(No Model.) 2 Sheets—Sheet 1.

W. D. SHERMAN.

STEAM ENGINE.

No. 532,994. Patented Jan. 22, 1895.

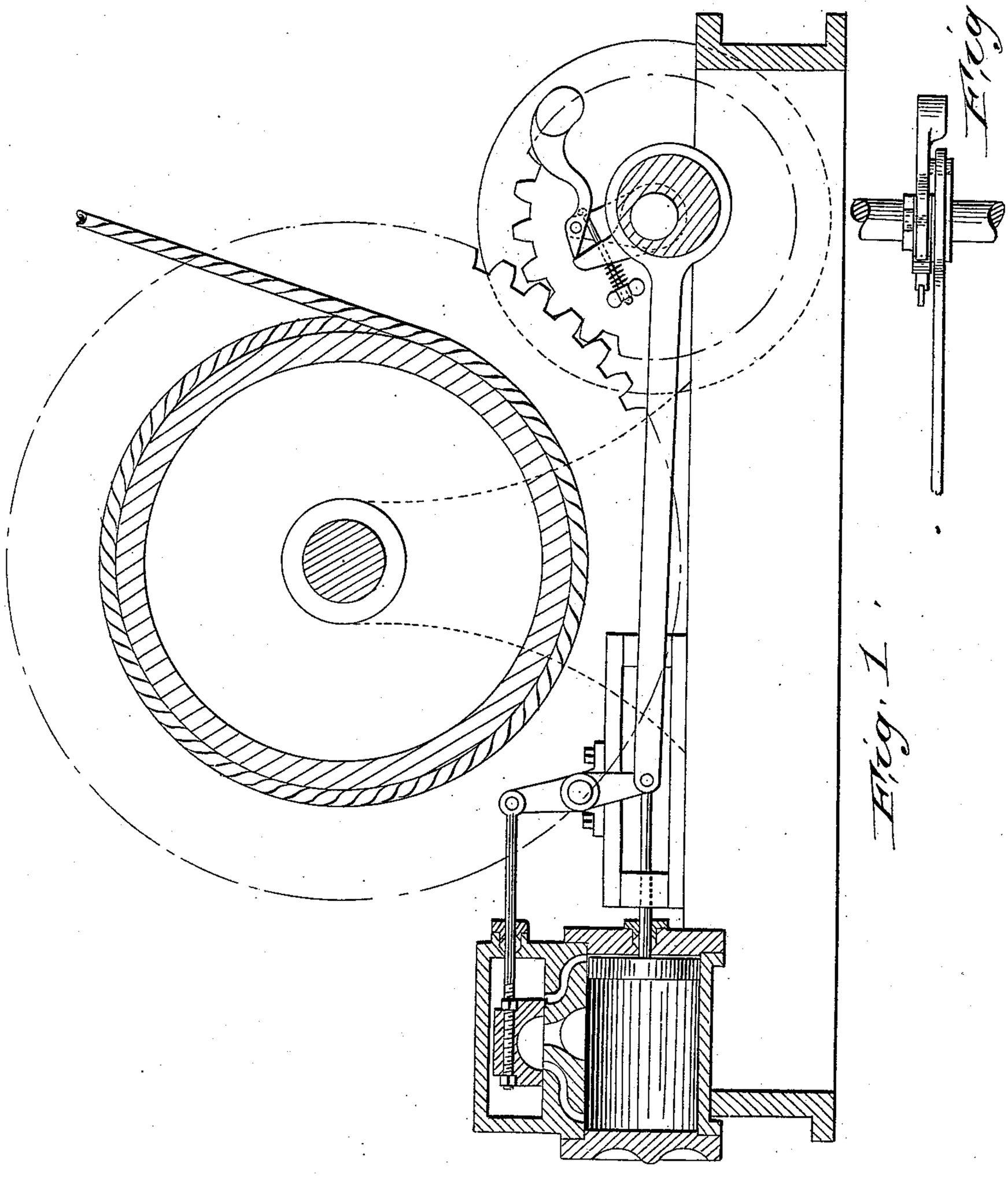

Fig. 1.

WITNESSES:
C. W. Benjamin
Patrick A. Fay

INVENTOR
Willis D. Sherman
BY
D. Walter Brown
his ATTORNEY

(No Model.) 2 Sheets—Sheet 2.

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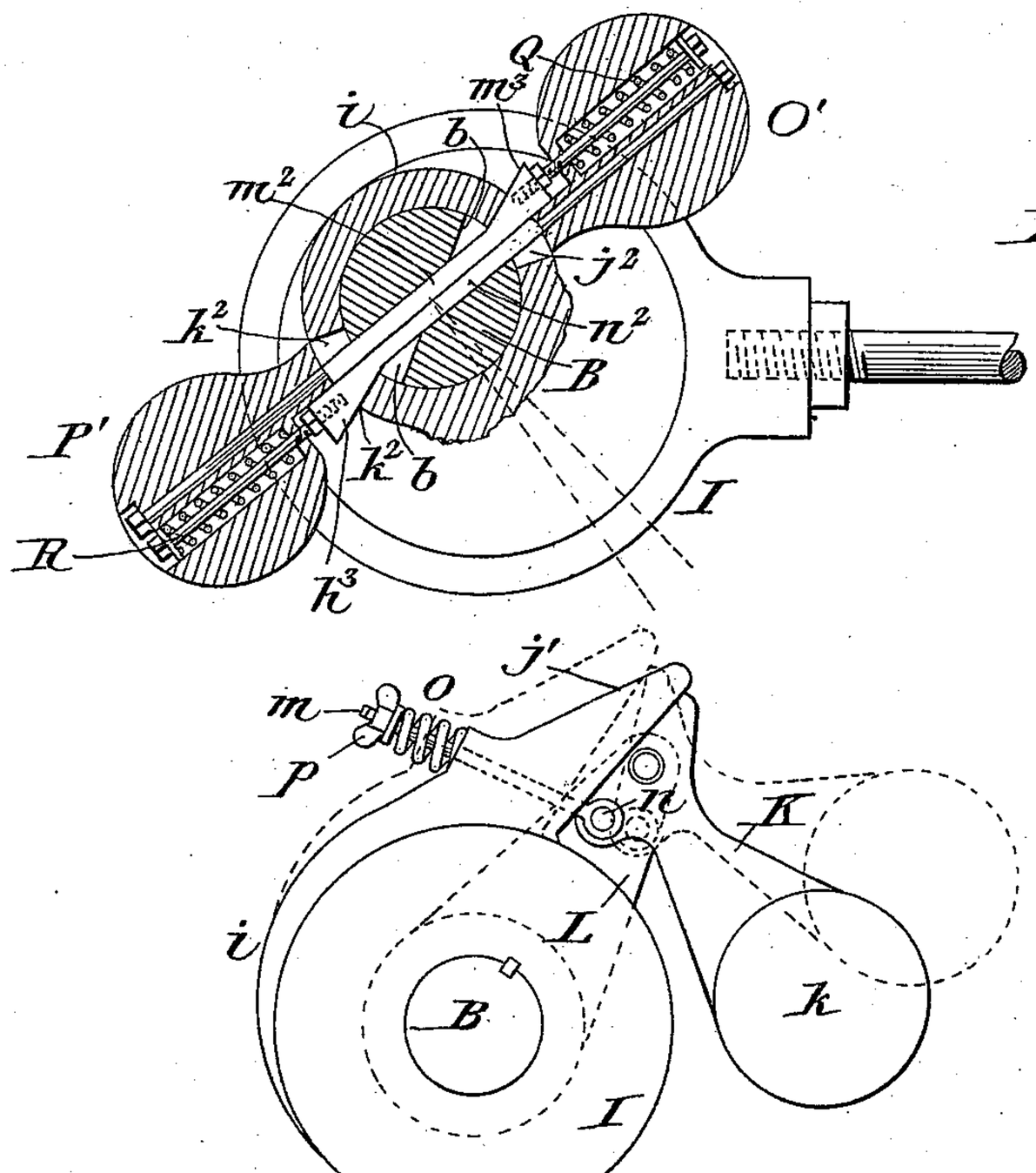

Fig. 3.

Fig. 4

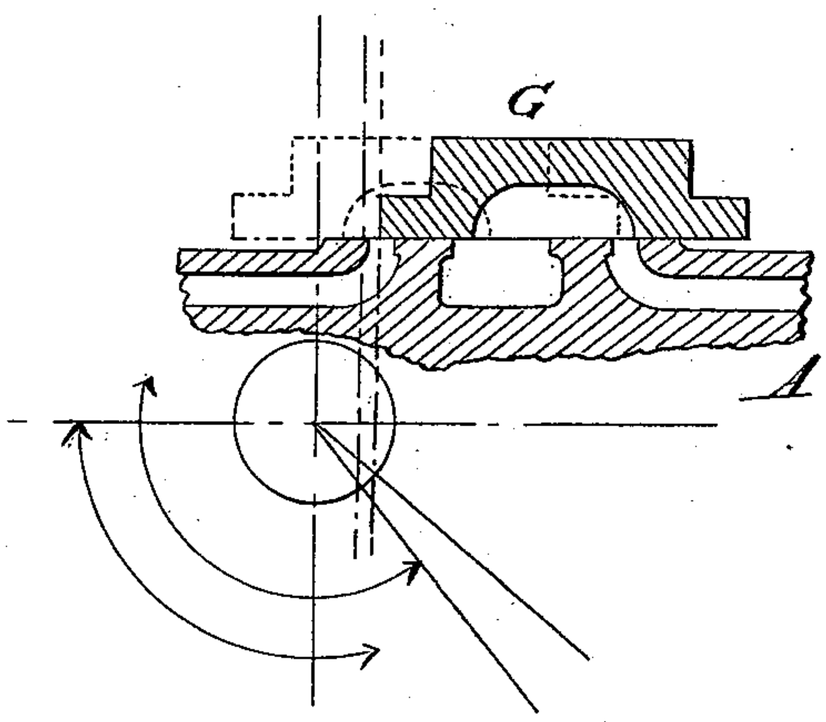

Fig. 5.

WITNESSES:
C. W. Benjamin
Patrick A Fay.

INVENTOR
Willis D Sherman
BY
D Wolter Brown
his ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIS D. SHERMAN, OF BROOKLYN, NEW YORK, ASSIGNOR TO HIMSELF, CHARLES B. JOHNSON, JOHN J. WILSON, ELLIS H. BAILLIE, FRANK B. JOHNSON, AND ELBERT SNEDEKER.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 532,994, dated January 22, 1895.

Application filed March 20, 1894. Serial No. 504,474. (No model.)

To all whom it may concern:

Be it known that I, WILLIS D. SHERMAN, a citizen of the United States, and a resident of Brooklyn, in the county of Kings, State of New York, have invented a certain new and useful Improvement in Steam-Engines, of which the following is a specification.

My invention relates to improvements in steam engines, and especially to what I term an "automatic steam counter-balance" for the same—that is is to say, a means consisting in an automatic variable lead whereby a steam cushion is formed in advance of the piston, in order to counterbalance the inertia of the piston and connected parts as the piston nears the end of its stroke, avoiding the violent shock attendant upon the reversal of the motion of the piston when running at variable speed, and the formation of this steam cushion being automatically controlled through the variable speed of the main shaft of the engine. This automatic counter-balance is especially of utility in engine of hoisting apparatus which are set on towers. Heretofore the vibrations of the engine consequent on the high speeds have resulted in so great vibrations that it has been found impracticable to place the engine on the comparatively light structure of a tower that is suitable for hoisting apparatus, except in cases where the apparatus is of such magnitude and cost that the tower is necessarily built very solid without a disproportionate cost relatively to the total cost of the apparatus. My invention, however, produces so smooth a running of the engine with irregular speed that it can be placed on a tower of moderate strength without any difficulty.

My invention proceeds upon an automatic variation of the lead of the valve which controls the main cylinder so that as the speed of the engine increases, the lead advances automatically and admits steam in front of the piston at a proportionately earlier part of the stroke, thereby forming an automatic steam cushion of greater or less extent as the speed of the engine tends to increase or decrease, producing an automatic counterbalance and absence of shock.

It is to be clearly understood that the invention is not a governor in the ordinary sense of the word, is in no way dependent upon the opening or closing of the main throttle valve, but operates entirely through the variation in the elastic resistance interposed in front of the piston by automatically regulating the earlier or later admission of the steam before the end of the stroke. This automatic regulation of the lead of steam engines which have irregular speed is new in the art and of great value.

Referring to the drawings which accompany the specification to aid the description, Figure 1 is a representation of one form of my device applied to a steam engine. Fig. 2 is a view of the parts from above. Fig. 3 is an enlarged detail partly sectioned, showing my preferred means of affecting the variation in the lead through the varying velocity of the main shaft. Fig. 4 is an elevation on a large scale of substantially the same device as is shown in Fig. 1. Fig. 5 is a sectional detail illustrating by solid and dotted lines the position of the valve corresponding to the positions of Figs. 3 and 4.

Referring to Figs. 1, 2 and 4 A is the main cylinder; B, the main driving shaft; C, the connecting and D the piston rod of a hoisting engine of any suitable description. E E′ represent the drum and its gearing. F is the usual valve chamber on the cylinder and G the usual slide valve, H being the valve rods and I the eccentric on the main shaft, or, of course, on a shaft driven from the main shaft through intermediate gearing, or any other suitable connections. Said eccentric I is set loosely on the shaft B and provided with a collar *i*, having an arm *j* against the face of which bears an end of a lever K that is pivoted on a standard L which is keyed on the shaft B. The other end of said lever K is provided with a weight *k*. A rod *m* pivoted to the lever K at *n*, works through a hole in the arm *j*, and has a spring *o* coiled on its outer end, *p* being a set screw to regulate the tension of the spring.

The operation is as follows: Suppose the valve set for a given lead as indicated by the cross hatched valve Fig. 5, and the engine running in the direction of the arrow, then

the centrifugal force of the weight *k* will tend to throw the same outward, thereby pushing the arm *j* correspondingly and increasing the lead of the valve G and allowing the steam to enter the cylinder A in front of the piston B and form a steam cushion at an earlier part of the stroke. Said steam cushion forms an automatic counterbalance to the inertia of the piston and connected parts and prevents vibration of the engine.

Referring to Fig. 3, the collar *i* is slotted at j^2 k^2 as indicated in Fig. 3, the edges of the slots being beveled as shown. The main shaft B has a corresponding through and through slot *b*, the sides of which are beveled or inclined each to each, as shown in Fig. 3. Through the said slots *b* and j^2 k^2 work the sliding rods m^2 n^2, the ends of which pass through holes in the weights O′ P′. The said rods m^2 n^2 are provided with the wedged surfaces m^3 n^3, respectively, which are adapted to bear as shown on the corresponding walls of the slots j^2 k^2. The rod m^2 is connected with the weight O′ through the medium of a compressible spring Q, and the rod n^2 is similarly connected with the weight P″ through the medium of the compressible spring R; also the rod m^2 has a rigid connection with the weight P′ by bolt and nut, as shown, and the rod n^2 a similar connection with the weight O′.

The operation is as follows: Suppose the engine running in the direction of arrow, and the speed to increase, then the centrifugal force tending to throw the weights O′ P′ outward increases, but the weight P by reason of such increased centrifugal force will draw the sliding rod m^2 through the collar *i* and the wedge m^3 bearing on the surface of the slot k^2 will shift the collar and with it the eccentric ahead. At the same time the weight O^2 will draw the rod n^2 through the slot j^2, shifting the collar and eccentric in the same direction and consequently automatically increasing the lead of the valve. It will be observed that the aforesaid springs Q and R exert a certain tendency against the centrifugal force and draw the weights O′ P′ back inwardly as soon as the speed of the main shaft decreases, thereby revolving the collar *i* and eccentric I in the reverse direction and diminishing the lead and consequently diminishing the steam cushion in advance of the piston.

Now, having described my improvements, I claim as my invention—

1. In steam engines, the combination of the cylinder, piston, main shaft, eccentric movable thereon and set to a normal position, main valve, and weights revolved by the main shaft and adapted to shift the eccentric so as to increase the lead of the main valve when the speed of the engine increases above the normal speed, substantially as described.

2. The combination in a steam engine of a cylinder, piston, shaft, valve and eccentric, of weights arranged to be thrown out from the center of the main shaft as the velocity increases above the normal velocity and adapted to co-operate with surfaces which actuate the eccentric for the purpose of increasing the lead of the valve, as the speed of the piston increases above the normal speed, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 13th day of March, 1894.

WILLIS D. SHERMAN.

Witnesses:
WILLIAM H. S. CARLILE,
FRANK B. JOHNSON.