(No Model.) 4 Sheets—Sheet 1

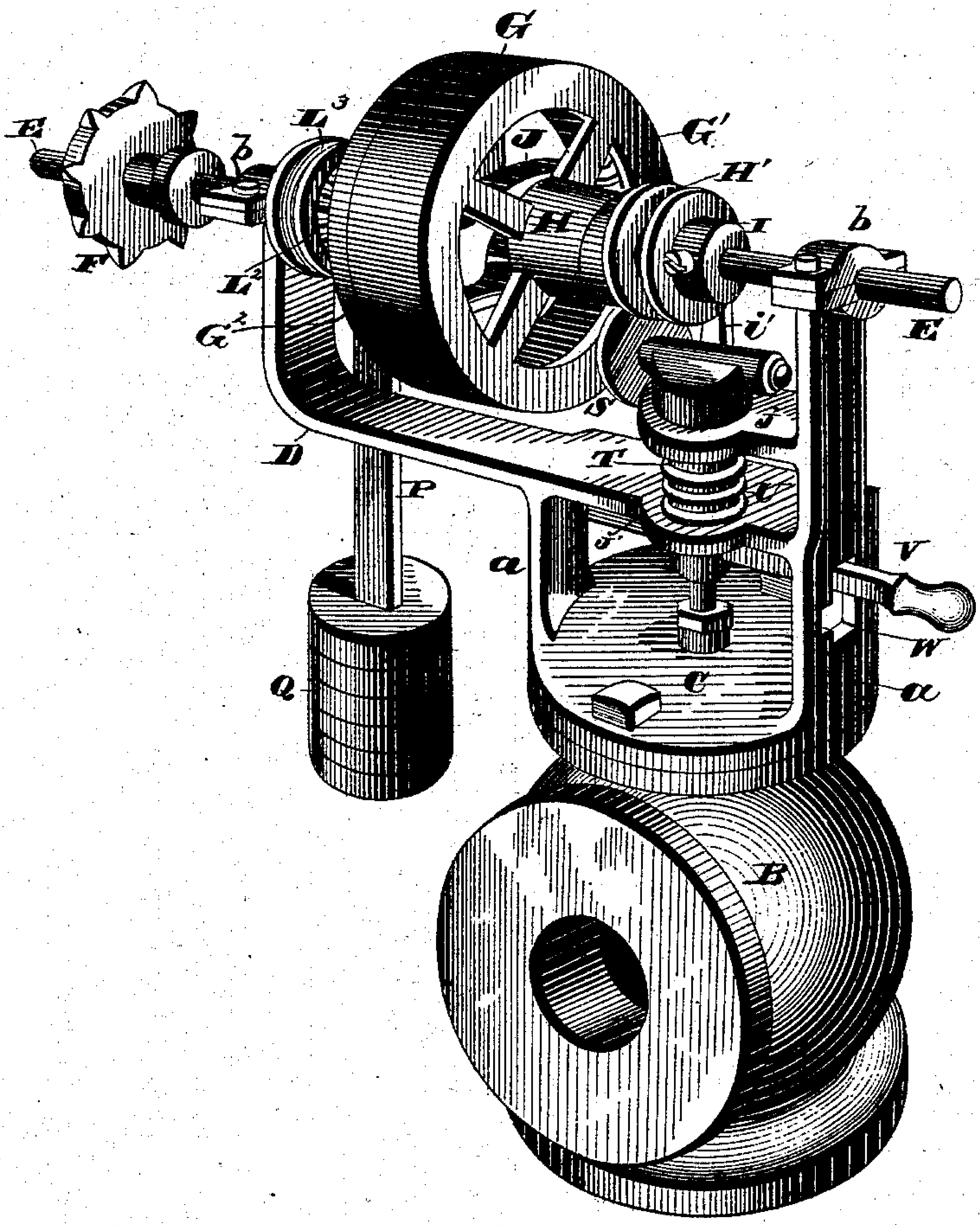
J. D. WILLOUGHBY, Dec'd.

D. E. ADAMS, administrator.

SPEED GOVERNOR FOR STEAM ENGINES.

No. 282,480. Patented Aug. 7, 1883.

Fig. 1.



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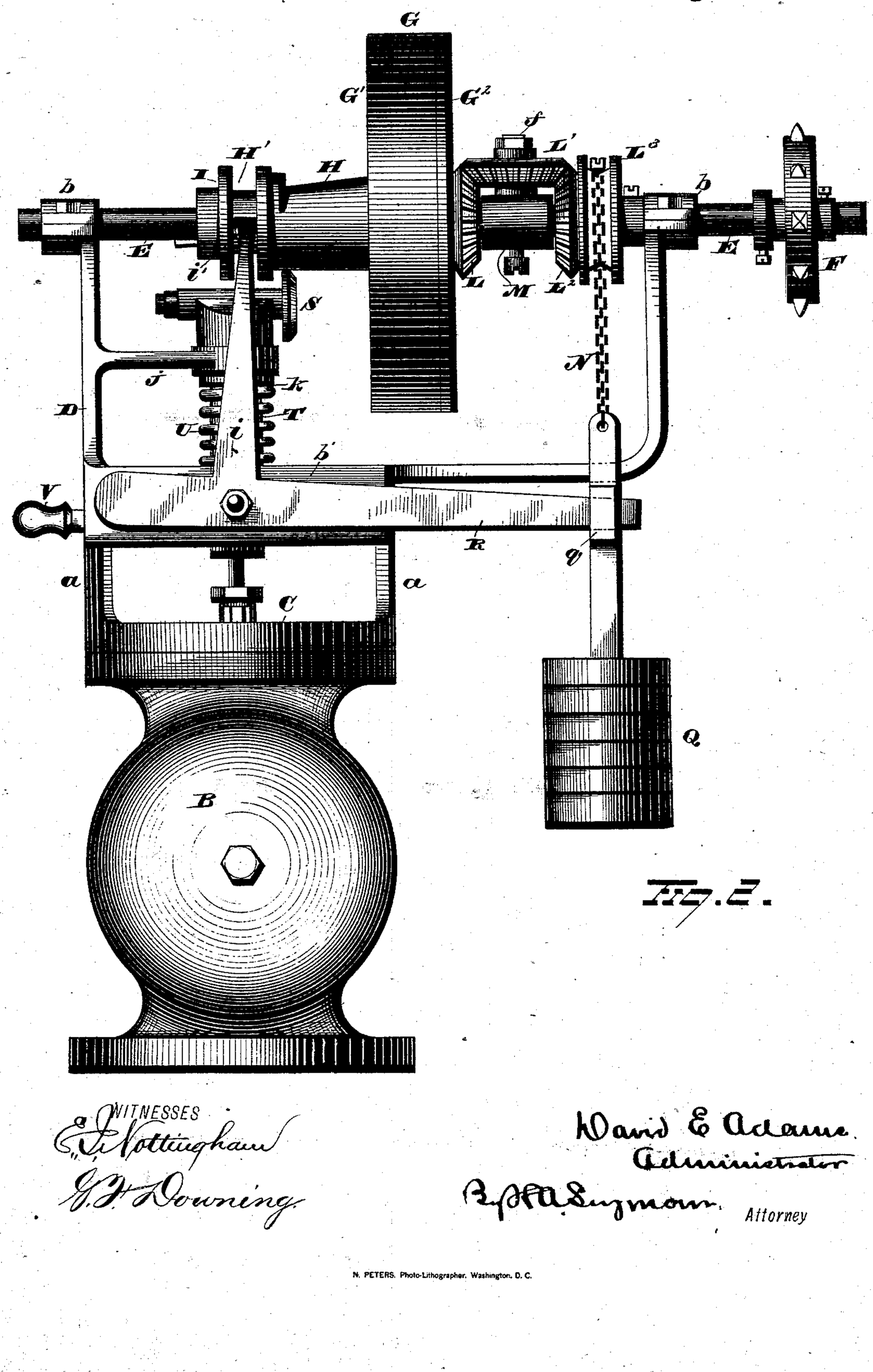

Fig. 2.

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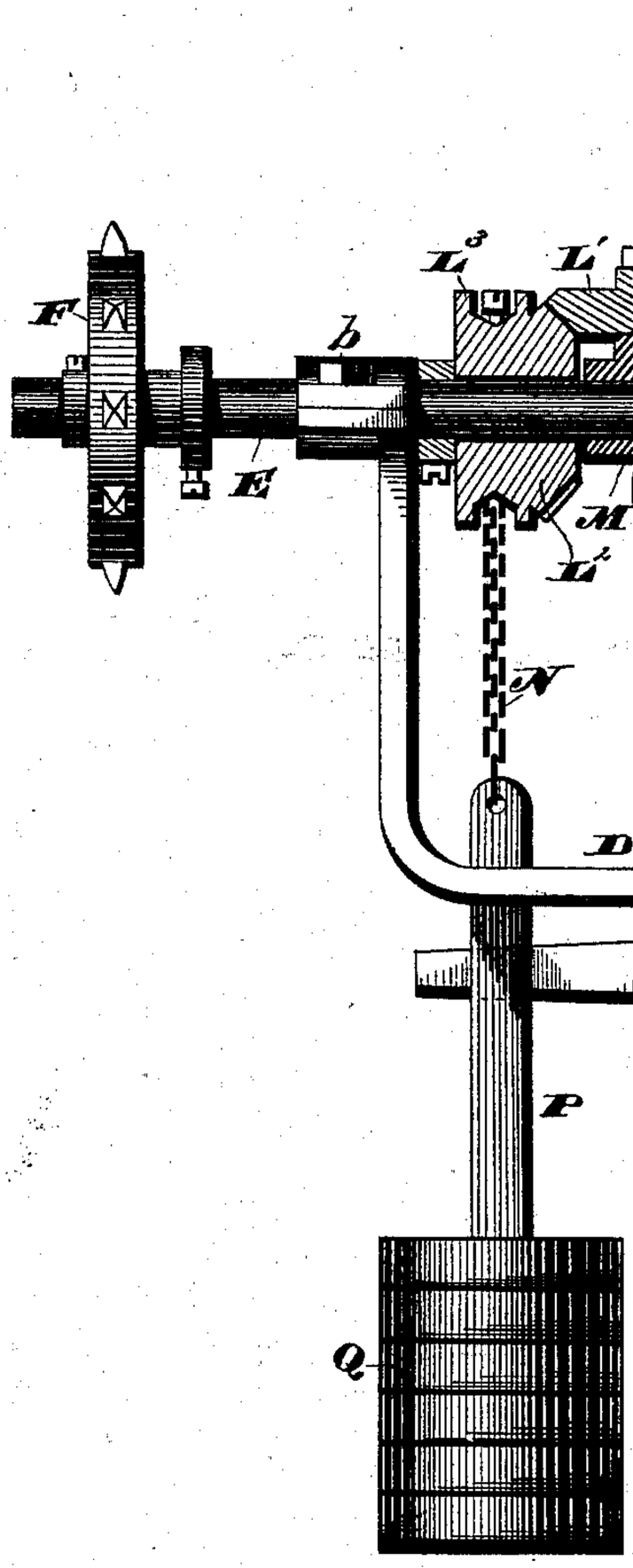

Fig. 3.

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SPEED GOVERNOR FOR STEAM ENGINES.

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Fig. 4.

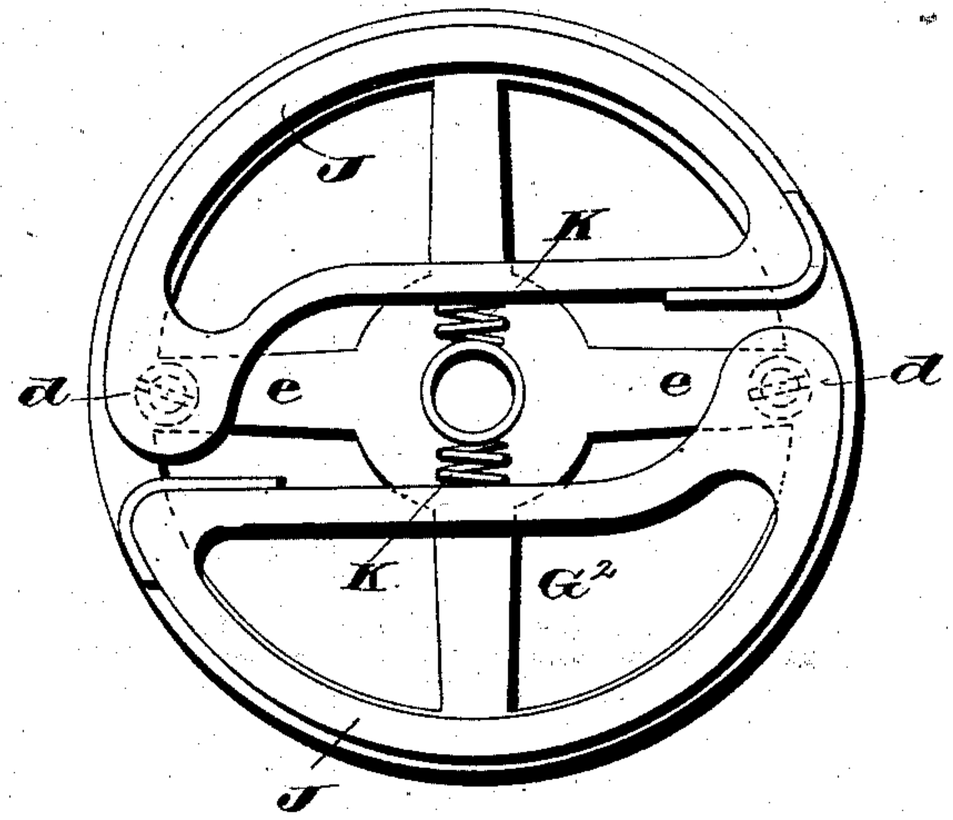
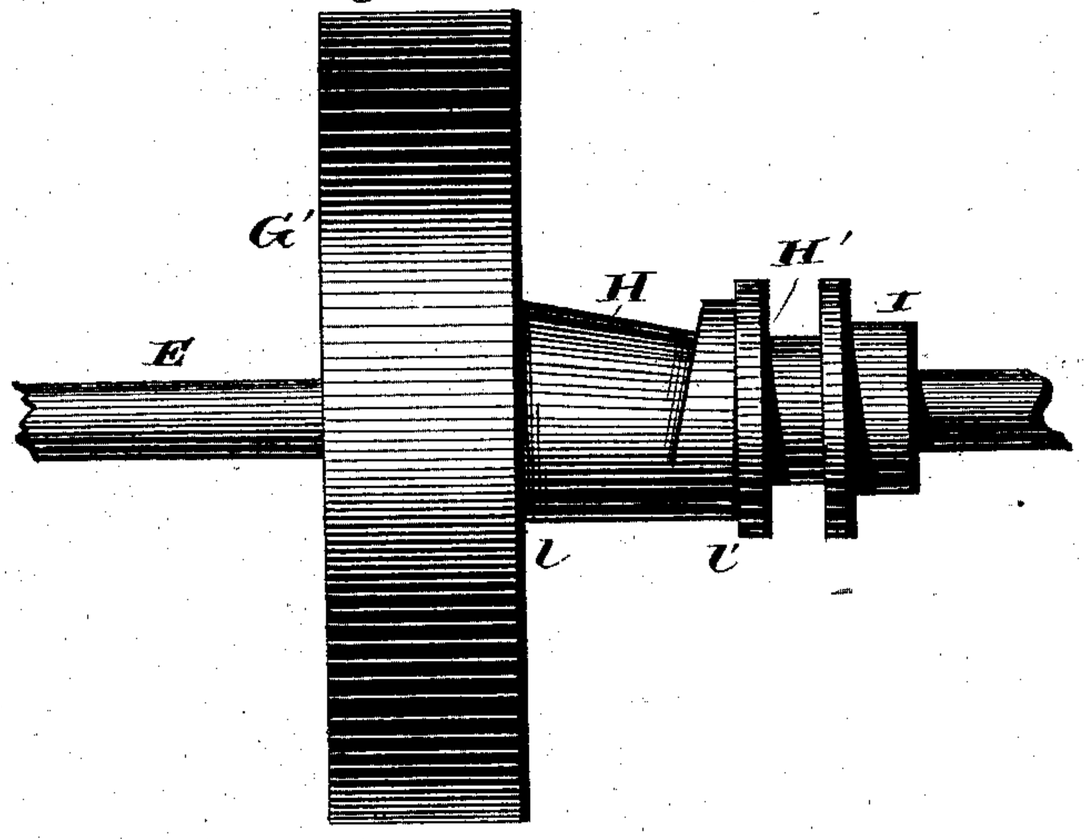


Fig. 5.



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UNITED STATES PATENT OFFICE.

DAVID E. ADAMS, OF PITTSBURG, PENNSYLVANIA, ADMINISTRATOR OF JAMES D. WILLOUGHBY, DECEASED.

SPEED-GOVERNOR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 282,480, dated August 7, 1883.

Application filed May 10, 1883. (No model.)

To all whom it may concern:

Be it known that JAMES D. WILLOUGHBY, deceased, late of Pittsburg, county of Allegheny, and State of Pennsylvania, did invent a new and useful Improvement in Speed-Governors, of which the following is a specification.

This invention relates to an improvement in speed-governors for steam-engines, the object of the same being to provide means for positively regulating the speed of the engine, whether the same be heavily loaded or with no load at all; and with these ends in view my invention consists in certain details in construction and combinations of parts, as will be more fully explained, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a perspective view of my improved governor. Fig. 2 is a side view of the same. Fig. 3 is a vertical sectional view through the sliding shaft. Fig. 4 is a detail view of the fly-wheel or friction device with its intermediate gearing, and Fig. 5 is a view of the cam.

A represents an ordinary balanced valve, B the casing, and C the casing-head, which latter is secured to the casing in any suitable manner, and is provided with the upright standards *a*, which latter are adapted to support the frame D. This frame D is provided on top with the bearings *b*, in which the horizontal shaft E is journaled and moves. The horizontal shaft E is connected directly with the main driving-shaft of the engine (not shown in the drawings) by a suitable chain or belt, which latter passes over the sprocket or belt wheel F on the horizontal shaft E, and moves it simultaneously with the main driving-shaft. The horizontal shaft E is also provided with the two-part drum G, the operating-cam H, operating-collar I, and suitable gearing, adapted to move one part of the drum at a greater speed than the remaining portion. This drum G^2 is composed of the parts G′ and G^2, the part G′ being rigidly secured to the shaft E and provided with the annular flange *c*, against which the arms J bear, while the part G^2 is loosely secured thereto and forms one side of the drum. These arms J (two in number) are semicircular in shape, and are about the width of the inner face of the flange, so that when the arms bear against the said flange the greatest amount of frictional contact between the surfaces will be produced. The arms J are provided with the enlarged heads or hubs *d*, by which they are secured to the inner face of the spokes *e* of the portion G^2 of the drum in any suitable manner, and are covered on their outer curved surfaces or peripheries with leather or other suitable material, to enable them to engage the inner face of the flange *c* and produce sufficient friction thereon to retard the forward movement of the portion G^2 of the drum. The arms J are so shaped that when they are secured in their proper position they form nearly a complete circle, and are pivoted to the spokes *e* on opposite sides of the hub, so as to enable both arms to be thrown outward against the flange *c* by centrifugal force and create a friction.

K are springs secured to each arm J, and are adapted to bear against the hub of the portion G^2, fly, or friction, and hold the arms outward and prevent them, when the machine is traveling at a slow rate of speed, from falling on the hub and producing noise, which would take place when the centrifugal force was not sufficient to hold the arms against the flange of the part G′ of the drum or wheel G.

L is a bevel-gear wheel rigidly secured to the portion G of the fly or friction wheel, and is adapted to mesh with the bevel-gear wheel L′, journaled on an arm, *f*, of the sleeve M, which latter is rigidly secured to the shaft E and moves therewith. This bevel-wheel L′ also meshes with the loose bevel-wheel L^2, to which latter the pulley or chain wheel L^3 is rigidly secured. The chain wheel or pulley L^3 is provided with means for attaching one end of the chain N thereto, while the other or lower end of the chain passes downward and is secured to the upper end of the arm P, on which removable weights, Q, are adapted to be placed when it is desired to increase the speed of the machine. The weighted arm P is provided near its upper end with the slot *q*, in which the end of the horizontal arm of the bell-crank lever R works. This bell-crank is pivoted to the frame at *b*′, and its vertical arm *i* is provided at its upper end with the finger *i*′, adapted to engage with the annular groove H′ in the cam H, or in a collar rigidly secured to the cam, which latter rests directly over the roller S, secured to the valve-stem T, and regulates

the admission of steam. The valve-stem T passes up through the guides *j* and *j'*, and is provided with the shoulder *k*, against which the spiral spring U bears and holds the balanced valve A and the roller S in position.

V is a hand-lever secured to the valve-stem T, and passes out through the elongated L-shaped slot W in the standard *a*. When it is desired to open the valve the hand-lever V is depressed and turned into the horizontal portion of the L-shaped slot, which causes the openings in the valve to register with the openings in the globe around the same, and allows the steam to pass into the cylinder of the engine. This hand-movement and low position of the valve are necessary to free it from the operation of the cam and allow the valve to stand open when starting or stopping the engine.

In starting or stopping the engine the throttle-valve is made use of in stopping to prevent the engine from standing on a dead-point, and in starting the engine to admit the necessary amount of steam to get up the speed desired, after which the valve is liberated from the position in which it was held by the hand-lever, and is then controlled by the cam. The construction and form of the cam are shown in Fig. 5. The two ends *l* and *l'* of the same are of a size sufficient to hold the valve in a closed position, while that portion between the dotted lines is cut away more or less to allow the stem to alternately rise and wholly or partly open the ports. After the engine has been started and speed obtained to produce friction enough between the arms J and the part G' of the drum to overcome the weights the shaft E is automatically moved to the left, as will be hereinafter more fully described, and moves with it the cam. As the cam moves along the cut-away portion thereof comes above the roller and allows the ports to open their full width, which starts the machines, the latter settling itself down to a steady speed.

To start the engine, the hand-lever V is moved down in the L-shaped slot and secured in the horizontal arm thereof, which opens the port and permits steam to enter the engine sufficient to run it. After the engine is started the hand-lever V is liberated from the slot, and the motion of the valve controlled by the cam. Motion is transmitted from a main shaft to the shaft E through the intervention of a suitable chain or belt. As this shaft E revolves the larger portion, G', of the drum, being rigidly secured thereto, necessarily revolves at the same rate of speed therewith, but the smaller portion, G^2, of the said fly-wheel, being loosely journaled on the said shaft or hub of the drum, is free to revolve independently of the remaining portion, but, being in gear with the wheel L', which is journaled to a sleeve rigidly secured to the said shaft, is also caused to revolve in the same direction therewith.

As before stated, the portion G^2 of the drum G is loosely journaled on the shaft E, but is in gear with the bevel-wheel L' through the intervention of the bevel-wheel L, while the said bevel L' is also in gear with the bevel-wheel L^2, which, when the engine is running at a steady speed, remains stationary, and merely performs the function of a rack-bar. Now, it follows that if the bevel-wheel L' were merely a clutch to engage the portion G^2 of the fly-wheel G, the said portion would only be revolved at the same speed with the remaining portion thereof. But in addition to performing the office of a clutch, as it does, and simply turning the portion G^2 of the fly-wheel G at the same speed with the remaining portion thereof, it also revolves once on its own axis by means of its engagement with the rack before described, which rotary motion is imparted to the bevel-wheel L, secured to the portion G^2 of the fly, and consequently causes it to be revolved once at each revolution of the shaft by the rotary motion of the bevel-wheel L' alone. From the foregoing it will be seen that at each revolution of the shaft E the portion G^2 of the fly-wheel is caused to revolve once by its simple engagement with the bevel-wheel, L' (the same as if the said bevel-wheel were a clutch revolving with the shaft E,) and once by each complete revolution of the bevel-wheel L' on its own axis, thereby making two revolutions while the remaining portion thereof is making one. After the engine has been started the ports *m* are opened to their full extent, and the chain N is carried around the pulley L^3 until the friction balances the weight. If the speed of the engine should increase, the arms J are thrown outward with increased force by centrifugal action, and produce considerable friction between the arms J and the flange *c*, which increases as the speed increases. Before the machine is started, however, a predetermined number of weights, Q, are placed on the arm P, and just the instant the friction between the two parts of the fly-wheel is sufficient to overcome the weights Q the speed of the portion G^2 of the drum is checked, which causes the bevel-wheel L' to remain stationary on its own axis, and the wheel L^2 and pulley L^3, being loosely journaled on the shaft E, are caused to turn in the direction of the drum, which elevates the weights Q and moves the bell-crank to the left, which carries with it the cam H and shaft E, to which the said cam is rigidly secured. As the cam H is moved to the left the cut-away portion thereof gradually diminishes until the end is reached, which is sufficient to keep the ports of the valve in a closed position. As the ports are gradually closed the speed of the machine is decreased until the original predetermined speed has been reached, when the wheel L^2 and pulley L^3 turn back to their original position, and the weights drop to their original position and carry with them the bell-crank, which latter carries with it the cam H and shaft E. To increase the speed of the machine, it is simply

necessary to add more weights to the arm P, and to decrease the speed thereof, it is simply necessary to remove one or more weights.

This machine is very positive in its action, and by actual test no perceptible difference in speed could be observed between the engine when heavily loaded and not loaded at all. One important feature in this case is that when the friction and weight are balanced the engine will run regularly and smoothly at that point without oscillating backward and forward, and thereby constantly changing the speed thereof by letting on and cutting off steam.

The friction device or drum G, being weighty, acts as a fly-wheel, and the loose sleeve or pulley L^3, on which the chain N wraps, is, as it were, balanced, and when there is an increase or decrease of speed in the engine that sleeve or pulley L^3 will be caused to move in the proper direction to give more or less steam, as the case may be.

It is evident from the foregoing that numerous changes both in the construction and relative arrangement of the different parts of my improvement may be resorted to without departing from the spirit of my invention, and hence I would have it understood that I do not limit myself to the particular form or construction shown and described, but consider myself at liberty to make such changes as come within the spirit and scope of my invention.

Having fully described the invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the valve-stem, of a revolving shaft, a two-part drum, one portion being provided with a cam rigidly secured to said shaft and adapted to actuate the valve, and the other portion being loosely mounted on said shaft, and mechanism, substantially as described, for moving the loosely-mounted portion of the drum at a different rate of speed from the other portion of the drum, substantially as set forth.

2. The combination, with the valve-stem, of a revolving shaft situated above the same and provided with a cam rigidly secured thereto, a two-part friction-drum, one part of which is rigidly secured to the shaft while the other part is loosely journaled thereon and adapted to be revolved in the same direction with the said rigid part, but at a greater speed, a bell-crank one end of which is weighted and connected to the mechanism, substantially as described, for imparting the rapid rotary motion to the friction device, while the other end is engaged in a collar on the said shaft, the said bell-crank being adapted, when the friction between the wheel and friction device equals or exceeds the weights, to move the said shaft with the mechanism secured thereon longitudinally, so as to bring that portion of the cam above the valve-stem, which will admit just enough steam to equalize the friction and weight, substantially as set forth.

3. The combination, with the shaft, of a two-part friction-drum thereon, and mechanism for moving one part of the said drum at a greater speed than the other portion.

4. The combination, with the shaft of the two-part friction-drum, one of the said parts being rigidly secured to the said shaft, and provided with a peripheral flange, the other portion being provided with pivoted arms, which latter are adapted to bear against the said peripheral flange, and mechanism for rotating the portion of the wheel with the pivoted arms at a greater speed than the other portion thereof, substantially as set forth.

5. The combination, with the shaft E, cam H, and means for imparting a rotary motion to the said shaft, of the drum G, composed of the parts G' G^2, arms J, bevel-wheels L L' L^2, pulley or sleeve L^3, chain N, weights Q, and bell-crank R, all of the above parts constructed and adapted to operate substantially as set forth.

6. The combination, with the shaft E, cam H, drum G, composed of the parts G' G^2, arms J, bevel-wheels L L' L^2, pulley or sleeve L^3, chain N, arm P, weights Q, and bell-crank R, adapted to operate as described, of the valve-stem T, spring U, and means for imparting a rotary motion to the said shaft, substantially as set forth.

7. The combination, with the casing B, casing-head C, frame D, valve A, valve-stem T, and spring U, the said valve-stem being provided on top with a roller, S, of the shaft E, collar I, cam H, drum G, composed of the parts G' G^2, arms J, bevel-wheels L L' L^2, pulley or sleeve L^3, chain N, weights Q, bell-crank R, and means for imparting a rotary motion to the said shaft.

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

DAVID E. ADAMS,
Administrator.

Witnesses:
THOS. T. WIGHTMAN,
MARSHALL JOHNSTON.