No. 711,195. Patented Oct. 14, 1902.

I. BENJAMINS.

WINDMILL.

(Application filed Aug. 14, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

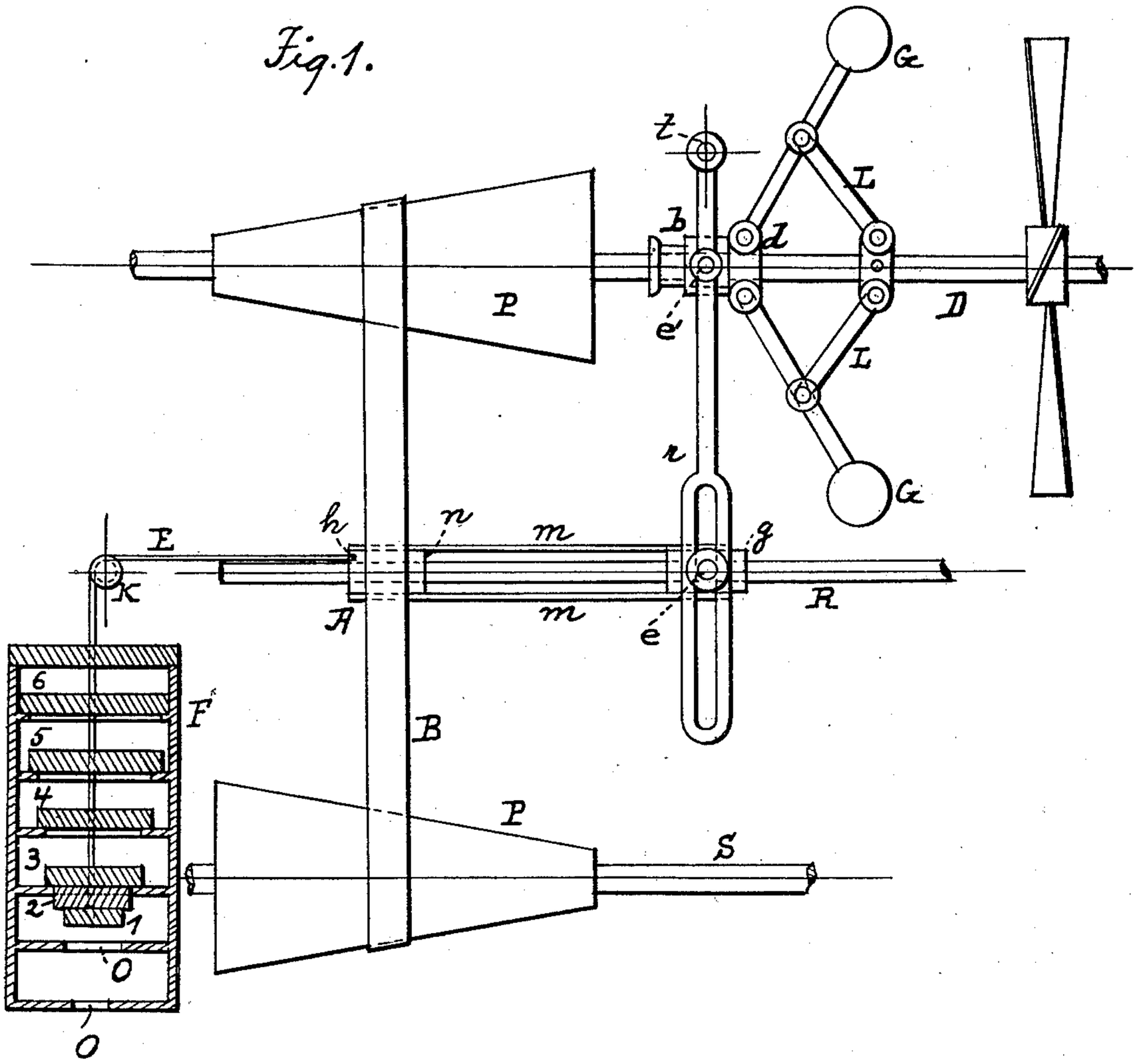

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Fig. 2.

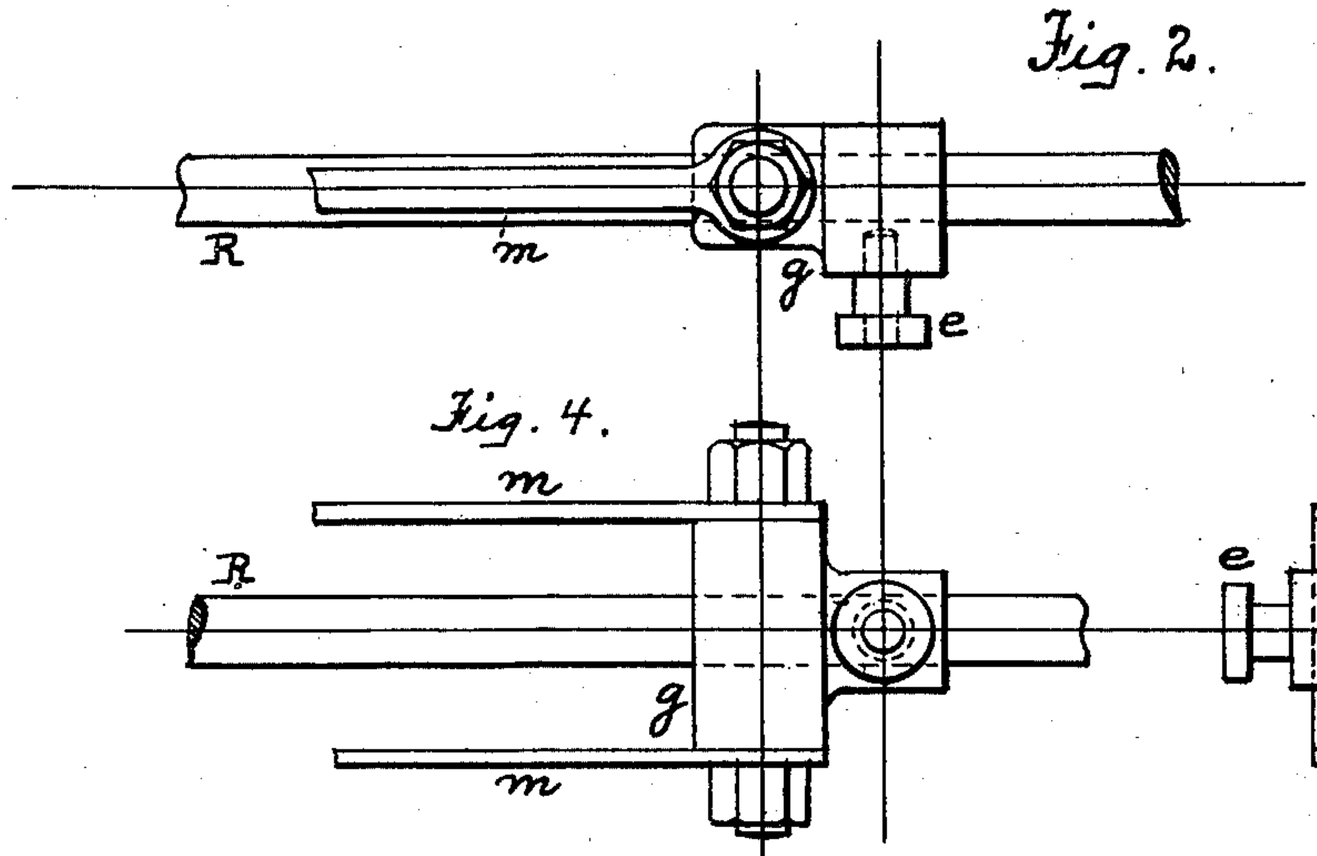


Fig. 3.

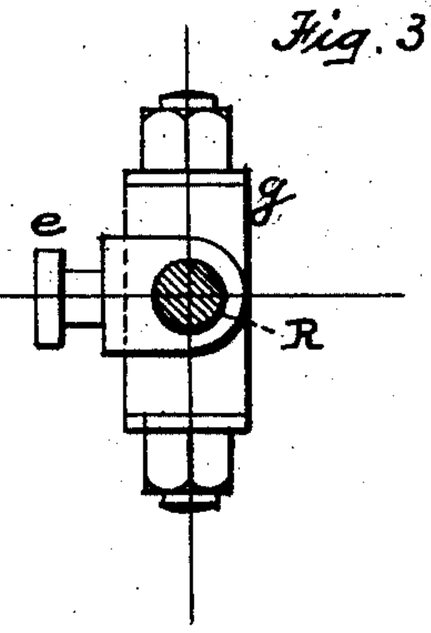


Fig. 4.

Fig. 5.

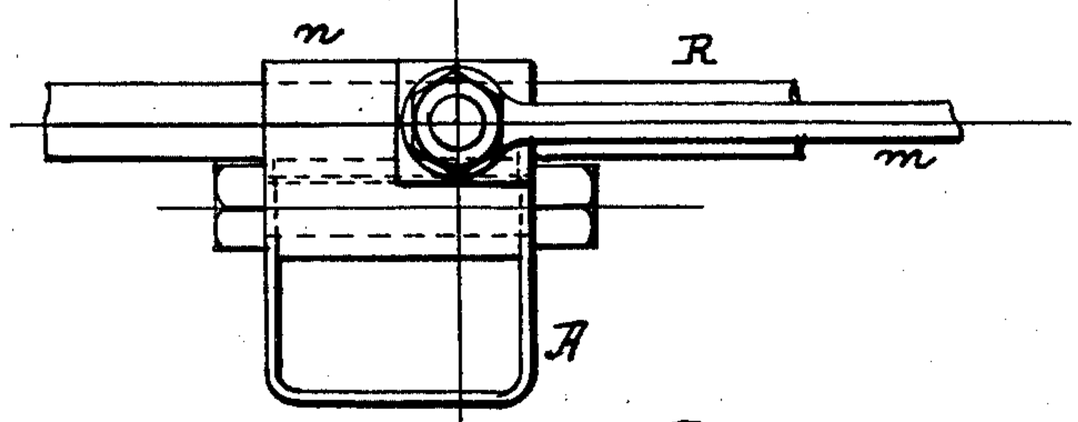


Fig. 7.

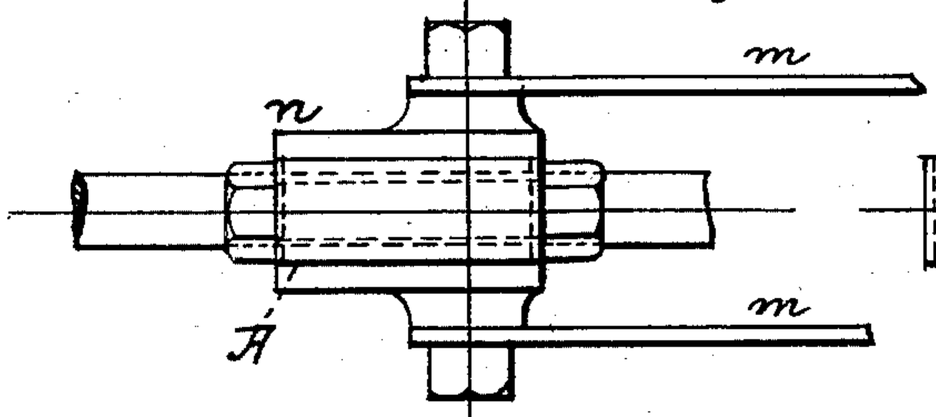
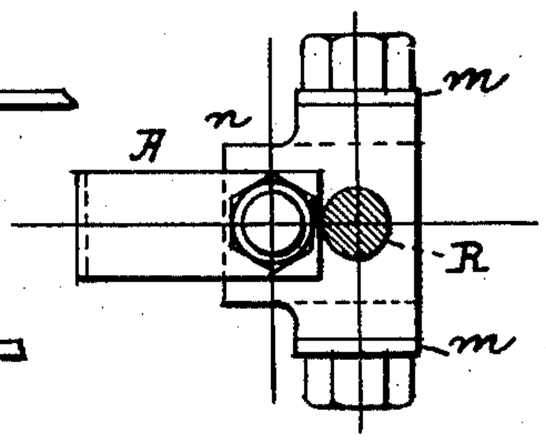


Fig. 6.



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UNITED STATES PATENT OFFICE.

ISRAEL BENJAMINS, OF NEW YORK, N. Y.

WINDMILL.

SPECIFICATION forming part of Letters Patent No. 711,195, dated October 14, 1902.

Application filed August 14, 1901. Serial No. 72,042. (No model.)

To all whom it may concern:

Be it known that I, ISRAEL BENJAMINS, a citizen of the United States, residing in the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Windmills, of which the following is a specification.

The invention relates to improvements in windmills; and it consists in the novel features and combinations hereinafter described, and particularly pointed out in the claims.

The object of the invention is to provide means for automatically varying the load of the windmill as the velocity of the wind changes, so as to maintain the ratio of the velocity of any point of the wheel to that of the wind fairly constant and of such value as to attain a maximum efficiency under all conditions of the wind, the load on the windmill being varied automatically with the automatic varying of the ratio of the angular velocity of the driven shaft to that of the wind-wheel and its shaft.

The invention will be fully understood from the detailed description hereinafter presented, reference being had to the accompanying drawings, in which—

Figure 1 is an elevation, partly in section and partly broken away, of all the features of a windmill necessary for a complete understanding of the invention. Fig. 2 is an enlarged detached detailed elevation of a slide for transmitting the motion of a rocker-arm to a grip for shifting the belt on a pair of cone-pulleys. Fig. 3 is an end view of same, the guide-rod being shown in section. Fig. 4 is a top view of same. Fig. 5 is an enlarged detailed elevation of the grip for the belt. Fig. 6 is an end view of same, the guide-rod being shown in section; and Fig. 7 is a top view of same.

In the drawings, D denotes the wind-wheel shaft or driving-shaft, and S designates the driven shaft or the shaft driven from the shaft D and whose power is utilized for operating the pump-rod or other mechanism. (Not shown.)

Upon the shafts D S are the conical pulleys P P, connected by the belt B, which is adapted to be shifted lengthwise of the said pulleys by means of a suitable grip A, attached to a slide *n*, guided on the fixed rod R. The slide *n* is connected by bars *m* with a slide *g*, having a pin *e* engaging the slotted rocker-arm or lever *r*, which is pivoted at *t* and adapted to be actuated or moved on its pivot by means of the centrifugal governor, comprising the usual weights G, pivoted links L, and sleeve or socket *d*, on the shaft D. The ring or sleeve *b* of the governor mechanism is connected by a pin *e'* with the rocker-arm *r* and is of usual character. To the grip A by means of a peg *h* is fastened one end of a cord E, said cord at its other end passing over a pulley K and then freely through central openings in a series of weights 1 to 6, inclusive, and being fastened to the lower weight 1. The weights 1 to 6, inclusive, are inclosed by a vertical frame F, having a series of parallel horizontal partitions affording seats for said weights, each weight having its own seat and said seats having central openings O so graded that any special weight may pass upward through the seats over it, but cannot pass downward below its own seat. The action of the grip A either effects an upward pull on the cord E against said weights, thereby lifting one or more of the weights, or releases the cord and permits said weights to settle, either a portion or all of them, on their seats. By reason of the separated seats for the weights 1 to 6 and the fact that said weights in series downward gradually lessen in diameter and the further fact that the openings in said seats are graded, as above described, the cord E when pulled upward will first lift the bottom weight 1 and carry it upward against the weight 2 and then lift the weight 2 (the latter resting on weight 1) until the weight 2 meets and elevates the weight 3 and the weight 3 moves upward against and elevates weight 4, and so on upward through the series of weights, the upward pull of the cord E lifting the weights one after another in series, commencing with the lowest weight. When the pull on the cord E is relinquished or lessened, the weights one after another in series, commencing with the upper weights, settle down upon their seats. The resistance offered by the series of weights 1 to 6, inclusive, is thus gradually applied and released. It will be understood, of course, that the six weights represent a maximum resistance and

that the resistance offered by the weights varies with the pull on the cord E, the latter lifting one or more of the weights, as occasion may require.

The operation of the mechanism above referred to is as follows: When the wind increases in velocity and tends to accelerate the motion of the wind-wheel and driving-shaft D, the centrifugal governor, acting through the rocker-arm *r*, causes the belt B to move on the pulleys P in a direction to increase the ratio of the angular velocity of the driven shaft S to that of the driving-shaft D, thus varying the load of the windmill as the velocity of the wind changes by automatically varying the ratio of the angular velocity of the driven or pump-rod shaft to that of the driving or wind-wheel shaft. In order that the belt B should not be carried too far by the rocker-arm *r* under the action of the governor and due to the increase in the velocity of the wind, the series of weights 1 to 6 are provided, said weights partly neutralizing the action of the governor. When the wind slackens down, the weights suspended move the belt B in a reverse direction along the pulleys P, thereby effecting the diminishing of the ratio of the velocity of the shaft S to that of the shaft D until some of the weights reach their seats and the remaining suspended weights are just balanced by the centrifugal governor. The exact magnitude for each of the weights and for any number of them in any given position of the belt B must be determined by calculation and experiment, having in mind the varying of the load of the mill as the square of the velocity of the wind. When the wind is light, the belt B will be on the left-hand portion of the pulleys P, so that the wind-wheel may turn under the action of a slight breeze, and as the wind increases and the motion of the wheel and its shaft D is accelerated the centrifugal governor, acting through the rocker-arm *r*, bars *m*, and grip A, will move the belt B toward the right on the pulleys P, the mill working with a maximum efficiency throughout the entire range of the velocities of the wind.

It is to be observed that under an increase in the velocity of the wind the belt B will be shifted toward the larger end of the pulley P on the driving-shaft and the smaller end of the pulley P on the driven shaft and that under a decrease in the velocity of the wind the said belt will be shifted toward the smaller end of the pulley on the driving-shaft and the larger end of the pulley on the driven shaft, by reason whereof the driven shaft is required to change its rate of speed more rapidly than does the driving-shaft, the object being that should, for illustration, the wind double in velocity the driving-shaft shall run about twice as fast as before and the driven shaft about eight times faster than before, and under such condition the load on the wheel will be about four times as great as before. If, for illustration, the wind should treble in force, the driving-shaft should run about three times as fast as before and the driven shaft about twenty-seven times faster than before, and under such condition the load on the wheel will be about nine times as great as before.

The windmill of my invention involves distinctly new features of construction and principles of operation in that with the employment of my invention I maintain fairly constant that ratio of the velocity of any point of the wheel to that of the wind which affords a maximum efficiency in the mill by automatically varying the load on the windmill and the ratio of the angular velocity of the driven shaft to that of the wind-wheel and its shaft as changes in the velocity of the wind occur. If it should be deemed that the highest efficiency of a mill may be attained when the tips of the wind-wheel blades travel two and one-half times as fast as the wind, I am enabled by means of my invention to maintain fairly constant this ratio of the velocity of the wheel to that of the wind under all conditions of the wind, and thus to at all times secure a maximum efficiency in the mill. When I say that under the varying conditions of the wind the load on the mill is "automatically varied," I do not mean that I vary the length of the stroke of the reciprocating pump or piston rod, but that the ratio of the angular velocity of the driven shaft to that of the wind-wheel and its shaft is automatically varied, the length of the stroke of the pump-rod remaining the same at all times and under all conditions of the wind, this load on the mill automatically varying in accordance with the condition of the wind and increasing with a strong wind and decreasing with a light wind.

In the foregoing description I speak of a reciprocating pump-rod as being operated from the shaft S; but I do not wish my invention limited to the use of a reciprocating pump-rod, since the invention is of broader scope and since, for illustration, the endless chain of a chain bucket-pump may with advantage be operated from the shaft S and the value of my invention be realized in connection therewith.

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

1. In a windmill, the driving-shaft to be operated from the wind-wheel, the driven shaft for transmitting the power to the mechanism to be operated by the mill, and variable power-transmitting means connecting said shafts for communicating motion from the said driving-shaft to said driven shaft and permitting of the relative speed of said shafts to be varied in accordance with changes in the velocity of the wind, combined with means subject to the action of the wind and engaging said transmitting means for automatically and positively varying the ratio of the angu-

lar velocity of the said driven shaft to that of said driving-shaft in accordance with the velocity of the wind, the said means which engage said transmitting means being arranged to under a greater velocity of the wind more rapidly increase the speed of the driven shaft than the speed of the driving-shaft is increased by such wind, and to under a decreased velocity of the wind more rapidly decrease the speed of the driven shaft than the speed of the driving-shaft is decreased due to such change in the wind, whereby the ratio of the velocity of any point of the wind-wheel to that of the wind may be maintained fairly constant and of such value as to give a maximum efficiency for all winds; substantially as and for the purposes set forth.

2. In a windmill, the driving-shaft to be operated from the wind-wheel, and the driven shaft for transmitting the power to the mechanism to be operated by the mill, combined with the conical pulleys on said shafts, the belt on said pulleys, and means for automatically shifting said belt on said pulleys to vary the ratio of the angular velocity of the said driven shaft to that of said driving-shaft in accordance with the velocity of the wind, said means being adapted under a greater velocity of the wind to shift said belt toward the larger end of the pulley on the driving-shaft and the smaller end of the pulley on the driven shaft, and under a decreased velocity of the wind to shift said belt toward the smaller end of the pulley on the driving-shaft and the larger end of the pulley on the driven shaft, whereby the ratio of the velocity of any point of the wind-wheel to that of the wind may be maintained fairly constant and of such value as to give a maximum efficiency for all winds; substantially as and for the purposes set forth.

3. In a windmill, the driving-shaft to be operated from the wind-wheel, and the driven shaft for transmitting the power to the mechanism to be operated by the mill, combined with the conical pulleys on said shafts, the belt on said pulleys, the centrifugal governor connected with said driving-shaft, and means to be actuated by said governor for shifting said belt on said pulleys to vary the ratio of the angular velocity of the said driven shaft to that of said driving-shaft in accordance with the velocity of the wind, the said means being adapted under an increase in velocity in the wind, to shift said belt toward the larger end of the pulley on the driving-shaft and the smaller end of the pulley on the driven shaft, and under a decrease in velocity of the wind to shift said belt toward the smaller end of the pulley on the driving-shaft and the larger end of the pulley on the driven shaft, whereby the ratio of the velocity of any point of the wind-wheel to that of the wind may be maintained fairly constant and of such value as to give a maximum efficiency for all winds; substantially as set forth.

4. In a windmill, the driving-shaft to be operated from the wind-wheel, and the driven shaft for transmitting the power to the mechanism to be operated by the mill, combined with the conical pulleys on said shafts, the belt on said pulleys, the centrifugal governor connected with said driving-shaft, a slide engaging said belt for shifting the same on said pulleys, means for actuating said slide from said governor to shift said belt, under an increase in velocity in the wind, toward the larger end of the pulley on the driving-shaft and the smaller end of the pulley on the driven shaft, and, under a decrease in velocity of the wind, toward the smaller end of the pulley on the driving-shaft and the larger end of the pulley on the driven shaft, and the series of weights connected with said slide and resisting the movement of the latter and said belt during increasing velocities of the wind, the shifting of said belt being to vary the ratio of the angular velocity of the said driven shaft to that of said driving-shaft in accordance with the velocity of the wind, whereby the ratio of the velocity of any point of the wind-wheel to that of the wind may be maintained fairly constant and of such value as to give a maximum efficiency for all winds; substantially as and for the purposes set forth.

5. In a windmill, the driving-shaft to be operated from the wind-wheel, and the driven shaft for transmitting the power to the mechanism to be operated by the mill, combined with the conical pulleys on said shafts, the belt on said pulleys, the centrifugal governor connected with said driving-shaft, the rocker-arm to be actuated by said governor, and means connecting said arm and said belt for shifting the latter, under an increase in the velocity of the wind, toward the larger end of the pulley on the driving-shaft and the smaller end of the pulley on the driven shaft, and under a decrease in velocity in the wind, toward the smaller end of the pulley on the driving-shaft and the larger end of the pulley on the driven shaft, thereby to vary the ratio of the angular velocity of the said driven shaft to that of said driving-shaft in accordance with the velocity of the wind, whereby the ratio of the velocity of any point of the wind-wheel to that of the wind may be maintained fairly constant and of such value as to give a maximum efficiency for all winds; substantially as and for the purposes set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ISRAEL BENJAMINS.

Witnesses:
B. L. GEISHEWITZ,
SAMUEL ROTROSEN.