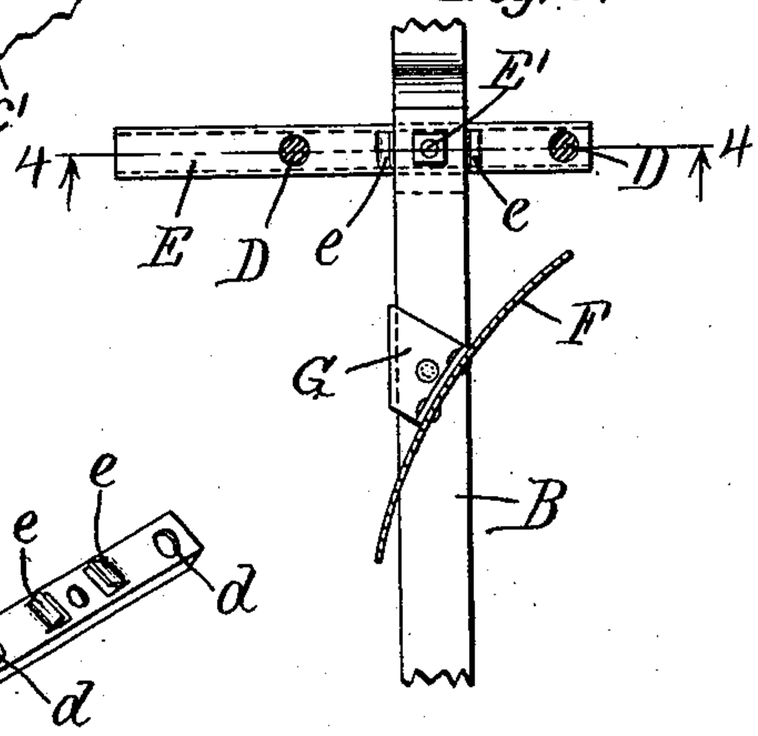


Fig. 2.

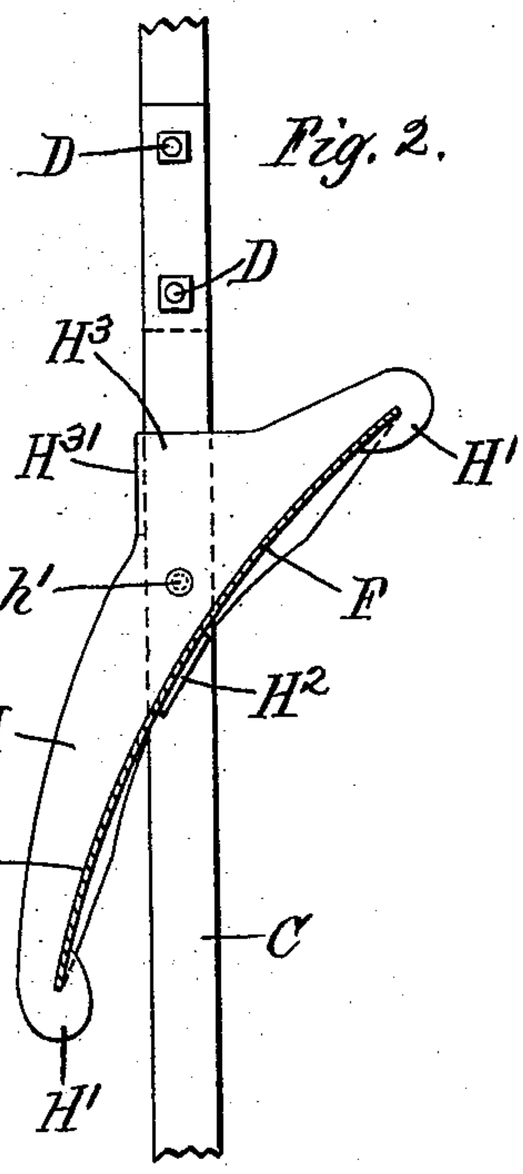


Fig. 5.

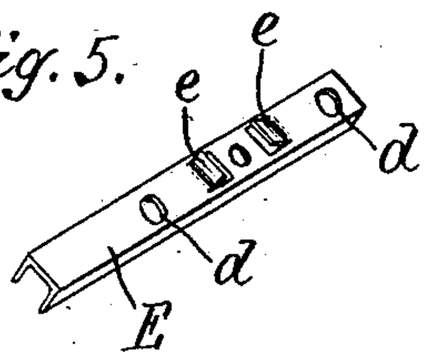


Fig. 8.

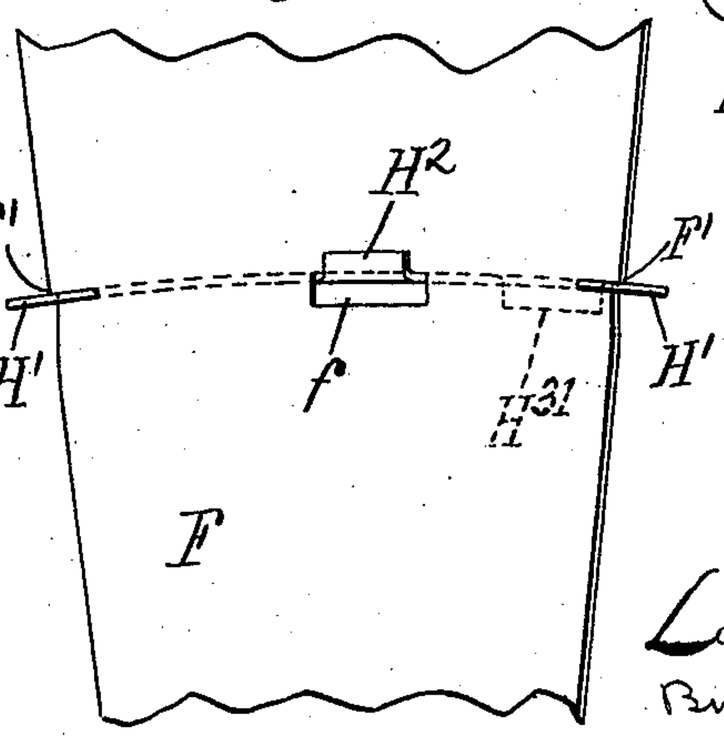
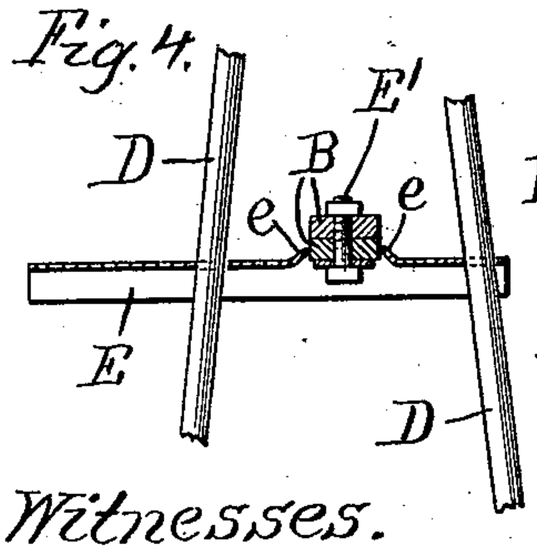


Fig. 4.



Witnesses.
E. T. Wray.
Jean Elliott.

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By Burton & Burton
Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LA VERNE W. NOYES, OF CHICAGO, ILLINOIS.

WIND-WHEEL.

SPECIFICATION forming part of Letters Patent No. 523,842, dated July 31, 1894.

Application filed October 31, 1893. Serial No. 489,669. (No model.)

To all whom it may concern:

Be it known that I, LA VERNE W. NOYES, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Wind-Wheels, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide a wind-wheel of superior rigidity and lightness. It consists in features and details of construction which are set forth in the claims.

Figure 1 is a face view of a portion of the wind-wheel embodying my invention. Fig. 2 is a detail section looking toward the center at the curved line 2—2 on Fig. 1. Fig. 3 is a detail section at the curved line 3—3 on Fig. 1, looking toward the center. Fig. 4 is a sectional detail at the line 4—4 on Fig. 3. Fig. 5 is a perspective of a cross-bar which connects the tangent spokes at the inner supporting ring or band. Fig. 6 is a side elevation of the hub of the wheel. Fig. 7 is a detail face elevation of one of the spoke-holding lugs on the hub. Fig. 8 is a detail elevation of part of one sail of slightly modified form.

The general character of the wheel to which my invention is applied is what is known as a "solid" wheel, or one in which the vanes or sails are fixed in position relatively to the plane of the wheel. More specifically, it is a wheel in which the sails are secured to two rings or bands, which are themselves held concentric in relation to the hub and shaft by spokes which rigidly connect the hub and the outer of said rings, the inner ring being held in concentric position by the co-operation of the spokes and the sails.

Two features of improvement are involved in the present invention. The first relates to the form of the spokes and their relation to each other and to the hub and bands. The second relates to the devices for securing the sails to the framework, and specifically, to the rings or bands mentioned, and for rendering the sails rigid in the transverse form which may be given them to render them most effective in gathering the force of the wind.

A is the hub of the wheel. B, the inner ring or band. C, the outer ring or band. The hub has two flanges or disk-like portions A' A^2, separated some distance along the axis of the hub to afford means for attaching the spokes in two sets or series widely spread at the base of a triangle whose apex is at the outer ring or band for the purpose of rendering the wheel as rigid as possible in resistance to the wind blowing through it. Each of the flanges or disks A' A^2 has a plurality of radially projecting lugs for the purpose of attaching the spokes, hereinafter described. As illustrated, each flange is provided with three of these spoke-holding lugs, the lugs A^{10} A^{10} A^{10} on the flange A' being similar in form to the lugs A^{20} A^{20} upon the flange A^2, and alternating with them in circumferential position, as seen in Fig. 1, wherein the six lugs appear projected upon one circle in the view, the lugs A^{10} and A^{20} alternating at equal intervals throughout the circle.

D D D D, &c., are spokes which are formed in pairs, the two members of each pair being of one piece of wire or rod bent at the middle point, and the two branches spread as seen in Fig. 1. These bent rods are hooked onto the T-shaped lugs A^{10} A^{20} in the manner illustrated, so that the bend engages around the stem or post a^{10} a^{20} of the lug, the two branches extending out non-radially with respect to the wheel behind or under the branches a^{11} a^{21} of the cross of the T, the form of both the stem and cross being made to afford snug seats for the rod in its course, that is, the stem being curved to fit the curve of the bend in the rod, as seen at c, and a shoulder c' being formed at the base of the stem to hold the bend of the rod close up to the stem, and the arms of the cross having concave seats a^{13} a^{13} on the inner side, as seen in Fig. 5. The form of the lugs having the stem projecting radially from the periphery of the body of the hub and the cross on the end of the stem, adapts the hub with such lug to be cast in a simple manner without cores for the purpose of forming the lug; and the construction which provides the seat for the bend of the rod on the outer side of the stem, so that the two branches extending from the bend make a return to pass behind the cross-bar of the

T, makes the lodgment of the double spoke of the lug very secure.

The proximate arms of the pairs of spokes which are consecutive in the circumference of the wheel,—counting those at both ends of the hub in one series or circle,—diverge oppositely and equally from true radial direction, and converging toward a radial plane midway between them, pass each other, and in face view of the wheel appear to intersect at such radial plane. But the spokes lean toward each other from the opposite ends of the hub, and their outer ends are located in the same circle; at the point of apparent intersection, therefore, they are separated from each other,—measuring along a line parallel with the axis,—a distance proportionate to the distance of that point from the center of the wheel. The ends are all secured to the outer band or ring C, and the inner band or ring B is located at the circle containing the points of apparent intersection of the proximate spokes. As stated, the outer ends, being all in one circle, all penetrate and are directly secured at the outer ring C. The inner ring B stands between the two sets of spokes which lean toward each other from the opposite ends of the hub, as stated, and at the points where the adjacent spokes pass, and in face view seem to intersect, there are secured to this inner band or ring, cross-bars E E E E, &c., through which, on opposite sides of the band B, the spokes of the two sets are inserted at *d d*.

As a matter of convenience in construction, both the rings B and C are made in several pieces or arcs which lap and are secured together at their proximate ends; and it is convenient to make the points of lapping also the points at which the cross-bars E are secured and the spokes pass, and in the drawings the structure is so illustrated; but this is not material to the present invention, except that the same bolt E′, which secures the cross-bar E serves also to secure together the lapping ends of the portions of the inner band B, and that the ends of the spokes themselves, being shouldered at *d′*, and threaded beyond the shoulder, serve the purpose of bolts to secure the lapping ends of the several sections of the outer band C. For the purpose of rendering the cross-bar E rigid in their cross-wise position with respect to the plane of the wheel, and specifically, with respect to the inner ring or band B, it is provided with projections *e e* from the face which abuts against the band B, such projections constituting shoulders upon opposite sides of said band between which the latter is embraced snugly. The cross-bar being then riveted to the band between these shoulders is prevented from turning from its cross-wise position except under strain sufficient to crush or distort the shoulders. Preferably, as being the lightest construction consistent with necessary stiffness, these cross-bars are made of channel-iron, and the shoulders *e e* are made by striking up the metal from the web of the channel-bar which is severed on three sides of the tongue thus formed, as seen distinctly in Fig. 5.

By means of this construction, the framework of the wheel comprising the hub, spokes and bands, is made very rigid proportionately to its weight, with very few fastenings by rivets or bolts, the spokes being secured to the hub without any devices of that nature, and the spokes serving to unite the different sections of the outer bands in lieu of additional bolts.

The wheel is rendered very stiff as to pressure against its face or in the direction of the axis, because of the wide spread at the hub of the spokes which converge to the same midway plane at the outer band; and by reason of the spreading of each pair of spokes which are formed in one piece to cause each spoke to diverge from true radial direction, the spokes all become what are commonly known as "tangent" spokes, half being tangent in one direction and half in the other direction to the small circle X on Fig. 1 with the usual advantage of tangent spoke construction.

The other feature of improvement in this wheel relates to the sail or vane and its mode of attachment to the framework.

F F F are the sails which are made of sheet metal, tapered longitudinally and curved transversely, as seen in Figs. 1 and 2, respectively. These sails are set at an angle to the plane of the bands, as seen clearly in Fig. 2, and have the aperture *f*, through which the band C passes. The inner narrower end is secured to the band B by a small angle clip G, as seen in Fig. 3.

H is a rib of sheet steel the form being clearly seen in Fig. 2, having one edge concave to conform to the transverse form of the sail, and having at the ends lugs H′ H′, which are notched in the arc of the curved edge to receive the edges of the sails, as also seen in Fig. 2. At the middle of the curved edge, there is formed the lug H^2, bent at right angles to the plane of the rib H, the width of this lug being substantially the thickness of the band C, and its length or extent in the direction of the concave edge being substantially the width of the aperture *f*, made in the sail for the band C. The rib is applied to the sail at the narrower end, and slid up on the vane, the edges of the latter entering the notches in the lugs H′, and when the lug H^2 reaches the opening *f*, it snaps into it, the sail having been sprung slightly from its normal curvature by thus passing the rib up into it, because the lug H is set off from the arc of the curved edge *h* of the rib a distance equal to the thickness of the sail, so that when the convex surface of the sail rests in the concave edge of the rib the lug stands through the sail and lies against the forward or concave surface of the latter. The rib being moved up after it snaps into the opening *f*, as far as it can move, the lug being now en-

gaged with the margin of the aperture, leaves that aperture open below the sail for the band C, which, being inserted, serves as a key to hold the rib in its place in the sail. The latter is thereby stiffened, being grasped by the rib at the edges where the lugs H′ of the rib clasp it, and at the middle where the lug H^2 clasps it through the opening *f*. The rib itself is forced into a curve conformed to that of the band B by the edges of the sail stopping in the notches in the lugs H′, before the lug H^2 reaches the aperture *f*, so that the rib has to be sprung up or outward from the wheel center at the middle part to cause the lug to reach and enter that aperture. If this were not done, and if, on the contrary, the rib were allowed to remain straight, it would stand in the direction of a chord of or tangent to the circle in which it would revolve with the wheel, and would very seriously retard the wheel and decrease its power. A modification of the form of the sail to more certainly cause the rib to be thus curved when it is put into place is shown in Fig. 7, shoulders F′ being formed on the lateral edges of the sails to positively stop the rib at both ends at the proper points instead of relying upon the exactness of the fit of the sail between the notches in the lugs H′ of the rib and upon the care of the workman in assembling the parts with the necessary precision. The form of the rib is further adapted to afford secure fastening of the sail to the band C, for it has the triangular projection H^3 extending beyond the line of its general crescent form, one edge of the triangular lug being directly cross-wise of the band, and the other edge parallel with the latter and folded down along its edge, as seen at H^{31} in Fig. 2 one bolt *h′*, through the rib at its widest part, exclusive of the triangular lug, co-operating with the flange H^{31}, makes the rib rigid with the band C, and so secures the sail firmly.

I claim—

1. In combination with the hub, two bands concentric therewith; two series of spokes all of which are connected to the outer band, said two series being connected to the hub at a distance from each other along the axis, the inner band being located between the two series and provided with cross-bars rigid with it, one individual of each series of spokes being inserted through each cross-bar at opposite sides of the band: substantially as set forth.

2. In combination with the hub, the outer band concentric therewith, two series of spokes separated axially at their fastenings to the hub and converging to the plane of said outer band and fastened to said band at the outer ends; the spokes being in non-radial planes successive individuals of each series being in planes which diverge oppositely from corresponding radial planes substantially as set forth.

3. In combination with the hub, the outer band concentric therewith, two series of spokes separated axially at their fastenings to the hub and converging to the plane of said outer band and fastened to said band at the outer ends; the spokes being in non-radial planes successive individuals of each series being in planes which diverge oppositely from corresponding radial planes and pairs comprising two such oppositely diverging individuals in each series alternating with like pairs in the other series about the hub: substantially as set forth.

4. In combination with the hub and the two concentric bands, two series of spokes separated axially at their fastenings to the hub and converging to the plane of the outer band and fastened to said band at the outer ends; the spokes being divergent from radial direction, successive individuals of each series having opposite divergence, and pairs comprising two such oppositely diverging individuals in each series alternating with like pairs in the other series in the circuit about the hub; the inner band being located between the two series and of radius equal to the distance from the center at which tangential planes of oppositely inclined spokes of opposite series intersect, and provided with rigid cross-bars at the point of such intersection, the spokes passing through such cross-bars: substantially as set forth.

5. In combination with the sail F, the ribs H conformed at one edge to the transverse shape of the sail and clasping its lateral edges and provided with the lug H^2 set off from the said conformed edge a distance equal to the thickness of the sail, and extending transversely to the plane of the rib; the sail having an aperture through which said lug may enter and whose margin it may engage by movement longitudinally with respect to the sail: substantially as set forth.

6. In combination with the band C, the sail F, the ribs H conformed at one edge to the transverse shape of the sail and clasping its lateral edges and provided with the lug H^2 set off from said conformed edge a distance equal to the thickness of the sail, and extending transversely to the plane of the rib; the sail having an aperture through which said lug may enter and whose margin it may engage by movement longitudinally with respect to the sail, the rib being secured to the band: substantially as set forth.

7. In combination with the band C, the sails F apertured to permit the band to pass through them, the ribs H conformed at one edge to the transverse shape of the sails and clasping their lateral edges, said rib provided with the lug H^2 which enters the hole through which the band passes and engages one lateral edge thereof in front of the sail: substantially as set forth.

8. In combination with the sail curved transversely and provided with the shoulder F′ F′ at its lateral edges, the rib H having the edge conformed to such curvature and adapted to clasp the lateral edges below said

shoulder; the sail having the aperture *f* and the rib having the lug H^2 set off from the concave edge adapted to enter the aperture and engage its margin, the aperture *f* being out of direct line between the shoulders: substantially as and for the purpose set forth.

9. In combination with the sail provided with the shoulders F′ F′ at its lateral edges and the aperture *f* intermediate the said edges, the rib H, adapted at its ends to clasp the lateral edges of the sail and be stopped under said shoulder, and having the lug H^2 set off from the edge of the rib adapted to enter the aperture in the sail, said aperture being out of direct line between the shoulders to require the rib to be sprung out of normal shape to enter the lug in the aperture when the rib is stopped at the end against the shoulder: substantially as set forth.

10. In combination with the band C, the tapering sail F, the rib H, having one edge conformed to the transverse shape of the sail and having the terminal lugs H′ notched in continuation of such conformity, and provided with the lug H^2, set off from the said conformed edge a distance equal to the thickness of the sail and extending transversely to the plane of the rib, the sail being apertured to permit the band to pass through it and the lug being adapted to pass through the same aperture before the band is inserted, whereby the rib may be advanced onto the sail from the smaller toward the larger end until the lug enters the aperture and by further movement engages with its margin and the band thereafter inserted serves as a key to retain it: substantially as set forth.

11. In combination with the hub and the two bands, and the spokes arranged substantially as described, the cross-bar E having the lips *e e* struck up from its web to form oppositely facing shoulders and define a seat between them for the band B and bolted to the band at that seat: substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 27th day of October, 1893.

LA VERNE W. NOYES.

Witnesses:
CHAS. S. BURTON,
JEAN ELLIOTT.