

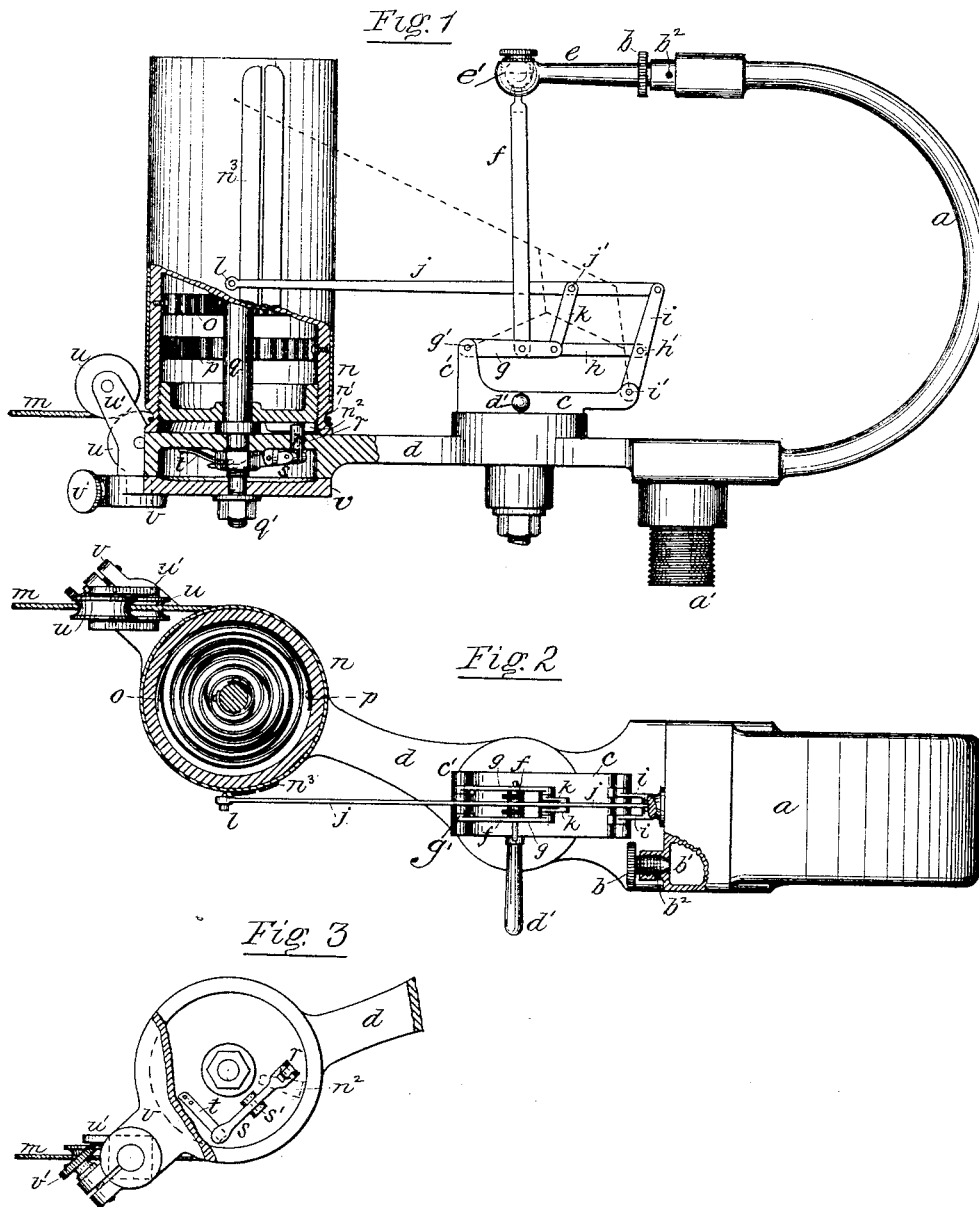
(No Model.)

J. RAE.

STEAM ENGINE INDICATOR.

No. 348,414.

Patented Aug. 31, 1886.



Witnesses

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UNITED STATES PATENT OFFICE.

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STEAM-ENGINE INDICATOR.

SPECIFICATION forming part of Letters Patent No. 348,414, dated August 31, 1886.

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To all whom it may concern:

Be it known that I, JOHN RAE, a citizen of the United States, residing at New York, county and State of New York, have invented certain new and useful Improvements in Pressure-Indicators, of which the following is a specification.

Letters Patent of the United States bearing date December 26, 1876, and numbered 185,773, were granted to Thomas Minor and myself for improvements in pressure-indicators for steam-engines, which covered the application of a spring-tube as the pencil or marker motor, and improvements in indicators were secured to me by United States Letters Patent No. 204,086, dated May 21, 1878.

This invention has for its object to further improve this class of steam-engine indicators, so as to make them more reliable and positive in action, and increase or extend the applications of a single instrument by adapting it to take in a perfect manner both right and left hand cards.

The invention consists, first, in the combination, with the spring-tube, of a vent by which the air contained therein may be discharged and the tube filled with steam only, it being found in practice that better results are had when the tube is filled with a single pressure medium; second, of an improved parallel motion consisting of a simple system of links, through the medium of which the pencil or marker is caused to move in a vertical path on the indicating-drum of the instrument; third, in the combination, with the indicating-drum, of means by which the pressure-indications of both right and left hand cards are caused to be marked thereon when the drum is rotated by direct pull on its actuating-cord.

In the accompanying drawings, forming part of this specification, Figure 1 is an elevation of my improved steam-engine indicator, showing the drum partly in section. Fig. 2 is a plan view showing a section of the drum taken over its reversing-springs and the end of the spring-tube partly in section. Fig. 3 is an underneath view of the indicating-drum, showing the bottom plate partly in section.

The spring-tube *a* is constructed and operated as described in my before-mentioned Let-

ters Patent, the steam entering the same through the screw-connection *a'*.

In a socket in the upper end of the spring-tube *a* is fitted the small screw-valve *b*, which, when turned back from its seat *b'*, opens the interior of the tube to the atmosphere through the small side hole, *b''*, thus allowing the steam, when the instrument is applied to an engine, to force all the air out of the tube. When this has been done, the valve *b* is screwed home, and steam only is then contained in the tube, insuring perfectly-uniform action thereof as the steam-pressure varies. Air when locked up in this form of pressure-actuated device acts as a cushion of a different nature to the steam and causes the tube to work irregularly. Any form of vent may be used for this purpose, the one shown being simple and efficient. The parallel motion by which the movement of the tube is imparted to the pencil or marker, is carried on the frame *c*, pivoted in the main frame *d*, immediately under the end of the arm *e*, which projects from the end of the tube *a*. This frame is provided with a handle, *d'*, by means of which the pencil may be moved to or from the indicating-drum. The double or forked rod *f* is connected to the end of the arm *e* by means of a ball-joint, *e'*, and is pivoted at its lower end to the pair of links *g*, hinged at *g'* to the standard *c'* of the frame *c*. The other ends of these links *g* are pivoted to one end of the link *h*, the other end of which is jointed at *h'* to the pair of levers *i*, which are pivoted at *i'* to the frame *c*. From the upper ends of the levers *i* extends the pencil-arm *j*, passing between the forked sides of the rod *f*, and a link, *k*, connects the point *j'* of this arm to the pivotal joint of the links *g* and *h*.

The proportions of the various parts of the parallel motion in the special case shown are as follows: The point *j'* of the pencil-arm is one-fifth of the length of the arm from its pivot on the lever *i*, and the length of the links *g* and *h* equals this one-fifth of the pencil-arm. The connection *h'* of the link *h*, with the levers *i*, is two-fifths of the length of the levers from their connection with the frame *c*, and the link *k* is equal in length to the other three-fifths of

the levers *i*. When in normal position, the pencil-arm *j* and links *g* and *h* are about horizontal, as shown by the full lines in the drawings. As the links *g* are raised by the rod *f* when the pressure of steam acts in the tube *a*, the pencil *l*, on the end of the arm *j*, is caused to move in a vertical path by reason of the end of the arm *j*, connected to the levers *i*, being caused to move forward a distance equal to five times the versed sine of the arc through which the end of the link *g* moves, said link, as before stated, being one-fifth of the length of the pencil-arm; for as the link *h* assumes substantially the same angular position as the link *g*, its end *h'* moves forward twice the versed sine of the arc of *g* or *h*, and as this end is connected to the levers *i* at two-fifths of their length, the ends of the levers *i* move five times the versed sine of the arc of *g* or *h*, which is equivalent to the versed sine of the arc of the angle through which the pencil-arm moves, it being, by reason of the system of links shown, always maintained parallel to the link *h*.

The dotted lines in Fig. 1 show the pencil *l* in its upper position and the parallelism maintained between the pencil-arm *j* and links *h* and the levers *i* and link *k*.

The drums of steam-engine indicators are generally actuated from the cross-head or other moving part of the engine by means of a cord passing around the drum and causing it to rotate against the action of a spring contained in the drum, and it is found advantageous to have the drum moved by a direct pull on the cord instead of by its reaction-spring during the taking of that part of the diagram known as the expansion curve. To do this with the ordinary indicators two instruments are often employed—one having a right-hand spring for taking indications from one end of the cylinder of the engine and the other having a left-hand spring for taking indications from the other end of the cylinder.

The method I adopt for adapting the instrument to take both right and left hand cards by direct pull on the cord *m*, whose end is fastened in the groove *n'*, in the lower end of the drum *n*, consists in applying two springs, *o* and *p*, reversely arranged in the drum *n*, the outer ends of these springs being secured to the drum and their inner ends to the central post or shaft, *q*, secured vertically in the main frame *d*. On the bottom of the drum *n* is a projection, *n'*, one or the other side of which will bear against the pin *r*, sliding through a hole in the plate *d*, according to which one of the springs *o* and *p* is placed under tension to act against the pull of the cord *m*. This pin *r* is connected to the end of the lever *s*, pivoted at *s'*, in a recess formed in the frame *d*. A spring, *t*, acts against the other end of the lever *s*, to cause the pin *r* to project above the frame to act as a stop for the projection *n'* of the drum *n*. These springs *o* and *p*, when fixed in position, are each wound up about

one-half of their movement, in which condition they normally oppose one another.

In the drawings, the drum *n* is shown set to take a left-hand card, the pencil *l* being on the left side of the paper-clamp *n'* of the drum *n*. To bring the drum into this position the pin *r* is moved clear of the projection *n'* by its actuating-lever *s*, and the drum *n* rotated so as to further wind up the upper spring, *o*, nearly to its full extent, and to nearly unwind the lower spring, *p*. The pin *r* is then allowed to pass in front of the projection *n'*, thereby holding the drum in the position shown. It being understood that the springs are now out of balance, the spring *o*, by being nearly wound up, exerts its full force to move the drum in a right-hand direction against the force applied to the cord *m*, which moves the drum in a left-hand direction, the opposing action of the spring *p* being slight, as it is nearly unwound.

To set the instrument to take right-hand cards, the drum is rotated in the opposite direction, and the pin *r* catches against the other side of the projection *n'*, the pencil *l* then being on the other side of the paper-clamp *n'*. The guide-rollers *u u* are carried in the standard *u'*, held in the plate *v* by the clamping-screw *v'*, which permits of the rollers being set tangentially to the drum *n*, as shown, and also to be thus set when the cord is wound up in the opposite direction to that shown. The plate *v* covers the recess in the bottom of the plate *d*, and is held in place by the nut *q'* on the lower projecting end of the shaft *q*, around which shaft the plate is free to rotate, to give proper direction to the cord *m*, in accordance with the relative position of the instrument and the part of the engine to which the cord *m* is attached. The end of the lever *s* may project through the side of the frame *d*, so that it may be manipulated without removing the plate *v*; but I prefer to cover it entirely by the plate *v*, to prevent the accidental releasing of the drum-springs when the instrument is adjusted.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a steam-engine indicator having a spring-pressure-actuated tube and a rotating indication-receiving drum, the combination, with the spring-tube, of a vent-valve fitted in its free end, substantially as and for the purpose set forth.

2. In a steam-engine indicator, the combination, with the indication-receiving drum, of the reversible tension device, substantially as described, whereby the drum is positively rotated in either direction by direct pull on its operating-cord against the action of a reversible-tension device.

3. In a steam-engine indicator, the combination, with the spring-tube *a*, of the screw vent-valve *b b'*, substantially as and for the purpose set forth.

4. In a steam-engine indicator, the parallel motion for imparting motion from the steam-pressure-actuated device to the pencil or marking device, composed of the following elements in combination: the frame *c*, the levers *i*, pivoted to the frame *c*, the pencil-arm *j*, connected to the ends of the lever *i*, the links *g*, pivoted to a standard of the frame *c*, the link *h*, connected between the ends of the links *g* and the body of the levers *i*, and the link *k*, connecting the juncture of the links *g* and *h* with the pencil-arm *j*, substantially as set forth.

5. In an indication-receiving drum of a steam-engine indicator, the combination, with the drum *n* and fixed shaft *q*, of the springs *o* and *p*, reversely arranged and connected to the drum and shaft, substantially as and for the purpose set forth.

6. In a steam engine indicator, in combination, an indication-receiving drum, a fixed vertical shaft upon which the drum rotates, two springs reversely arranged between the drum and shaft, and a locking device for holding either of the springs under excess of strain, substantially as set forth.

7. In a steam-engine indicator, in combination, the indication-receiving drum, the operating-cord connected thereto, the reversible tension device, by which the drum is positively rotated in either direction by direct pull on the operating-cord against the action of the reversible tension device, guide-pulleys, and an adjustable standard, whereby the pulleys are set in

tangential positions to either side of the drum, substantially as set forth.

8. In a steam-engine indicator, in combination, the indication-receiving drum *n*, the fixed vertical shaft *q*, upon which the drum rotates, the two springs *o* and *p*, reversely arranged between the drum and shaft, a locking device, *r s*, for holding either of the springs under excess of strain, the operating-cord *m*, placed around the drum *n*, and the guide-pulleys *u u*, carried by the adjustable standard *u'*, fitted on the lower plate, *v*, substantially as set forth.

9. In a steam-engine indicator, in combination, the spring-tube *a*, provided with the vent *b b'*, the spring-drum *n*, the reversible tension device contained therein, the operating-cord *m*, the guide-pulleys *u u*, the adjustable standard *u'*, carrying pulleys *u u*, by which they may be set tangentially to either side of the drum, and the pencil *l*, and its parallel movement connected to and actuated from the free end of the spring-tube *a*, whereby the pencil *l* is caused to move vertically up the drum in direct accordance with the variations of pressure in the tube *a* while the drum is being positively rotated, substantially as set forth.

In testimony whereof I have hereunto set my hand at New York, county and State of New York, this 13th day of February, 1886.

JOHN RAE.

Witnesses:

JACOB SCHAUS,

H. D. WILLIAMS.