T. MINOR & J. RAE.

INDICATORS FOR STEAM ENGINES.

No. 185,773. Patented Dec. 26, 1876.

Fig. 1.

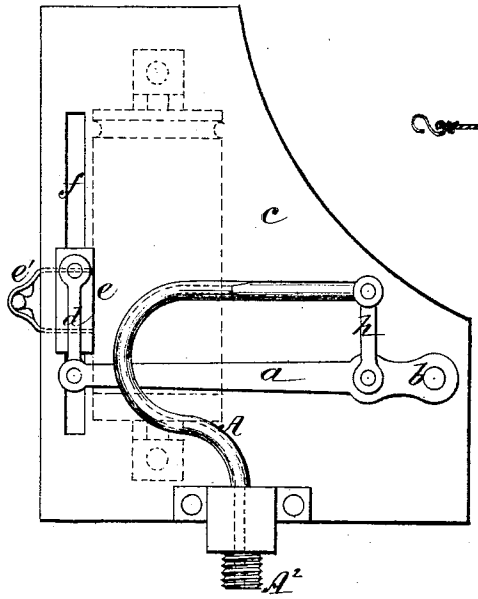


Fig. 2.

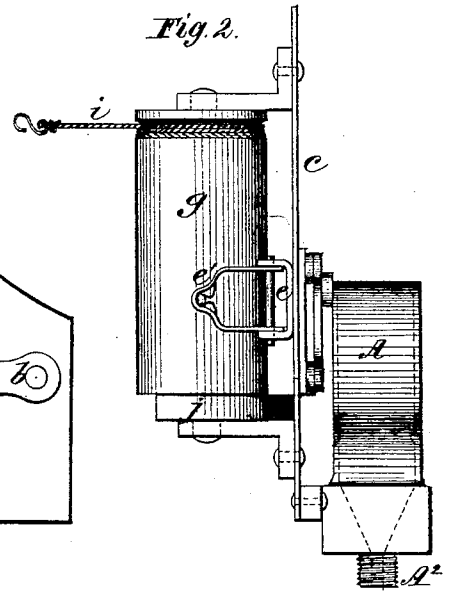
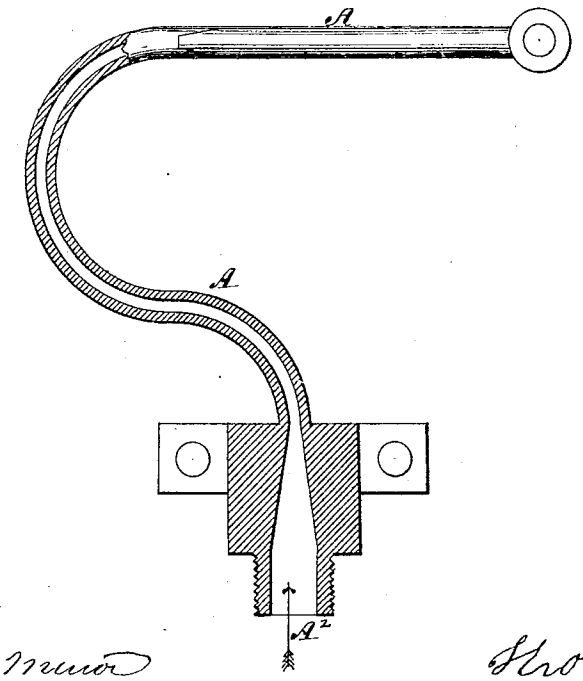


Fig. 3.



Witnesses.

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THOMAS MINOR, OF BROOKLYN, AND JOHN RAE, OF NEW YORK, N. Y.

IMPROVEMENT IN INDICATORS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **185,773**, dated December 26, 1876; application filed April 29, 1876.

To all whom it may concern:

Be it known that we, THOMAS MINOR, of the city of Brooklyn, county of Kings, and State of New York, and JOHN RAE, of the city, county, and State of New York, have invented a new and useful Improvement in Indicators for Steam or other Engines, of which the following is a specification:

The object of our invention is to produce an improved indicator, simple in construction, durable, and effective, for taking diagrams of the pressures of steam and other engines.

For this purpose we employ a hollow spring, the chamber of which is in communication with the steam-cylinder or other part, and said chambered spring connects with the pencil-operating devices, so that the pressure in the cylinder, being above or below the atmosphere, expands and contracts the spring by acting within its hollow surface, and according to the difference of the areas of the outer and inner surfaces, and thereby causes the pencil to indicate the variations of the pressures during each stroke of the piston and the several pressures existing in the engine. The cylinder containing the paper has a reciprocating movement given to it simultaneously with the movements of the marking-point, and the line made thereby gives the limits of variation of the pressures with each stroke of the piston.

In the accompanying drawings, Figure 1 represents a side elevation of our improved indicator; Fig. 2, an elevation at right angles thereto; and Fig. 3, a sectional view of the hollow spring, which has direct communication with the steam-cylinder.

By our invention we dispense with the usual cylinder, its piston, and piston-spring, and employ a hollow spring, A, of any suitable form, connecting with, and having direct communication with, the pipe A^2, leading to the engine-cylinder. This pipe is provided with the usual cut-off cock, to control such communication of the hollow spring with the cylinder. The area and extent of the chamber of the spring is such as to allow it to perform its proper function. It is connected to the pencil-operating devices at any suitable point, and these devices may be of any suitable construction. In the example shown, they consist of a lever, *a*, pivoted at *b* to a suitable support, *c*, and connecting at its free end, by means of a link, *d*, to a reciprocating slide, *e*, fitted to move in a slot, *f*, in the support. To this slide *e* is connected an arm, *e'*, which carries the pencil in contact with the drum *g*, upon which the paper to receive the indications is secured in the usual manner. The lever *a* is jointed, by a link, *h*, to the hollow spring, so that the pencil is caused to move over the paper in a straight line. The drum *g* has a reciprocating movement simultaneously with the movements of the pencil, which movement is given to said drum by a cord, *i*, connected to it and to any moving part of the engine, and a spring, *j*, attached to said drum and the standard which carries its axis-bearings. Any movements, therefore, of the lever caused by the different pressures in the chamber of the spring will be communicated to the pencil-carrier, and thus record the several pressures existing in the engine at each stroke of the piston, for it will be seen that when the chamber of the spring is in communication with the steam or other cylinder the pressure in said cylinder will extend into the spring, and thereby cause it to expand and contract, according to the degree of such pressure, and correspondingly move the pencil, the force equal to the excess of the steam above that of the atmosphere acting directly within the spring to expand it, and the vacuum produced by the condensation of the steam in the cylinder, or the decrease of such pressure, causing the spring to contract equal to the excess of the atmospheric pressure over that in the cylinder.

The chambered spring, having direct communication with the steam-cylinder, is the essential feature of our invention; and we find it highly effective for the purpose, simplifying the construction, rendering the device durable, and giving a faithful record of the variations of the pressure, the intermediate devices being only those which connect and control the movements of the pencil.

The chambered spring may be of the form shown in the drawings, or of an elliptical or other form, so long as its hollow opens into the cylinder and produces the results stated.

The pencil-arm *e'* may be held in contact with the drum in any suitable way.

We claim—

1. For steam or other indicators, a hollow spring, the chamber whereof is in direct communication with the steam-cylinder or other motor.

2. The combination, with the pencil moving and carrying devices and the paper-carrying device, of a hollow spring, having direct communication with the steam or other cylinder, and connecting the indicating devices, for conjoint action of these several agencies to produce the desired results.

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