No. 713,094. Patented Nov. 11, 1902.

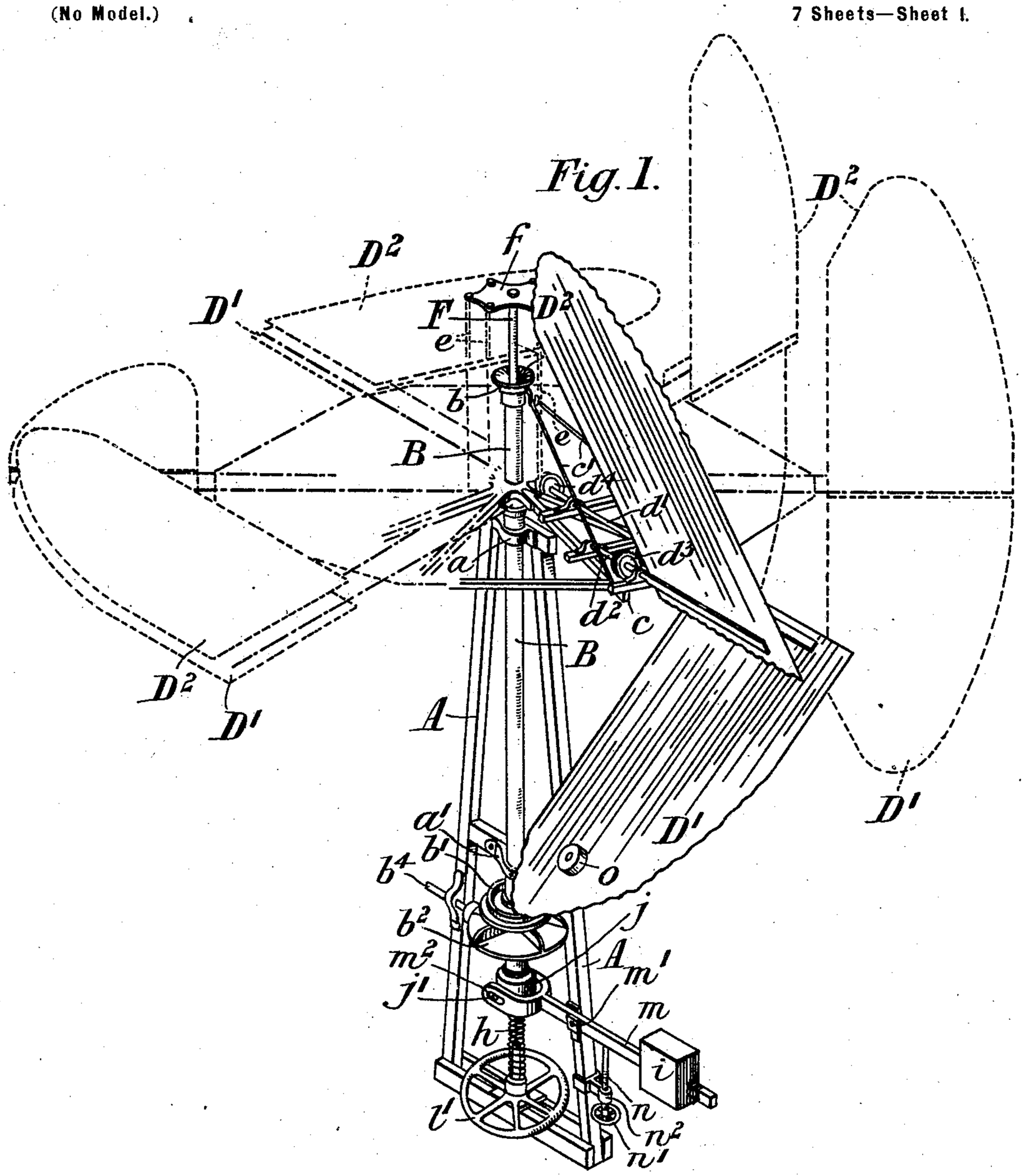
H. GRIST.

WIND MOTOR.

(Application filed May 1, 1901.)

(No Model.) 7 Sheets—Sheet 1.

Fig. 1.



Witnesses:
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M. E. Torrence.

Inventor:
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by William B. Browne
his Attorney

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

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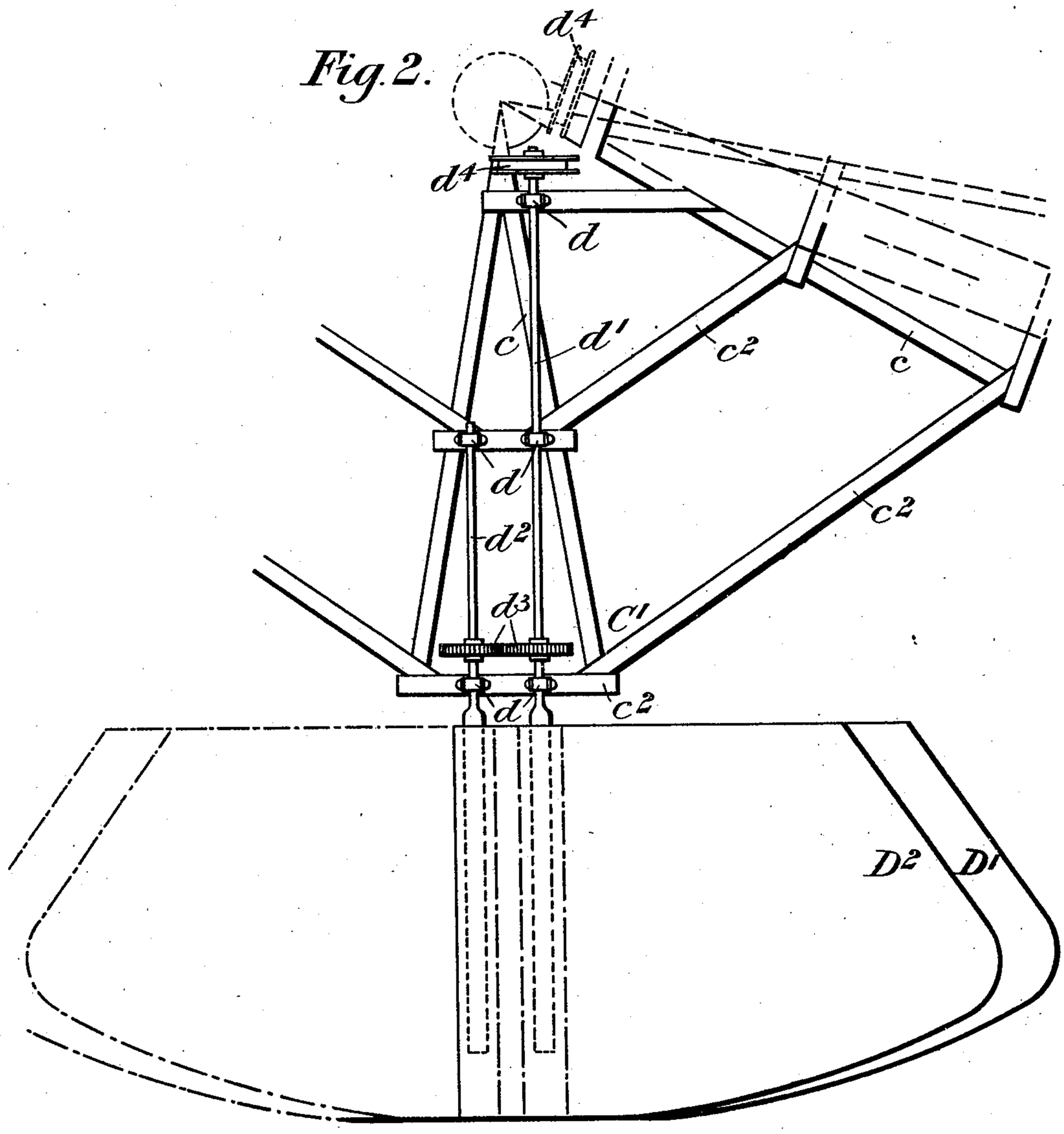
(No Model.) 7 Sheets—Sheet 2.

Fig. 2.



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(No Model.) 7 Sheets—Sheet 3.

Fig. 3.

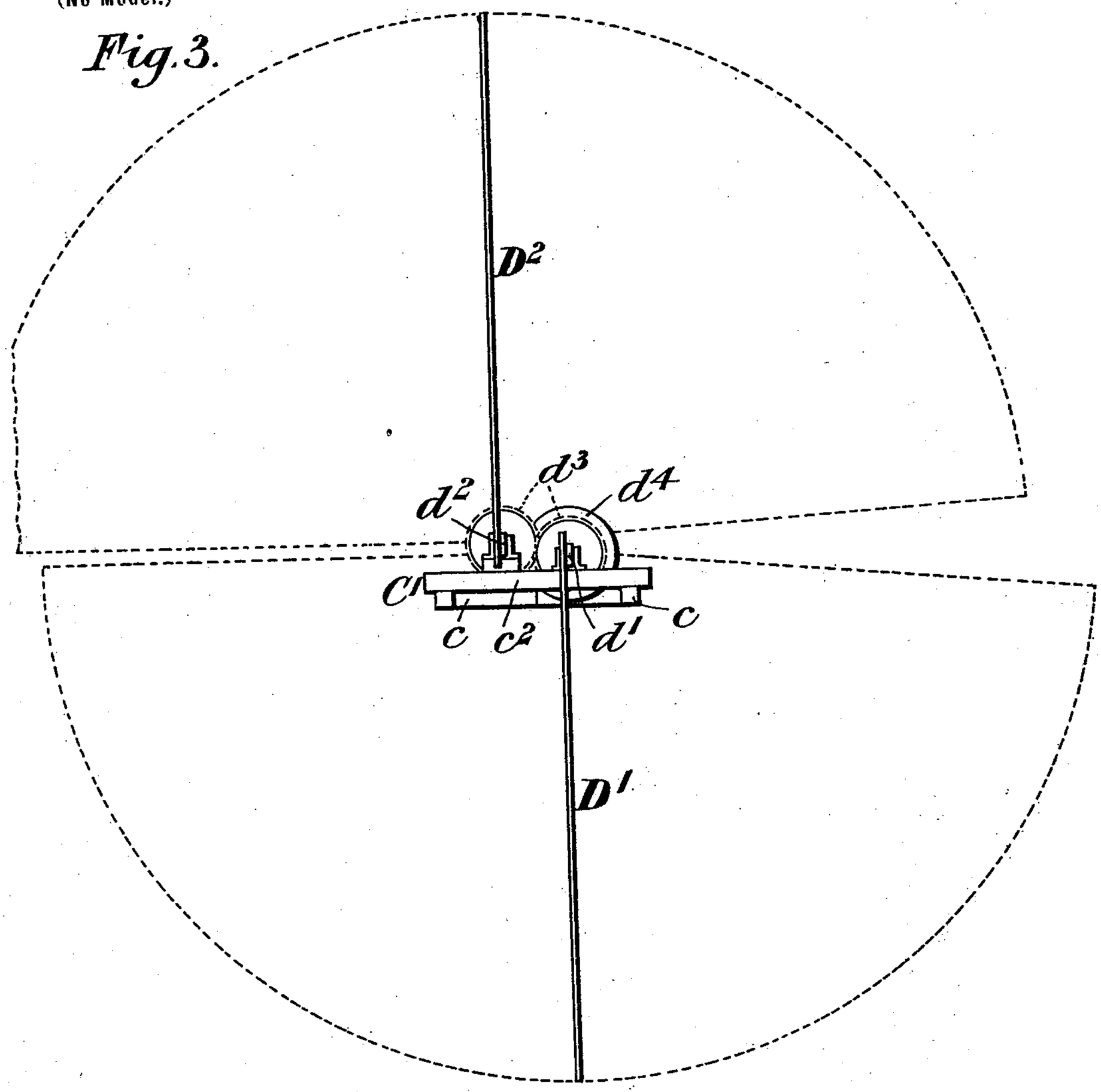

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Fig. 5.

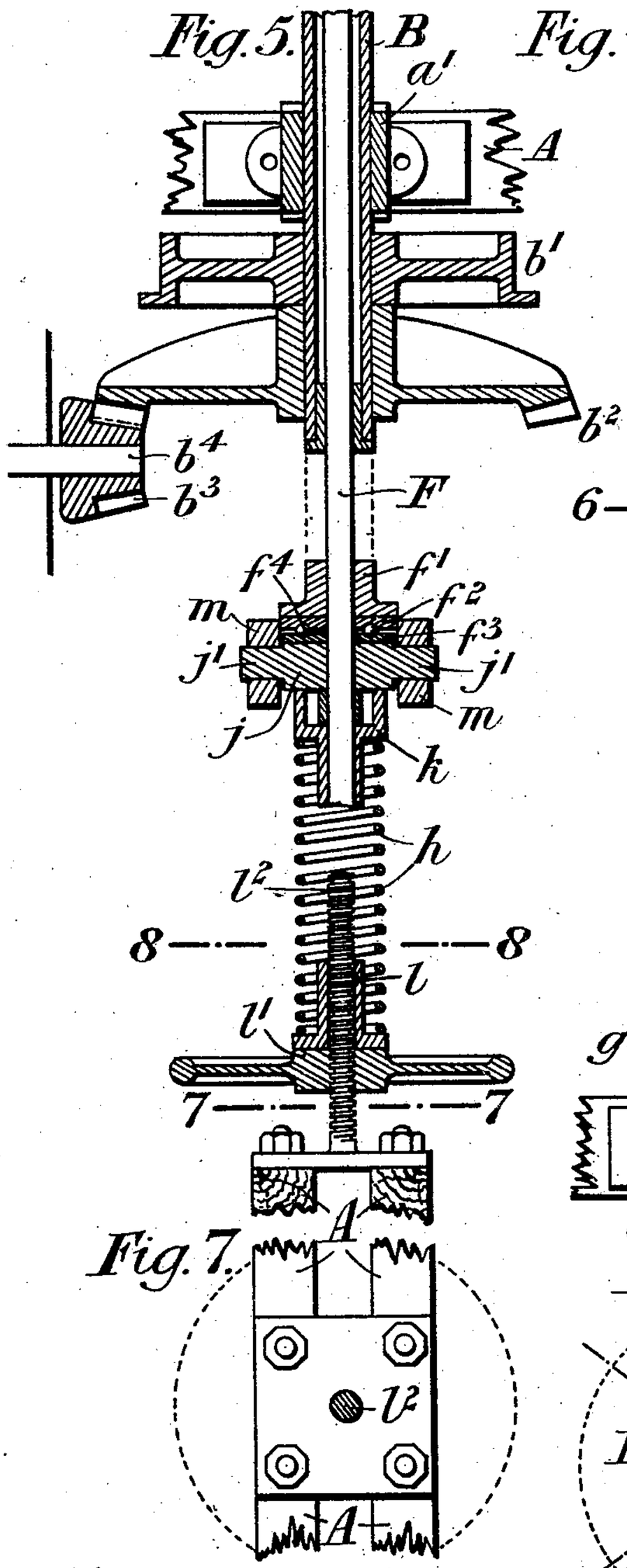

Fig. 7.

Fig. 4.

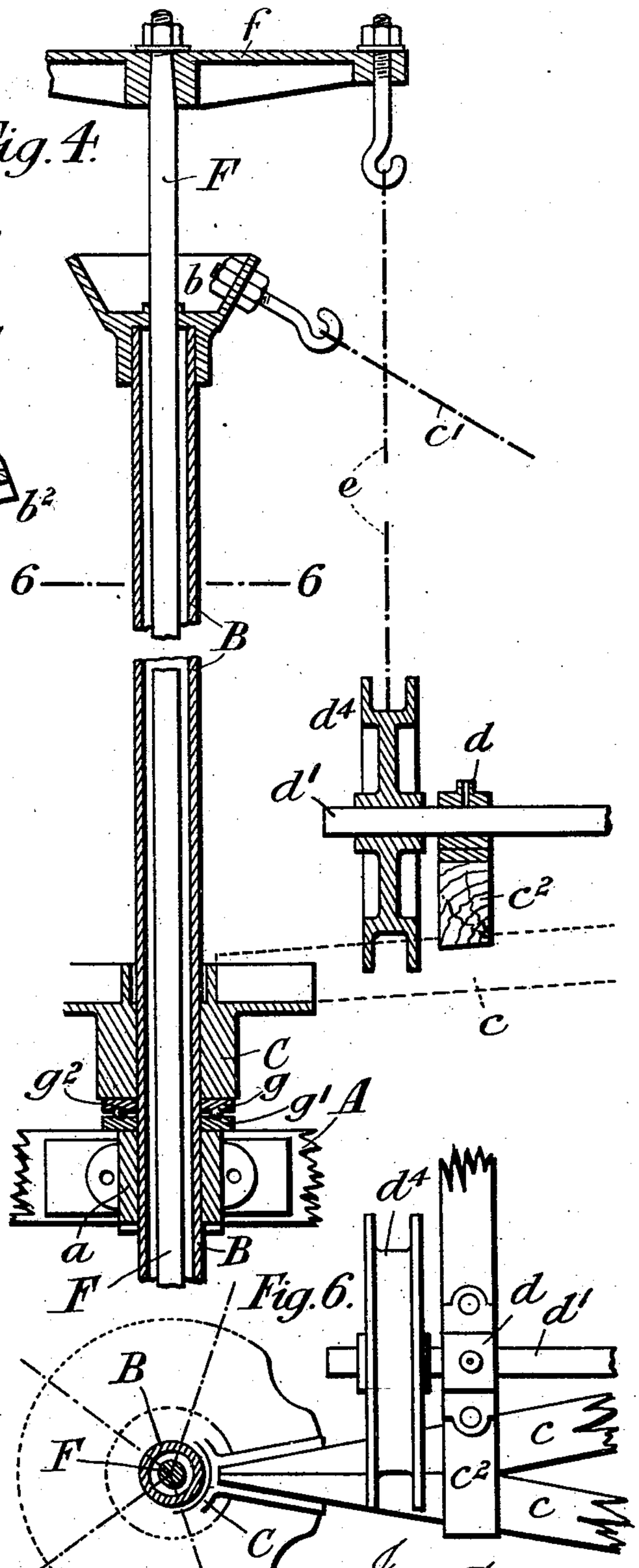

Fig. 6.

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(No Model.) 7 Sheets—Sheet 5.

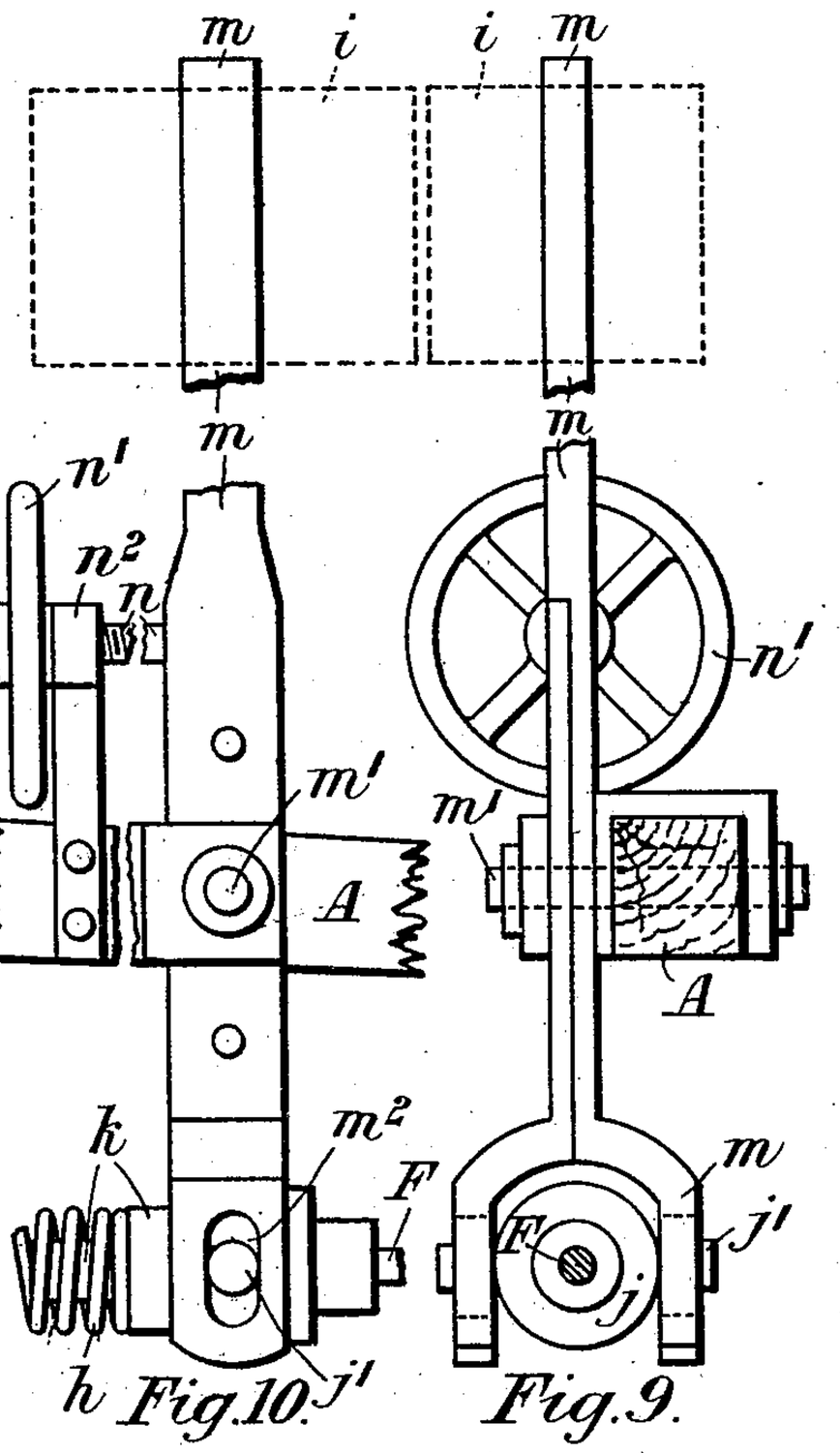

Fig. 10.

Fig. 9.

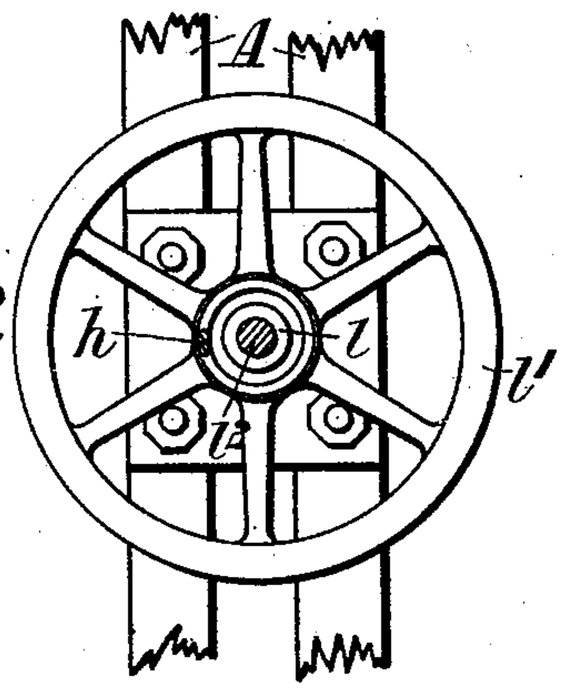

Fig. 8.

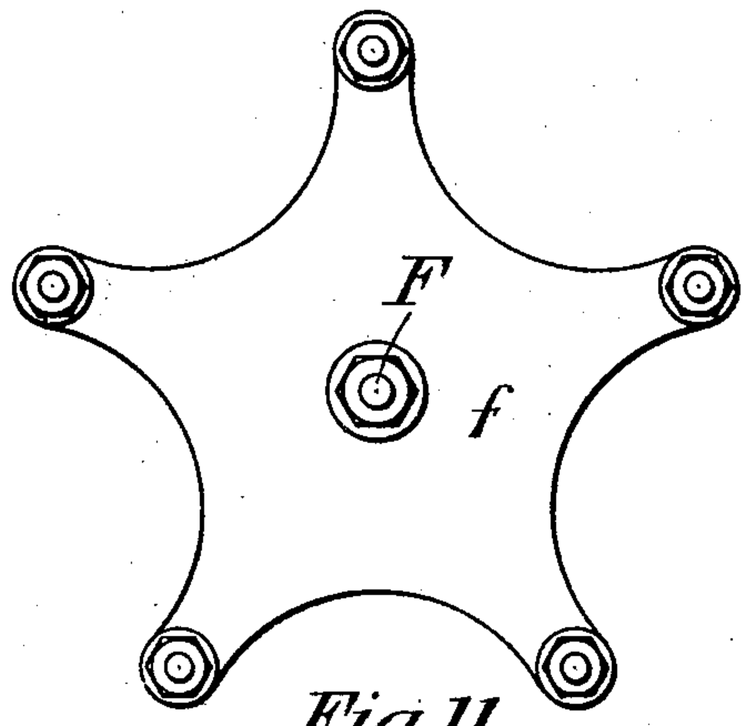

Fig. 11.

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(No Model.) 7 Sheets—Sheet 6.

Fig. 12.

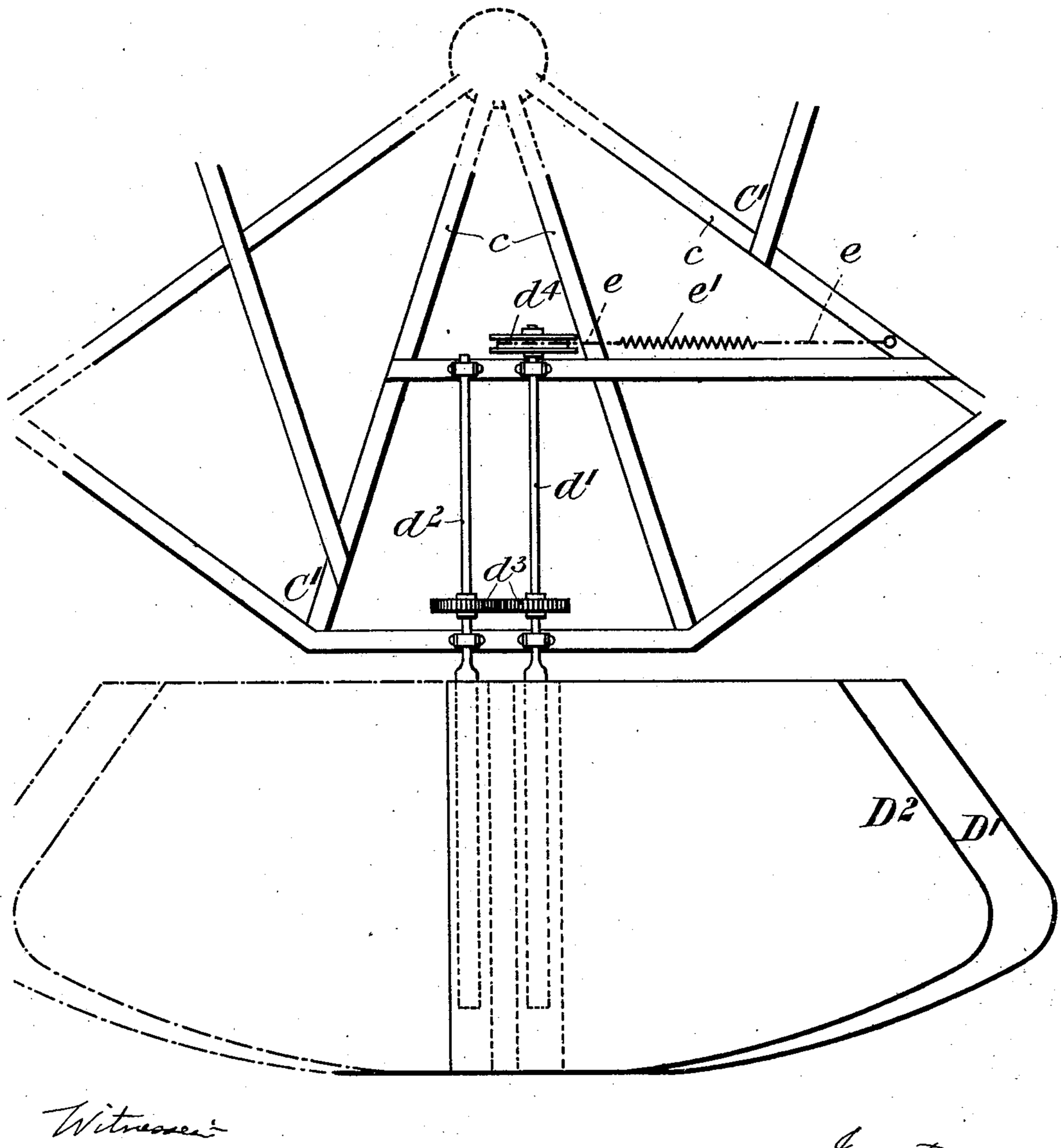

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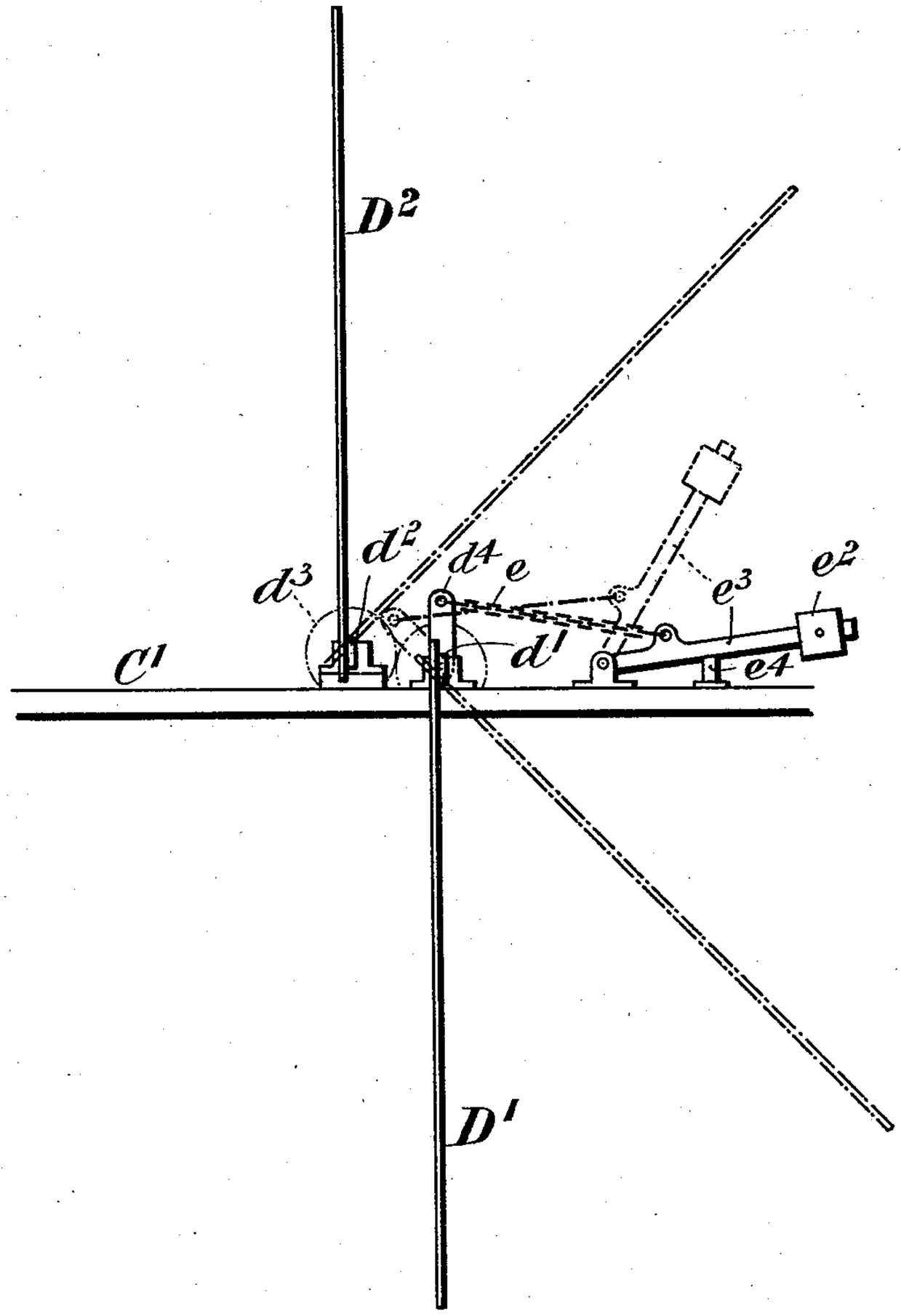
Fig. 13.



Witnesses:
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UNITED STATES PATENT OFFICE.

HENRY GRIST, OF HORSHAM, ENGLAND.

WIND-MOTOR.

SPECIFICATION forming part of Letters Patent No. 713,094, dated November 11, 1902.

Application filed May 1, 1901. Serial No. 58,279. (No model.)

To all whom it may concern:

Be it known that I, HENRY GRIST, a subject of the King of Great Britain, residing at 58 Bishoprick, Horsham, in the county of Sussex, England, have invented new and useful Improvements in Wind-Motors, of which the following is a specification.

In ordinary wind-motive engines as hitherto generally constructed a considerable portion (often the greater part) of the wind-pressure is spent against the structure and sails as direct thrust and only a portion of the force is converted into rotary motion of the sails at right angles to the direction of the wind.

Now my invention relates to a novel form of motive apparatus for wind-power so mounted that the vanes on which the wind acts revolve in a horizontal plane around a vertical axis and is designed so that nearly all the force of the wind is spent in turning the apparatus and very little of it passes as dead pressure on the structure. The vanes, or, as I prefer to call them, "wings," are so mounted in pairs that during about half of each revolution they take a vertical or nearly vertical position and oppose their surfaces to the wind, and during the other half of the revolution they lie horizontally, with their edges turned toward the wind.

The vertical axis, hereinafter referred to as the "main shaft," may be tubular and mounted in any convenient manner and carries near its upper extremity a flange or projecting rim or the like, to which are attached a series of horizontal radial arms or frames, hereinafter referred to as "arms," which are supported in the horizontal position by suspensory stays from the upper part of the main shaft, and these arms are also stayed laterally one to another or otherwise. In some cases it is convenient to attach such arms to the main shaft or the flange thereon, with joints allowing them to be lowered into a nearly vertical position around the shaft to facilitate erection and for other purposes. On each such arm or frame are mounted two horizontal parallel or nearly parallel shafts, hereinafter referred to as "wing-shafts," the one in the preferred arrangement extending inward nearly to the center and the other shorter and both extending outward beyond the arms and each carrying one of the wings. The members of each pair of wing-shafts are so connected together, either by the device next indicated or otherwise to produce the same effect, that when either shaft makes part of a revolution on its longitudinal axis the other shaft is compelled to make an equal and like movement but in the opposite direction, and for these purposes I may key onto each wing-shaft a spur-wheel, the cogs of each pair of which intermesh, so that the two wing-shafts share equally in any rotary movement, but in opposite directions. On each wing-shaft is fixed a wing which may be made of corrugated galvanized-iron sheeting or other suitable material and is fastened at one end of it to the wing-shaft, the wings of each pair being arranged to lie in opposite directions, so that in the operative position one of them rises upward from its attachment and the other hangs downward, and when the wing-shafts are rotated from this position a quarter-revolution, or thereabout, in the proper direction the two wings lie horizontally face to face.

In the arrangement which I generally adopt and which is particularly adapted for the larger motors I fix at the inner end of each elongated wing-shaft a pulley, chain-wheel, or equivalent arrangement which is connected by a chain or the like or otherwise with the upper end of a vertical connecting rod or tube, hereinafter referred to as the "controlling-rod," which passes down the interior of the main shaft and is connected below to apparatus for producing, controlling, and regulating the pressure which holds the wings up or open against the pressure of the wind. The main shaft is provided with a collar or projecting rim which carries the weight of and supports the same and the under surface of which runs on a fixed step either with or without the intervention of ball or roller bearings. The lower end of the main shaft is fitted with a brake-wheel and with bevel-gearing or other gearing for transmitting the rotation as required. The lower end of the controlling-rod extends below and beyond the main shaft and is pressed upward with such force as may be required to hold up the wings against the wind, and for this purpose a spring may be arranged with adjusting

mechanism for regulating its force, or a weight or weighted lever may be used for the same or a combination of both with suitable devices for adjusting the weight and limiting the extent of motion and otherwise controlling and regulating the action of the same. For smaller motors, such as are intended for constant loads—such, for instance, as pumping or the like, and particularly for such as are fixed in a tolerably easily accessible position as regards height and otherwise—the controlling apparatus described hereinafter is to be preferred.

The invention as first above described will be best understood by reference to the accompanying drawings, in which—

Figure 1 is a perspective view of the preferred form of my improved wind-motors with certain parts shown diagrammatically for the sake of clearness. Fig. 2 is a plan of portion of the upper part of the apparatus. Fig. 3 is an elevation of the lower end of Fig. 2 with the wings in positions differing from those in which they are represented in said Fig. 2. Figs. 4 and 5 are central vertical sections of respectively the upper and lower portions of the vertical shaft and other immediately-adjacent parts. Fig. 6 is a section on the line 6 6 of Fig. 4. Figs. 7 and 8 are horizontal sections taken, respectively, on the lines 7 7 and 8 8 of Fig. 5. Fig. 9 is a plan, and Fig. 10 is a side elevation, of the device for adjusting the position of the wings and determining the limit at which they shall yield under excessive wind-pressure. Fig. 11 is a plan of the upper end of the vertical controlling-rod and chain-connecting disk attached thereto. Figs. 12 and 13 are respectively a plan and an elevation of portions of two different slightly-modified forms of the controlling mechanism.

The same letters of reference are used to indicate like parts throughout the several figures of the drawings.

In carrying my invention into practice in the manner indicated in the drawings I provide a rigid frame A, which may be of any desired construction and is fitted with bearings a a' for supporting the main shaft B in a vertical position. The shaft B is tubular and has secured to it, near its upper extremity, a flange, rim, or collar C, to which are attached a series of radial arms c, supported in a horizontal or substantially horizontal position by suspensory stays c', connected to the outer end of said arms and to a casting or boss b, secured on the upper end of the shaft B. The radial arms c are also stayed laterally by stays, rods, or bars c^2, extending from one to another of the said arms, or the arms c may be supported and stayed in any other convenient manner.

On the frame C', constituted by the radial arms c and bars c^2, are secured a number of bearings d, in which are revolubly supported a number of horizontal shafts d' d^2, hereinafter referred to as "wing-shafts." These shafts d' d^2 are arranged in pairs, the shafts of each pair being parallel or nearly parallel to each other and the shaft d' extending inward to near the vertical shaft B, while the shafts d^2 terminate at some distance from the said shaft B, as shown most clearly in Fig. 2. The outer ends of all of the wing-shafts d' d^2 project beyond the frame C', and on each of these outwardly-projecting parts is secured one of the wings D' or D², which are hereinafter more particularly described.

The members of each pair of wing-shafts d' d^2 are so connected together either by equal spur-gearing d^3, as represented in the drawings, or by linkage or otherwise, that when either shaft makes part of a revolution on its longitudinal axis the other shaft is compelled to make an equal movement in the opposite direction.

The wings D' D² may very conveniently be formed of corrugated galvanized sheet-iron, and each is secured to its shaft near one edge of the said wing, so that the wings may turn upon the axes of the shafts d' d^2 through about one hundred and eighty degrees. In the operative position each wing D' extends downward below its shaft d', and each wing D² extends upward above its shaft d^2, the two said wings being then at an angle of about one hundred and eighty degrees apart, or nearly so. This angle may, however, be adjusted, as hereinafter described, to enable the effective area of the wings to be varied to suit the different wind-pressures.

On the inner end of each of the wing-shafts d' is secured a chain wheel or pulley d^4, to which is attached one end of a chain or equivalent flexible connecting device e, whose other end is connected to a disk or arms f, rigidly secured to the upper end of a vertical rod F, hereinafter referred to as the "controlling-rod," capable of sliding longitudinally within the main shaft B.

The weight of the main shaft B and its directly-connected parts is supported by the bearing a, between which and the collar C above may be interposed two loose annularly-grooved collars g g' and a ring of balls g^2, running in the grooves of the said collars g g'. On the lower end of the main shaft B, below the bearing a', is secured a brake-wheel b' and a bevel-tooth wheel b^2, to the former of which brake-pressure may be applied in any convenient manner and with the latter of which gears a bevel-pinion b^3, which, through a shaft b^4, transmits its rotary motion to any desired mechanism or apparatus.

The lower end of the controlling-rod F extends beyond the lower end of the main shaft B and is pressed upward with such force as may be required to hold the wings D' D² up against the wind, for which purpose an adjustable spring h or weight i, or, as shown in the drawings, both of such devices, may be employed. In this arrangement the controlling-rod F has rigidly secured to it a collar f', beneath which are provided a loose collar

j, having trunnions j' and a sleeve k, two loose annularly-grooved collars f^2 and f^3, and an interposed ring of balls f^4 being provided between the fixed collar f' and the loose collar j. The lower and reduced end of the sleeve k enters and is supported by the spring h, whose lower end receives and bears upon a flanged sleeve l, supported by a nut or hand-wheel l', adjustable on a stationary screw l^2, fixed to the base of the main frame A.

m is a forked lever pivoted at m' to the main frame A and engaging by its slots m^2 with the before-mentioned trunnions j' and having a weight i adjustably secured on its outer end. Beneath this outer end of the lever m I provide a screw-stop n, adjustable by a hand-wheel n' in a bracket n^2, fixed to the frame A, so as to enable the lever m by means of such screw adjustment and through the medium of the weight i to be turned on the pivot m', and consequently the controlling-rod F to be lowered or raised for expanding or more or less collapsing or contracting the wings D' D². The wings D' are weighted, so as to tend always to move them into their vertical position, and consequently through the gearing d^3 to similarly move the other wings D². Rubber or other equivalent buffers o may be provided, preferably on the lower wings D', to prevent the members of each pair of wings D' D² from coming into actual contact and making a clashing noise.

In some cases where, for instance, the load is constant, such as for pumping and the like, more especially for the smaller sizes of motors, the controlling mechanism may be made simpler by attaching a separate controlling-spring to each wing or pair of wings, as shown in Fig. 12, in which the wheel d^4 is placed farther from the center and a chain e or other connection therefrom is provided with a spring e', which is connected to some convenient fixed part of the frame C' in such manner that the length of the chain e, and consequently the tension of the spring e', may be easily adjusted.

Instead of controlling the wings D' D² by a spring e', as last described, they may, as shown in Fig. 13, be controlled by a weight e^2, adjustably secured on a lever e^3, pivoted to the frame C', the said lever being connected by a chain e to a pulley or lever-arm d^4, secured on the wing-shaft d', the arrangement being preferably such that the weight e^2 presents the greatest resistance to the wings collapsing under excessive wind-pressure when they are fullest expanded and gradually less resistance the more the wings yield or collapse under such pressure. The movement of the lever e^3 is limited by a stop e^4, secured on the frame C'.

The arrangements shown in Figs. 17 and 18 render it unnecessary for the main vertical shaft B to be hollow, and in these forms I prefer to make the said shaft solid, and I provide greater brake power than is necessary in the first-described arrangement in order to stop the motor when required.

The wings D' D² are preferably of such shape that their outer edges form portions of circles described from a center situate in the axis of the main shaft B and as near as possible in the plane of their surfaces, so that in whatever position they may be the curve of their outer edges will substantially be included in or form part of the same sphere or figure of rotation; otherwise the wings D' D² may be of the general shape indicated in Figs. 1 and 2.

It will be understood from the foregoing description that when the wind, acting in a direction perpendicular to the plane of Fig. 1 and from the observer toward that figure on one side of the vertically-supported wings D' D², drives the apparatus around, the wings, as soon as each pair reach the point at which the wind commences to blow on the other side or back of them, yield to the pressure of the wind and cause a partial rotation of their respective wing-shafts d' d^2 in such wise that the wings lie flat face to face, as shown at the left-hand side of Fig. 1, and in this movement they are not restrained by the connection of the wing-shafts d' d^2 with the controlling mechanism, because the rotation of the wing-shafts d' d^2 in that direction only slackens the chains e or produces the like effect. As soon as the closed pairs of wings reach the point at which the wind again blows on the other side of them—that is to say, against and between their free edges—the wings separate and reassume their open or vertical position. When in this position, they are prevented from yielding and turning farther over by the action of the controlling mechanism so long as the force of the wind does not exceed the power required for the load on the motor or, in other words, that for which the said controlling mechanism has been previously adjusted; but when this is exceeded the wings D' D² yield and turn backward, rotating their wing-shafts d' d^2 against the pressure of the controlling mechanism until the wings assume an oblique or nearly horizontal position, in which the wind glances off them with very little resistance, thus relieving the structure from excessive strain in boisterous or stormy weather, and thus maintaining a fairly regular speed.

With the mechanism shown in Figs. 1 to 11 the motor may be rendered inoperative when desired by lowering the nut or hand-wheel l' to its lowest position and raising the screw-nut n, so as to remove all resistance to the collapsing of the wings.

By the use of the mechanism hereinbefore described I am enable to employ for an apparatus yielding a given power a much lighter supporting structure in proportion to the power developed than has hitherto been practicable.

As tubular shafting such as that of which

the main shaft B should be constructed is expensive and not readily obtainable, I may with very considerable advantage construct the said main shaft of wrought-iron pipe, such as that ordinarily employed in gas and water supply installations, this being used in single or multiple thicknesses, according to the power to be transmitted.

For readily and efficiently coupling together the ends of these pipes, which are not usually long enough to in one piece form the complete shaft B, I may use a device, such as shown in Figs. 12 to 16, inclusive, comprising a liner or bush p, bored or otherwise formed to constitute a guide for the controlling-rod F and externally of such diameter that it will nicely fit into the ends of the two pipes or innermost of the pipes to be connected. In Figs. 12 to 14 I have represented the shaft to be made up of two concentric pipes q q'; but it will readily be understood that any other desired number may be similarly combined. The end of each pipe which is to be coupled to its neighbor is formed with diametrically opposite recesses r, adapted to engage with feathers or keys p', formed on the exterior of and integral with the liner or bush p, the depth of the said recesses being approximately about one-half the width (measured longitudinally of the bush) of the feathers or key p'. Each of the concentric pipes q q' is similarly fitted to the feathers or keys p', which latter extend radially outward beyond the outer surface of the outermost of the said pipes—viz., q'—so that its outer ends may engage with recesses s, formed in the inner surface of a split or divided clamp or band s'. This clamp or band s' may be rigidly secured about the pipe-joint, and the coupling thereby made complete by screwing the two portions of the said clamp together by bolts or nuts s^2, the feathers or keys p' by engaging with the recesses s preventing any longitudinal displacement of the clamp on the pipes. Any difficulty which may be experienced as regards the looseness of fit of one pipe within another may be readily overcome by means of a tube-expander or equivalent device applied to merely the ends of the said pipes, so that the whole construction of the shaft is one which may be readily carried out.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In a wind-motor such as described the combination for supporting and operating the controlling-shaft consisting of a collar with trunnions j' forked lever m, a weight i adjustable on the lever m, a spring h, and adjusting-nut or hand-wheel l' substantially as hereinbefore described and illustrated in the drawings.

2. In a wind-motor such as described, mechanism for supporting the wings against the wind, including pivot-rods for the wings, intermeshing gear-wheels d^3 on said rods inside the vanes, pulley d^4 on one of the rods, and controlling means operatively associated with said pulley, substantially as and for the purpose described.

3. In a wind-motor such as described, mechanism for supporting the wings against the wind, including pivot-rods for the wings, connecting means between the wings to cause equal movement thereof, and controlling means operatively associated with one of said pivot-rods at the inner end of said rod, substantially as described.

4. In a wind-motor such as described, mechanism for supporting the wings against the wind, including pivot-rods for the wings, connecting means between the wings to cause equal movement thereof, controlling means, and connecting instrumentalities between said controlling means and one of said pivot-rods at the inner end of said rod, substantially as described.

5. In a wind-motor such as described, wings D′, D², means connecting said wings whereby when one wing is operated an equal movement is imparted to the opposite wing, and means for controlling the operation of said wings including a vertically-disposed central rod, flexible connections between the rod and one of the wings, and means permitting longitudinal movement of the rod with the excessive movement of the wings, substantially as and for the purpose described.

6. In a wind-motor such as described, wings D′, D², means connecting said wings whereby when one wing is operated an equal movement is imparted to the opposite wing, and means for controlling the operation of said wings, including a device movably associated with one of the wings, a central rod, a flexible connection between the rod and said device, and adjustable means permitting longitudinal movement of the rod with the excessive movement of the wings, all for the purpose and substantially as described.

7. In a wind-motor such as described, wings D′, D², means connecting said wings whereby when one wing is operated an equal movement is imparted to the opposite wing, and means for controlling the operation of said wings including a device movable with one of the wings, a central rod, a flexible connection between the rod and said device, and weight-controlled means at the lower end of the rod normally retaining the rod in position but permitting the same to shift longitudinally with the excessive movement of the wings, substantially as and for the purpose described.

8. In a wind-motor such as described, wings D′, D², means connecting said wings whereby when one wing is operated an equal movement is imparted to the opposite wing, and means for controlling the operation of said wings including a device movable with one of the wings, a central rod, a flexible connection between the rod and said device, weight-controlled means at the lower end of the rod normally retaining the rod in position but

permitting the same to shift longitudinally with the excessive movement of the wings, and means for adjusting said weight during the operation of the motor, substantially as and for the purpose described.

9. In a wind-motor, a vertical main shaft, vanes or wings adapted to travel in a horizontal plane, means for causing the vanes or wings to open or close together including shafts for said wings, a pulley on one of the wing-shafts, a controlling-shaft, a flexible connection between the top of said shaft and the pulley, said controlling-shaft passing longitudinally through the main shaft and terminating below the same, and an adjustable controlling apparatus at the lower end of the controlling-rod whereby the controlling-rod is held up and the vanes or wings are supported in open position against the action of the wind, but so that the said vanes or wings will, if the pressure becomes excessive, yield and incline backward on their horizontal axes and force the controlling-rod downward, substantially as and for the purpose described.

10. In a wind-motor, a vertical main shaft, vanes or wings adapted to travel in a horizontal plane, means for causing the vanes or wings to open or close together including shafts for said wings, a pulley on one of the wing-shafts, a controlling-shaft, a flexible connection between the top of said shaft and the pulley, said controlling-shaft passing longitudinally through the main shaft and terminating below the same, and an adjustable controlling apparatus at the lower end of the controlling-rod whereby the connecting-rod is held up and the vanes or wings are supported in open position against the action of the wind, but so that the said vanes or wings will, if the pressure becomes excessive, yield and incline backward on their horizontal axes and force the controlling-rod downward, said controlling apparatus including a collar with trunnions j', forked lever m, a weight i, adjustable on the lever m, a spring h, and adjusting-nut or hand-wheel l', substantially as and for the purpose described.

11. In a wind-motor, a vertical main shaft, vanes or wings adapted to travel in a horizontal plane, means for causing the vanes or wings to open or close together, including shafts for said wings, a pulley on one of the wing-shafts, a controlling-shaft, a flexible connection between the top of said shaft and the pulley, said controlling-shaft passing longitudinally through the main shaft and terminating below the same, and an adjustable controlling apparatus at the lower portion of the machine within easy access of an operator whereby the controlling-rod is held up and the vanes or wings are supported in open position against the action of the wind, but so that the said vanes or wings will, if the pressure becomes excessive, yield and incline backward on their horizontal axes and force the controlling-rod downward, substantially as and for the purpose described.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY GRIST.

Witnesses:
NEWRHAM BROWNE,
WALTER J. SKERTEN.