

(No Model.)

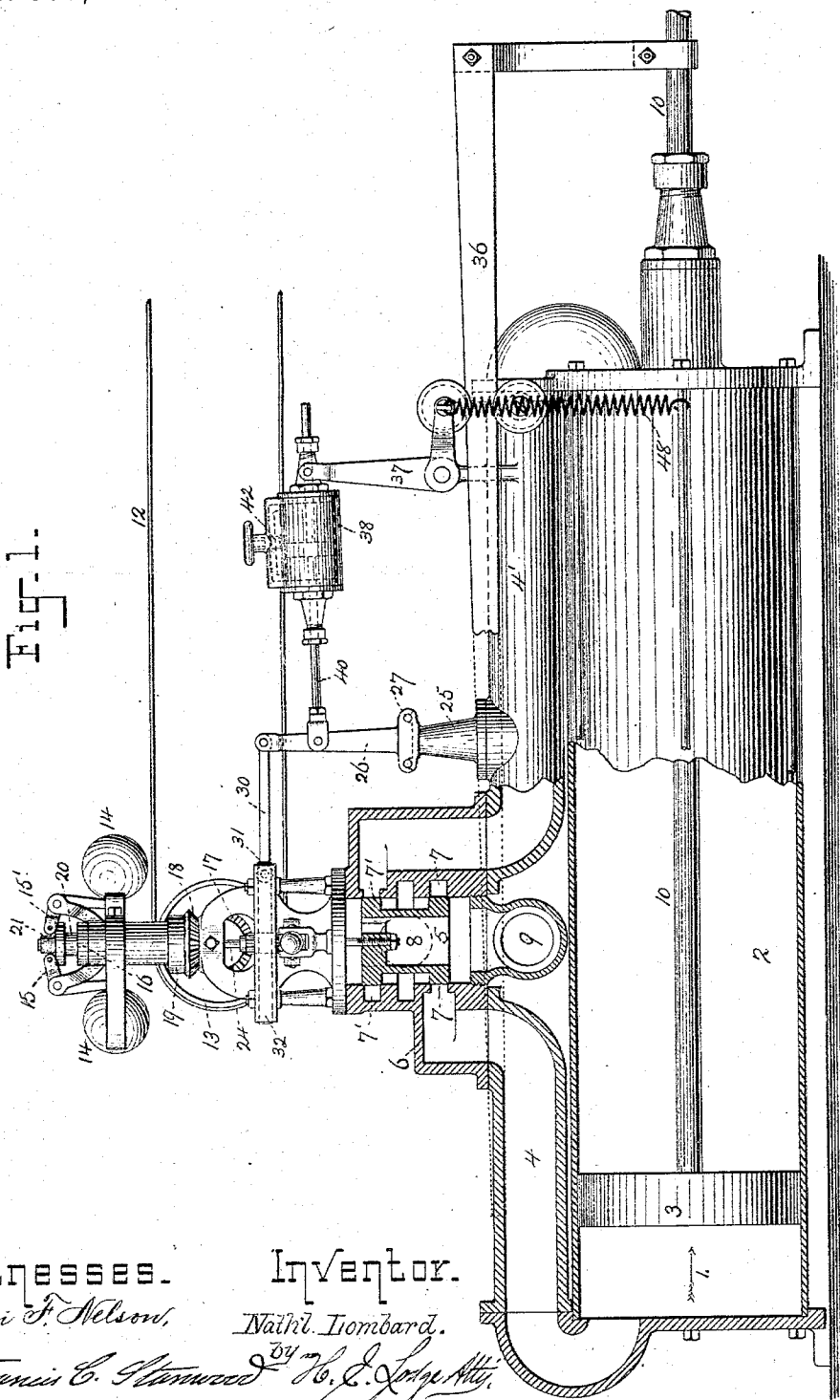
2 Sheets—Sheet 1.

N. LOMBARD.
SPEED REGULATOR.

No. 533,656.

Patented Feb. 5, 1895.

Fig. 1.



Witnesses.

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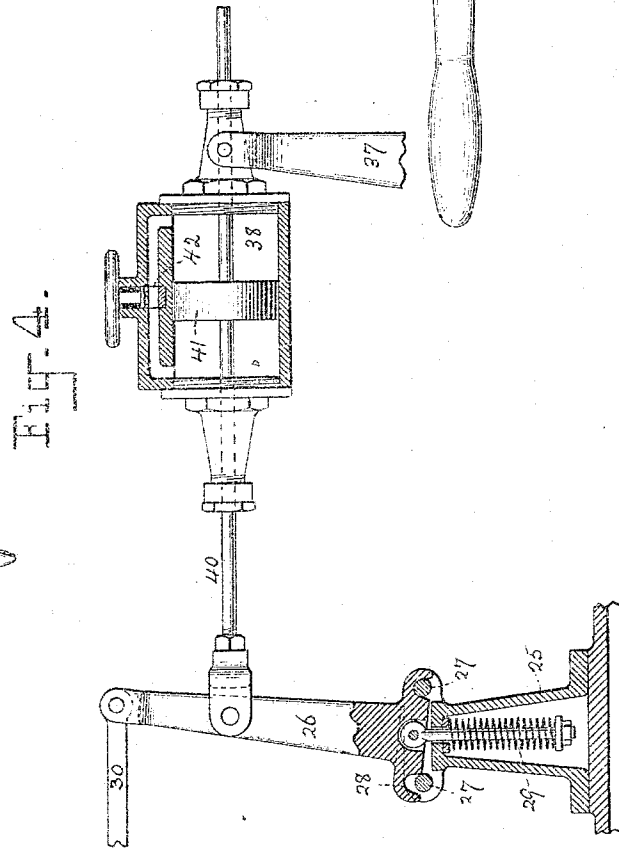
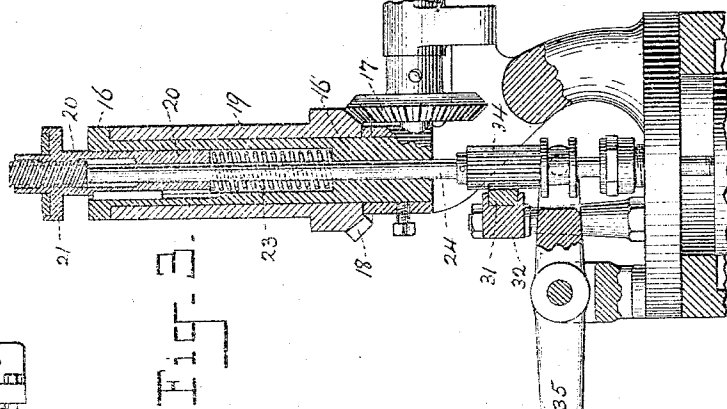
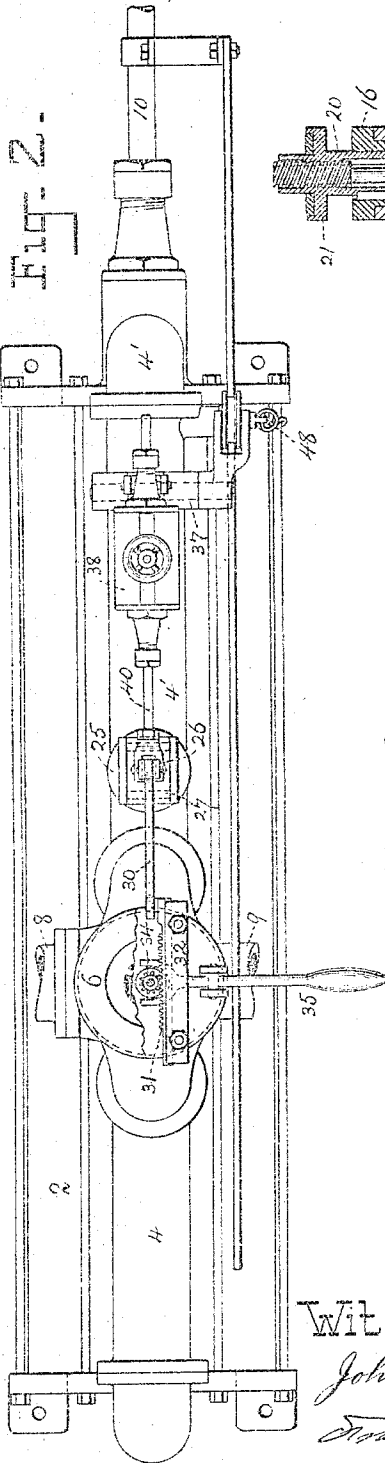
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2 Sheets—Sheet 2.

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SPEED REGULATOR.

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Witnesses.

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UNITED STATES PATENT OFFICE.

NATHANIEL LOMBARD, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE LOMBARD WATER WHEEL GOVERNOR COMPANY, OF SAME PLACE.

SPEED-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 533,656, dated February 5, 1895.

Application filed August 14, 1894. Serial No. 520,258. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL LOMBARD, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Speed-Regulators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in speed regulators, particularly that class operated by centrifugal action upon revolving weights. It is a well known fact that in regulators of this class there is a tendency to continued changes due to various agencies, as the amount of work, steam pressure, or other incidental causes. As these changes require more or less motive power in the form of steam, water or gases, the valve which admits such and is controlled by the speed regulator is being incessantly shifted. In consequence of these changes very frequently continual variations in speed occur due to the excessive diminution or increase of the fluid agency—that is, if a change in the main valve is made, the period during which the valve is opened or closed is too long. As a result in the event of the speed falling below the normal the regulator causes the valve to open, and this latter in lieu of being opened a certain amount and then stopped continues to open. The result is that the speed increases until the normal is not only reached, but very often exceeded, when the weights again operate to partially close the valve, and perhaps reduce the speed too much. However this may be, the general effects of the present and most approved speed regulators are to keep the apparatus fluctuating constantly. This tends to maintain the speed not at a steady normal rate, but either too fast or too slow.

The purpose and object of my invention is to endeavor to preserve the speed at a normal, and when the main valve which admits the actuating medium is shifted by the action of the weights, to produce a change, certain

mechanism is put into activity to operate a secondary valve, which checks the movement of the main valve before the full effects of the change in the said main valve upon the motion is fully felt; hence excessive variations cannot take place. If, as before instanced, the speed is below the normal the weight opens the main valve which is very soon stopped; the full amount of gate demanded by the balls not being used. If this is not sufficient the weights again operate and these acts are repeated, the main valve which admits the power, as steam or water, being successively changed until the desired degree of opening or closing is attained.

My present improvements relate to that class of speed regulators in which the main gate or valve supplying the medium, as steam, water or gas, is held in position or changed, as circumstances may require, by means of a piston adapted to reciprocate within a fluid-filled cylinder, the fluid in the latter being allowed to circulate from end to end, and by such circulation to permit movements of the piston. This circulation is regulated by means of a secondary valve under the control of the speed regulator weights, and normally said valve is closed over both inlet and outlet ports by which means the main gate is held locked fast and prevented from moving.

My invention is embodied as before premised in mechanism which operates to bring the secondary valve or that which regulates the circulation of liquid within the closed cylinder to a fixed predetermined position and so maintains it. This secondary valve however is free to be shifted by the action of the regulator weights, and such shifts or changes cause the piston to move within the cylinder; but the mechanism which I consider as novel is intended to return the secondary valve at once or very shortly thereafter to its normal or closed position after it has been shifted or opened by the regulator weights, and also to allow return of the weights to their proper place, and which departure necessitated more or less movement of the main valve, without disturbing the position of the secondary valve. In brief this mechanism comprises a stationary post adapted to rock and to which is attached two oppositely disposed rods, one

equipped with a piston contained within a brake cylinder for air or fluid. The other rod terminates in a rack, which engages a pinion fast about the secondary valve rod. Thus this valve is adapted to be opened by the regulator weights, while the travel of the piston in the main cylinder serves to reciprocate a tapered bar, which rocks a bell-crank lever and tilts the post to close the secondary valve. The time during which the post is inclined from the vertical is intended to allow the weights to shift their position commensurate with the change in the speed due to the movement of the secondary valve without changing the said valve from its normal closed position.

The other peculiar features and the method of operating the various parts which co-operate to produce the object to be attained under my invention will be hereinafter fully set forth and explained.

The drawings represent in Figure 1 a longitudinal sectional elevation of a speed regulator equipped with mechanism embodying my invention. Fig. 2 is a plan. Fig. 3 is a vertical central sectional elevation in part of the regulator proper, and secondary valve-stem, and transversely of the main cylinder. Fig. 4 is an enlarged view of the rocking post and the secondary cylinder which serves as the resistance to the movement of said post.

In said drawings I have shown a closed cylinder 2 liquid-filled and adapted to contain a piston 3 which is capable of movement therein only as the liquid circulates from one side of said piston to the other. This is effected by means of two pipes 4, 4', which connect with a valve 5 termed the secondary valve. This valve is located within a casing 6 and contains the feed parts 7, 7', respectively for the pipes 4, 4', as likewise a common discharge 8. The supply pipe is at 9, while a rod 10 interconnects the piston with the main gate or valve, not shown, which admits the active medium as steam, water or gas to the prime motor.

A belt 12 to the pulley 13 serves to rotate a pair of centrifugal weights or balls 14. These latter are supported on levers 15, 15', which are mounted upon a fixed upright 16. Rotation of the balls is created by means of the toothed wheel 17 which meshes with another 18 affixed to the lower end of a sleeve 19 secured to the upright. A flanged tube 20 is placed within the upright standard and is constructed to reciprocate, but not to rotate by aid of a spline and groove connection. The flange 21 bears against the inner ends of the ball levers, while a spring 23 maintains these parts in contact.

Centrally of the standard is located the rod or stem 24 of the secondary valve. The upper end of this valve-stem or rod 24 is screw-threaded and engages the bore of the tube 20. Hence it will be understood that the flanged tube 20 is adapted to move up and down according to the changes in the

position of the balls due to varying speed in the rotation of the sleeve 19. Such reciprocations likewise carry the valve 5 and valve-rod 24 and serve to open the valve wholly or in part, according to the amount of change in the speed; but when circulation takes place in the cylinder 2 the piston 3 is advanced and such movement is accompanied by rotation of the valve-stem. This latter act serves to close the secondary valve without further change in the position of the balls. Immediately after such closing of this valve the balls begin to move again in order to resume the position they held prior to this change in the gate which has just been effected, this movement of the balls being occasioned by the prime motor now influenced by this change of gate. To prevent the secondary valve being actuated by such movement of the balls and to retain the valve closed at times and again to allow it to be opened at other times is one of the important features of my invention which I shall now proceed to describe.

To effect rotation of the valve stem 24 at proper times and to cause the operating mechanism to quickly close the valve I have employed the following group of instrumentalities: Upon the top of the pipe 4' for compactness of form is secured a hollow block or pedestal 25 which is capped to receive the base of a rocking post 26. The manner of uniting these two pieces is very simple and consists in the present instance of two transverse pins 27, which enter corresponding grooves 28 in the base of the post, while centrally is a pivotal rod 29 which is pendent from the base but within the pedestal and is spring-actuated. The tension of this spring is such that the post always tends to assume the vertical whichever way it is inclined from a normal. At the free or top end of this rocking post is positioned a bar 30 which interconnects said post with a toothed rack 31 suitably supported in a horizontal-guide block 32, while a pinion 34 is affixed about the valve-stem 24. This pinion is of considerable length, see Fig. 3, in order that the valve and valve-rod may be raised or lowered, when the valve is given longitudinal movement without causing the rack and pinion to disengage. A hand lever 35 may be attached in order that manual operation of the secondary valve may be effected if circumstances require. Furthermore to cause the rotation of the valve-stem which results in sliding of the secondary valve to close and to render this act directly dependent upon the travel of the piston 3, the following elements are provided: In parallelism with the piston rod 10 and attached thereto and moving with it is a tapered bar 36 which serves to oscillate a bell lever 37 fastened to the cylinder 2. One arm of this is equipped with an antifriction roller which co-operates with a similar roller on the cylinder, while the tapered bar 36 slides therebetween. A spring 43 maintains constant contact between the bell lever and the bar in or-

der to render the latter active should it move in either direction. The upper end of the opposite bell-lever arm is pivotally fastened to a cylinder 38 which serves as a brake or retarder and prevents the too quick return of the rocking post to the vertical, this return being varied by means of liquid or air confined within the cylinder 38. From the rocking post extends a rod 40 which passes through the cylinder, while a piston 41 affixed upon said rod is permitted movement within the cylinder according as the position of a valve 42, operated externally, allows more or less free circulation of the contents between opposite ends of the cylinder. It will be observed that the rod 40 is oppositely attached to the post from that of the bar 30.

The operation and correlation of the various groups of elements hereinbefore described are as follows: it being understood that the secondary valve is to stand normally closed irrespective of the variable positions of the balls. Hence, as before stated, the secondary valve is to be opened by the balls to advance the piston 3 one way or the other, but this shift of the valve is but temporary for the reason that the very act of moving said piston 3 serves to operate to close the valve quickly, but likewise causes said valve to remain closed during subsequent movement and return of the balls to their proper position, and which return has been produced by the change in the main gate just effected. With these premises, it will be seen that the piston 3 is now held stationary, and the main gate (not shown) at the end of the rod 10 positively locked because the valve 5 is shut and no circulation occurs in the cylinder 2. Upon this assumption and that the various parts are now operating normally, when an extra burden is assumed by the prime motor this calls for more main gate. At this moment the ball drop slightly and raise the flanged sleeve 19, see Fig. 3, carrying up the valve-stem and valve 5 which now allows fluid to enter the pipe 4 and advances the piston 3 in direction of arrow 1 to open the main gate; but to prevent excessive results from this opening of the main gate, the tapered bar 36 is withdrawn from beneath the bell-lever 37, when the spring 48 rocks said lever to the right and simultaneously tilts the post 26 likewise to the right since the rapid action of the spring causes the contents in the brake cylinder to serve as a solid body. This tilting of the post to the right also causes the rack to revolve its pinion and the valve 5 is immediately closed by the rotation of its valve stem, the flanged tube being a stationary or fixed point. It is evident that with a change in the gate, as instanced, the speed of the prime motor will be accelerated and the balls now below their normal position will tend to rise and resume their proper place. This act would again rotate the valve rod and actuate the valve. Hence to keep said valve closed during the return of the balls, the post is retarded more or

less as it returns to the vertical, since it is this latter act which serves to prevent movement of the valve from its seat, the valve being rotated slowly to maintain a constant position and to counteract the effect which otherwise would be produced by the movement of the balls. This spring mounted post 26 now moves back slowly as the liquid or air in the brake cylinder flows through the valve 42. When said post has again assumed the vertical reverse rotation of the valve-stem 24 has taken place to compensate for the movement of the balls to their proper position and the valve 5 is maintained closed during such act.

From the above description it will be understood that the return of the tilting post to the vertical is intended to counteract the return of the weights to their proper position, the deviation of said weights from such position necessitating a change in the main gate. Hence this movement of the post is intended to be slow, as the balls ordinarily are not suddenly influenced by the main gate. It will be further understood that when the post is at the vertical, then movement of the balls in either direction will open the secondary valve. On the other hand the departure of the rocking post from the vertical caused by the movement of the weights will serve to close the valve.

What I claim is—

1. The combination with a centrifugal regulator, a fluid-filled cylinder, and a piston therein which controls a main valve for some prime motor, of a regulator valve adapted to control the travel of the piston, mechanism operated by movement of the piston to close the valve, and means to counteract the functions of the balls in the act of resuming their normal position to prevent the valve being operated, substantially as specified.

2. The combination with a centrifugal regulator, a main valve, a fluid-filled cylinder, and a piston operating the said valve, of a regulator valve for the piston, and mechanism interconnecting said regulator valve and piston and adapted to neutralize at certain times the functions of the regulator weights to move said valve, substantially as and for purposes explained.

3. In combination with a centrifugal regulator, a fluid-filled cylinder, and a piston therefor, a secondary valve to control circulation in said cylinder, and a rocking post operated by the piston to regulate the movements of the valve, substantially as set forth.

4. A centrifugal regulator, a fluid-filled cylinder, its piston, and a valve operated by the regulator, combined with a rocking post, mechanism from the post to the valve, as likewise means to actuate the post by travel of the piston, substantially as stated.

5. In speed regulators having centrifugal weights, a liquid-tight cylinder, a piston therein, a valve to regulate travel of the piston, combined with mechanism operated by the regulator to shift the valve in right line move-

ment without rotation, as likewise means by which to unite the piston with the valve and impart rotation and slide said valve endwise, substantially as specified.

5 6. In combination with a centrifugal speed regulator, a fluid-filled cylinder, its piston, and a valve to control circulation, of a valve rod united with said regulator for right line sliding travel, a rocking post, a rack and pinion to rotate at times said valve rod to slide the valve, and mechanism to interconnect the post with the piston, substantially as set forth.

7. In regulators, a rotary sleeve, centrifugal weights thereupon, a flanged tube reciprocated by said weights, combined with a valve, a valve rod longitudinally of the flanged tube, connections between the valve rod and tube to permit independent rotation of the rod means for producing rotation of said rod, and a piston controlled within a cylinder by the movements of the valve, substantially as described.

8. In combination with a cylinder, its piston, a valve to control the travel of said piston, a rocking post, and mechanism to operate the valve upon tilting of the post, a bar affixed to the piston, a lever to tilt the post, and brake mechanism to regulate the return of the post to a normal, substantially as specified.

9. The combination with a fluid-filled cylinder, a piston, its piston rod, an actuating bar, and a bell lever operated by the bar, of a rocking post adapted to stand upright a regu-

lator valve operated thereby, means to incline the post from the vertical, and brake mechanism to regulate the return of the post to an upright position, as stated.

10. The combination with a fluid-filled cylinder, its piston, a brake cylinder, and a regulator valve adapted to slide endwise upon movement of the piston, of a tilting post, a rack and pinion united with said post to rotate the regulator valve, and a bell-lever likewise connected with said post and actuated by the travel of the piston, substantially as explained.

11. In regulators a cylinder, its piston, a regulator valve, and a reciprocating rod, attached to said valve, combined with a fixed standard, a tilting post adapted to stand upright thereupon, a bell-lever, and a bar affixed to the piston rod for actuating the said lever, a piston-equipped rod pivotally secured to the post, a brake cylinder secured to the bell-lever, and means to regulate the travel of the brake piston by which to control the return of the post to a normal, substantially for purposes specified.

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

NATHANIEL LOMBARD.

Witnesses:

H. E. LODGE,

FRANCIS O. STANWOOD.