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J. L. HEALD.

CONTROLLING MECHANISM FOR ENGINES.

No. 554,340. Patented Feb. 11, 1896.

Fig. 1

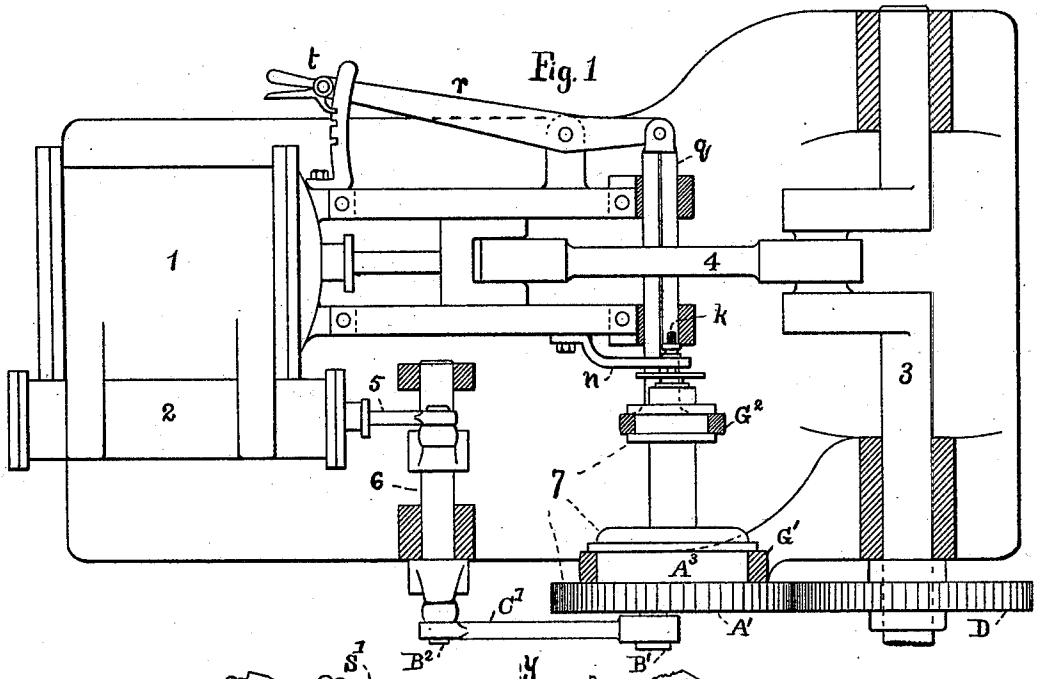
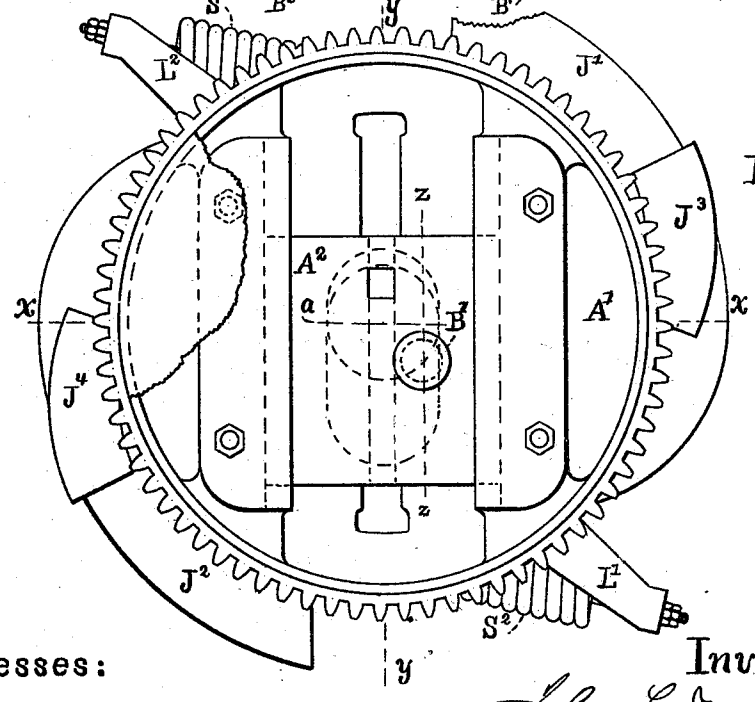


Fig. 2.



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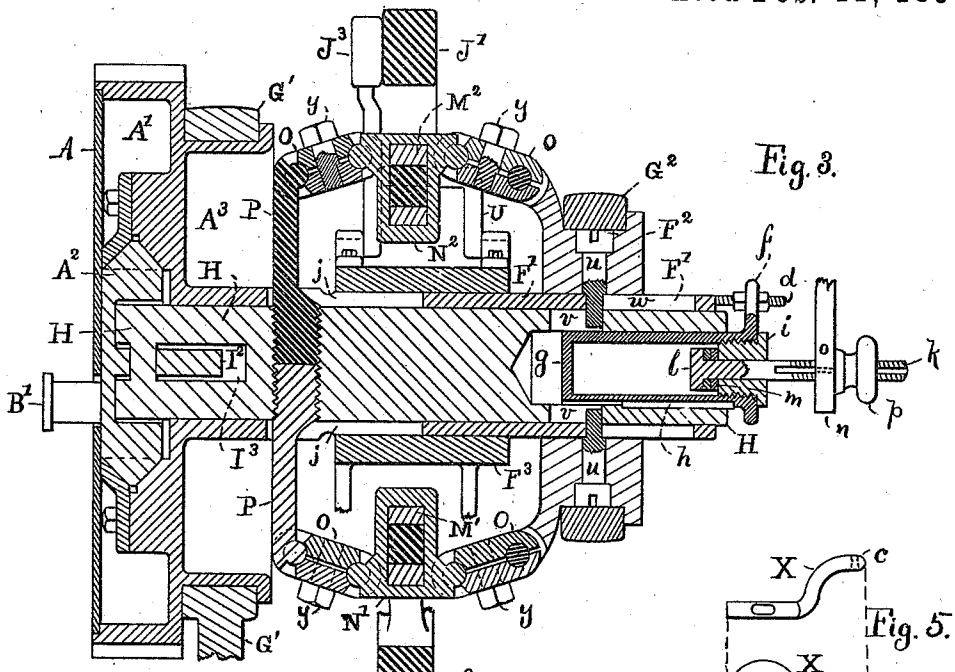

Fig. 3.

Fig. 5.

Fig. 4.

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Fig. 6.

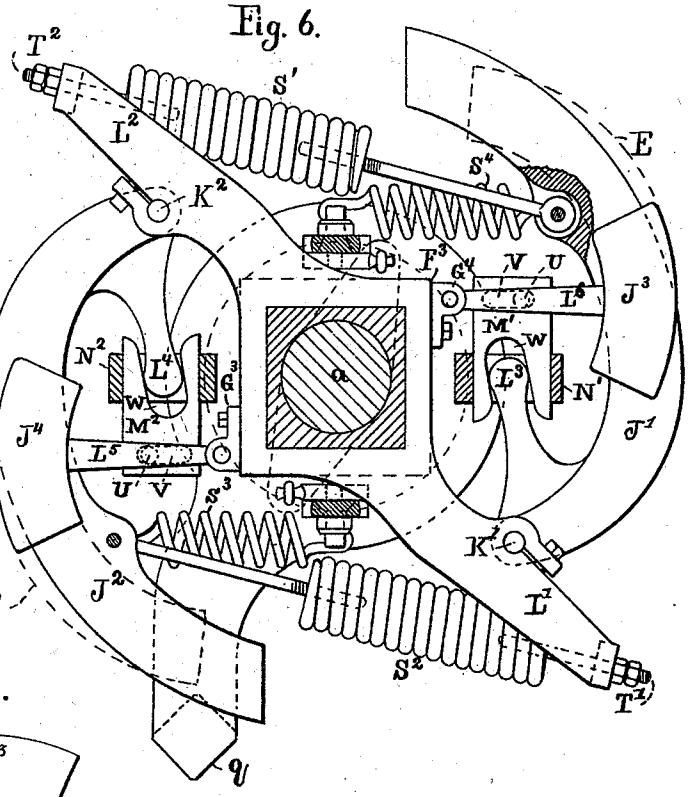

Fig. 9.

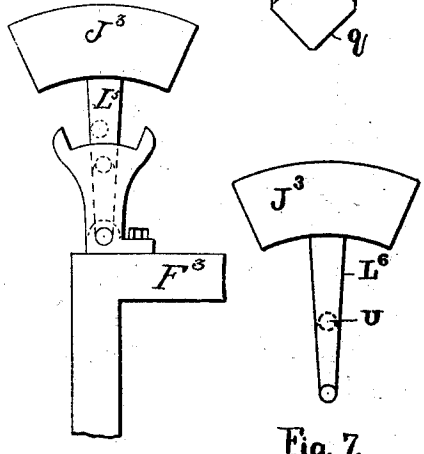

Fig. 7.

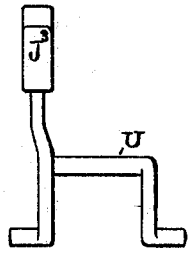

Fig. 8.

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UNITED STATES PATENT OFFICE.

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CONTROLLING MECHANISM FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 554,340, dated February 11, 1896.

Application filed April 6, 1895. Serial No. 544,804. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. HEALD, a citizen of the United States, residing at Crockett, Contra Costa county, State of California, have invented certain new and useful Improvements in Controlling Mechanism for Steam-Engines; and I hereby declare the following specification and the drawings therewith to be a complete description of my improvements.

My invention relates to apparatus for the control of reciprocating steam-engines, in stopping, starting, and reversing the motion of such engines, also to their regulation and the point at which steam is cut off by adjustable, self-contained and detachable mechanism, not constituting an integral portion of the engine itself, and applicable to any single-valve engine of ordinary construction adapted for regulation by variable valve-gearing.

My improvements consist in variable, expansive, regulating and reversing gearing, operating by centrifugal force, by hand, and also by the inertia and momentum of revolving weights, and capable of adjustment while an engine is in motion, the whole attachable to and separable from the engine.

My improvements also include the construction and arrangement of the different elements constituting the apparatus, as hereinafter specified and pointed out in the claims.

The objects of my invention are to attain complete control of an engine in respect to its speed of revolution, power generated, and the direction of its motion by a single device or apparatus, also to provide, when required, for sensitive regulation by a combination of centrifugal action and inertia, and to constitute such controlling apparatus, as a whole, an article of separate manufacture, the same as in the case of centrifugal throttling governors for steam-engines.

In the drawings, Figure 1 is a plan view showing the main parts of a common steam-engine fitted with my improved controlling apparatus. Fig. 2 is a front view of the eccentric-disk from which the engine-valve is operated, with the covering-plate removed. Fig. 3 is a section through my improved engine-controlling device, taken on the line $x\,x$ in Fig. 2. Fig. 4 is a section in a plane at a right angle to Fig. 3 and on the line $y\,y$ in Fig. 2. Fig. 5 shows a detail of Fig. 4 in two planes. Fig. 6 is a cross-section on the line $z\,z$ of Fig. 4. Figs. 7 and 8 show a detail of Fig. 6. Fig. 9 is a detail view showing the weights having stops to limit their range of movement.

Similar letters and numerals of reference are employed to designate corresponding parts in the different figures of the drawings.

Referring first to Fig. 1, 1 is the cylinder, 2 the valve-chamber, 3 the crank-shaft, 4 the connecting-rod, 5 the valve-rod, and 6 the rock-shaft, of a common single-valve steam-engine arranged for control by one of my improved devices. (Represented at 7, and to be hereinafter fully described.)

Referring next to Fig. 2, A′ is a main disk or plate, on which is mounted a sliding plate A^2, moving in angular guideways, as seen in Fig. 3, and having a crank or eccentric pin B′, that moves on the line $z\,z$ across the center line a to give the required angle of advance for running the engine in either direction, and at intermediate points determine the point of cut off for speed and power regulation in the usual manner of eccentrics for variable cut-off slide-valve engines.

The main disk A′ is driven by teeth formed on its periphery engaging a tooth-wheel D on the crank-shaft 3 of the engine, both wheels having the same number of teeth and remaining in the same relative position one to the other.

A link C′ connects the eccentric-pin B′ to the pin B^2, rock-shaft 6 and the valve-rod 5, as seen in Fig. 1. By referring to the sections, Figs. 3 and 4, it will be seen that the element referred to as the "eccentric-disk" A′ is formed integrally with a chamber A^3 and a sleeve of square section F′, the latter supported in a collar F and a movable bearing G^2, the main end or members A′ A^2 being supported in a fixed bearing G′ of large diameter, as shown in Figs. 1, 3 and 4.

The eccentric-disk A′ and sliding plate A^2, the extension or chamber A^3, the sleeve F′, and the collars F^2 F^3, with the elements attached to each, all revolve together in the bearings G′ G^2, driven by the gear-wheel D, as before explained.

Through the axis of the controlling device and sliding within the sleeve F′ is a cylindri-

cal bar or stem H, the longitudinal movement of which controls the position of the slide A^2 and the eccentric-pin B′ in the following manner: The front of the disk A′ is preferably inclosed by a plate A, as shown in Figs. 3 and 4, having a slot for the pin B′, but otherwise close, so as to retain a quantity of oil for lubricating the moving parts inclosed.

At the back of the sliding plate A^2 is a diagonal slot I′, its rear face formed by a projecting bar I^2, that passes through an oblique mortise or slot I^3 in the end of the sliding bar H, as seen in Figs. 3 and 4, so that end movement of this bar H slides the plate A^2 across the face of the disk A′ on the line *z z*, Fig. 2. This longitudinal movement of the central bar, H, and consequently that of the plate A^2 and the pin B′ at a right angle to the bar H, are the principal operative movements, or is the medium through which the engine is controlled and reversed. This longitudinal movement of the bar H is performed or controlled in three different ways or by three different forces—namely, by centrifugal weights J′ J^2, by the inertia and momentum weights J^3 J^4, and by the movement of the bearing G^2, the latter being employed only in reversing an engine.

Referring first to the centrifugal weights J′ J^2 and their connection to this central bar, H, and to Fig. 6 of the drawings, these weights J′ J^2 are pivoted at K′ K^2 to the arms L′ L^2, formed integrally with a rectangular collar F^3 fitting loosely on the sleeve F′. These swinging centrifugal weights J′ J^2 are held against centrifugal force by means of coiled centripetal springs S′ S^2 adjustably attached to the ends of the arms L′ L^2 by means of the screw-nuts T′ T^2 and made strong enough to resist the centrifugal strain due to a predetermined rate of speed for the engine. These weights J′ J^2 have teeth or extensions L^3 L^4, that fit into and move laterally the blocks M′ M^2, which fit loosely and slide through the members N′ N^2, as seen in Figs. 3 and 6, so that when the weights J′ J^2 are moved outward or inward the blocks M′ M^2 and the members N′ N^2 are moved accordingly away from or toward the center or axis of rotation. This radial movement of the members N′ N^2 is converted to longitudinal movement of the bar H in the following manner: The split toggle-links (marked O in Fig. 3) connect these members N′ N^2 at one side with the collar F^2 and at the other side with the studs P P, the latter rigidly fastened in the bar H, as shown in Fig. 3, so that any movement outward or inward by the weights J′ J^2 acts upon the blocks M′ M^2, the members N′ N^2 and the toggle-links O moving the studs P, the bar H, sliding plate A^2, and the eccentric-pin B′ accordingly, so the point of cutting off steam is determined by the position of the centrifugal weights J′ J^2.

The elements thus described have the functions of a common cut-off shaft-governor for single-valve steam-engine, the range of the valve or point of cut-off being as the radial position of centrifugal weights revolving about the crank-shaft. As, however, action of these elements is dependent upon time as well as speed, the control of the point of cut-off or regulation of the engine's speed is too tardy, and I attain a more sensitive action by means of the weights J^3 J^4, arranged to act upon the bar H by inertia and momentum without interfering with the before-described centrifugal elements in the following manner:

The members N′ N^2 and the toggle-links O being the medium through which the centrifugal weights J′ J^2 act upon the bar H, it follows that any mechanism that changes the relation between these weights J′ J^2 and the bar H will move the latter in the same degree. This is done by the weights J^3 J^4 acting upon and sliding the blocks M′ M^2 by means of the levers or links L^5 L^6 and the cranks U, which pass through slots V in the blocks M′ M^2, as shown by dotted lines in Fig. 6. The cranks U are supported in brackets G^3 G^4, bolted to the sleeve F^3, as seen in Fig. 6. These inertia weights being connected almost radially by the levers or links L^5 L^6, it follows that if the rate of rotation is suddenly diminished these weights will by their momentum go on at their attained velocity, sliding the blocks M′ M^2 outward, and by reason of the diagonal slots W W cause an outward movement of the members N′ N^2 independent of the centrifugal weights J′ J^2, thus causing a corresponding backward movement of the bar H and a later cut off of the engine-valve. If, on the contrary, the speed of revolution is suddenly increased, these weights J^3 J^4 lag behind by their inertia and by means of the crank U move the blocks M′ M^2 inward, producing a backward or inward movement of the bar H, causing an earlier cut off by reason of shifting the slide-plate A^2 and the eccentric-pin B′ inward, in the manner already described.

The weights J^3 J^4 are shown equally disposed on each side of the links L^5 L^6; but it is evident by changing the mass of these weights to the side of the levers or links, as shown by dotted lines at E E, the centrifugal force will fall in a radial line from the center *a*. The weights J^3 J^4 or the links L^5 L^6 are provided with stops to regulate the range of movement in either direction, as shown in Fig. 9. The construction of such stops is obvious, and can be varied in any manner. In this manner initial movements of the bar H and of the eccentric-pin B′ are derived from the momentum or inertia of the weights J^3 J^4 independent of and not interfering with the action of the centrifugal weights J′ J^2, which, however, follow and complete the adjustment of the bar H.

Referring now to the means for adjusting the point of cut-off or speed of an engine while in motion, I apply to the centrifugal weights J′ J^2 supplementary springs S^3 S^4. (Shown in Fig. 6.) These springs act in uni-

son with the main springs S′ S², but are attached at their inner ends to adjustable bell-cranks X X that vary the tension and consequent position of the weights J′ J², or of the bar H and the point of cut-off or speed of the engine. These bell-cranks X X are attached to brackets Y, bolted to the member A³ by the screws *b*, as shown in Fig. 4. The springs S³ S⁴ are attached to the hooks *c c*, Fig. 5, and two adjusting or tension rods *d d* are attached to the hooks *e e* at right angles to *c c*, so the tension of the springs S³ S⁴ falls on these rods *d d* and on the cross-bar *f*, as seen in Figs. 3 and 4. This cross-bar *f* is formed integrally with a cylindrical shell *g* that slides loosely in the bar H, as seen in Fig. 3, a feather or key *h* causing the shell to revolve with the bar H. Screwed into the outer end of this shell *g* is a plug *i*, through which passes a bolt or stem *k*, having a collar-head *l* and friction-washers *m* bearing against the inner end of the plug *i*.

The stem *k* passes through a stationary bracket or support *n*, attached to some part of the engine-framing, as seen in Fig. 1, a pin or feather *o* being provided to keep the stem *k* from turning in the bracket *n*. On the end of this stem *k* is a thumb-nut or hand-wheel *p*, by means of which the stem *k*, the sleeve *g*, and rods *d d* can be drawn outward while the engine is in motion, increasing the tension on the springs S³ S⁴, causing the weights J′ J² to move inward, and thus increase the speed of the engine by means of these devices.

If it is desired that the engine run at diminished speed the hand-nut *p* is turned the other way, the stem *k*, sleeve *g*, and rods *d d* moving inward, reducing the tension on the spring S³ S⁴, permitting the weights J′ J² to move outward, and thus cause the engine to run at a slower rate.

The chamber in the shell *g* can be filled with oil or grease to lubricate the washer *m*.

Referring next to the method of reversing an engine by means of my improved controlling devices, this is performed by lateral movement of the bearing G², producing at the same time an inward movement of the bar H independent of the regulating mechanism hereinbefore described, shifting the eccentric-pin B′ to the opposite side of the center *a*, and reversing the engine. This bearing G² can slide upon a base-plate moving in guides, or in any other suitable manner. In the present case I show it in Fig. 1 mounted on a sliding bar *q*, which extends across to the opposite side of the engine, where this bar is operated by a lever *r*, having a notched sector and detent at *t*, in the usual manner.

Referring to Fig. 3, the collar F², which moves with the bearing G², is connected to the sliding bar H by means of the screws *u u*, which extend loosely through a slot *w* in the side of the sleeve F′ and into a slot *v* in the bar H, this slot *v* being long enough to permit independent movement of the bar H by the speed-regulating elements hereinbefore described, but not more, and when the bearing G² and the collar F² are moved outward or backward these screws *u* draw the bar H inward from the slide A², causing that and the pin B′ to move to the opposite side of the center *a*, or to a corresponding angle of advance for running the engine in a reverse direction. In this movement all the regulating elements, including the sleeve F³, slide on the sleeve F′, slots *j j* being provided, as seen in Fig. 3, to permit lateral movement of the studs P P.

To reverse the speed-regulating elements in my improved controlling device, so the engine may in common service be run in either direction, I reverse the bar H or turn half around, arranging the slide-plate A² and the pin B′ accordingly. In this manner it may be seen provision is made in a single device or apparatus for all functions required in controlling single-valve steam-engines; also that these various functions are independent in so far that they can be combined or segregated, as the nature of the duty of one engine may require.

If an engine is to be reversed only, the speed-controlling elements can be omitted. If, on the contrary, ordinary regulation only is required, the reversing and inertia elements can be omitted. If accurate regulation is required, as in the case of driving dynamos, the centrifugal and inertia elements can be employed together and the reversing elements omitted, such changes not impairing the operation of whatever of the several elements are employed in any case.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a steam-engine-controlling device, a sliding plate or eccentric provided with a pin to operate the engine-valve, a slotted diagonal bar A² to move and control the same, operated by a central shaft or stem H passing through the axis of the main eccentric-shaft, actuated by means of revolving weights S′ S² S³ S⁴, moving the eccentric-pin B′ in the manner described, thus permitting either hand or automatic control of the engine, in the manner substantially as described.

2. In a steam-engine-controlling device, a movable slide and eccentric-pin mounted on an axis separate from the main engine-shaft, but driven positively thereby, the eccentric-pin moved by a diagonal bar or guide controlled for regulation by centrifugal weights in the manner described, and in connection therewith a hand lever and adjusting devices to regulate, stop, start, and reverse the engine, in the manner substantially as described.

3. In a steam-engine-controlling device, the eccentric-pin B′, sliding plate, diagonal bar A², adjustable bar H, and in combination therewith the sliding collar G, operated by centrifugal weights J′ J² for the regulation of

speed, and by a hand-lever for reversing the engine, in the manner substantially as described.

4. In a steam-engine-controlling device, a movable slide and eccentric-pin in the manner described, a central moving bar H and a diagonal guide A^2, the studs P, links O, and collars C^2 operated by the centrifugal weights J' J^2 and springs in the manner described, also by the inertia-weights J^3 J^4 for accelerating or retarding the action of the main centrifugal weights, in the manner substantially as described.

5. In a steam-engine-controlling device, a movable slide and eccentric-pin B′ capable of movement across the center to operate an engine in either direction, a diagonal slotted extension A and a movable bar H to control the position of the eccentric-pin, an annular collar connected to this bar H operated by a slide *g* and lever *r* to reverse the engine by hand, in the manner substantially as described.

6. In a steam-engine-controlling device, the revolving and separately-geared hollow wheel A′ provided with an inclosing slotted plate A, a movable slide A^2 and eccentric-pin B′, a central moving bar H having a diagonal slot I^3 actuating the sliding member A^2, the whole incased and capable of retaining a supply of lubricating-oil, in the manner and for the purposes substantially as described.

7. In a steam-engine-controlling device, a movable slide and eccentric-pin, a diagonally-slotted bar to move the slide and pin, centrifugal weights to adjust this bar, and connected thereto by means of the toggle-links O and the slotted blocks M' M^2, in connection therewith the main springs S' S^2 to resist centrifugal force and the auxiliary springs S^3 S^4, the latter adjustable by links and a screw when the engine is in motion, substantially as described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

JOHN L. HEALD.

Witnesses:
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