Wiegand & Le Van,

Steam Engine Indicator,

No. 41,182, Patented Jan 5, 1864.

Fig. 2

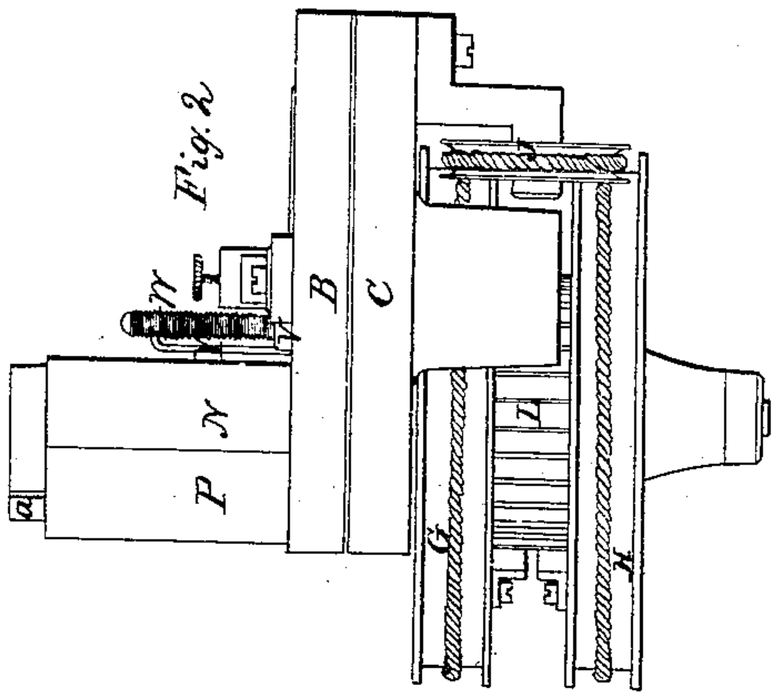


Fig. 3

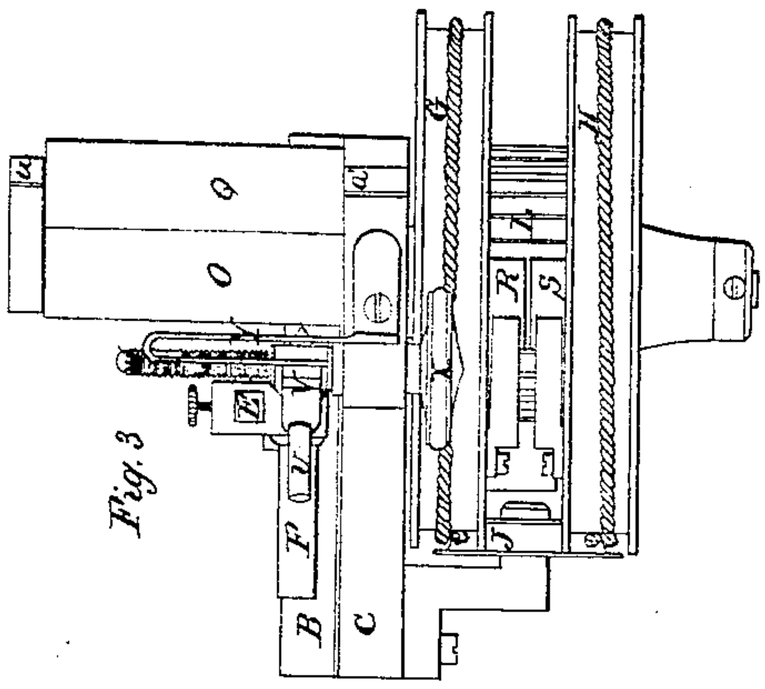


Fig. 1

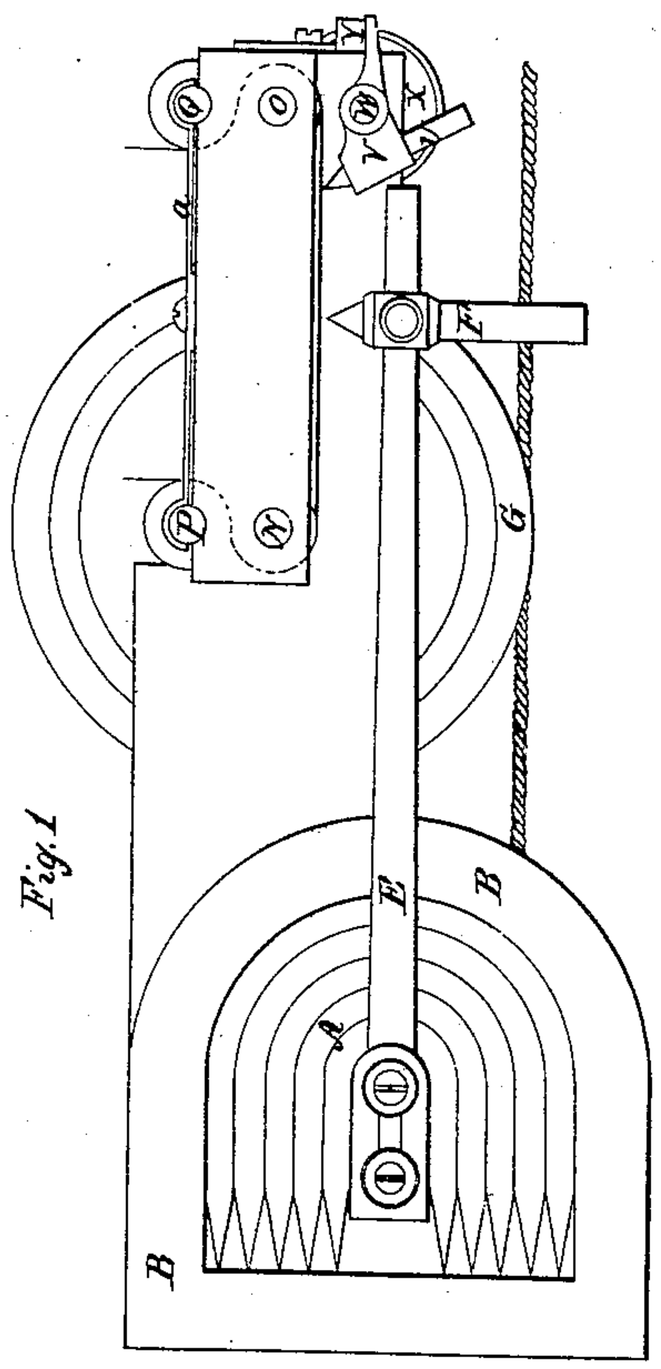
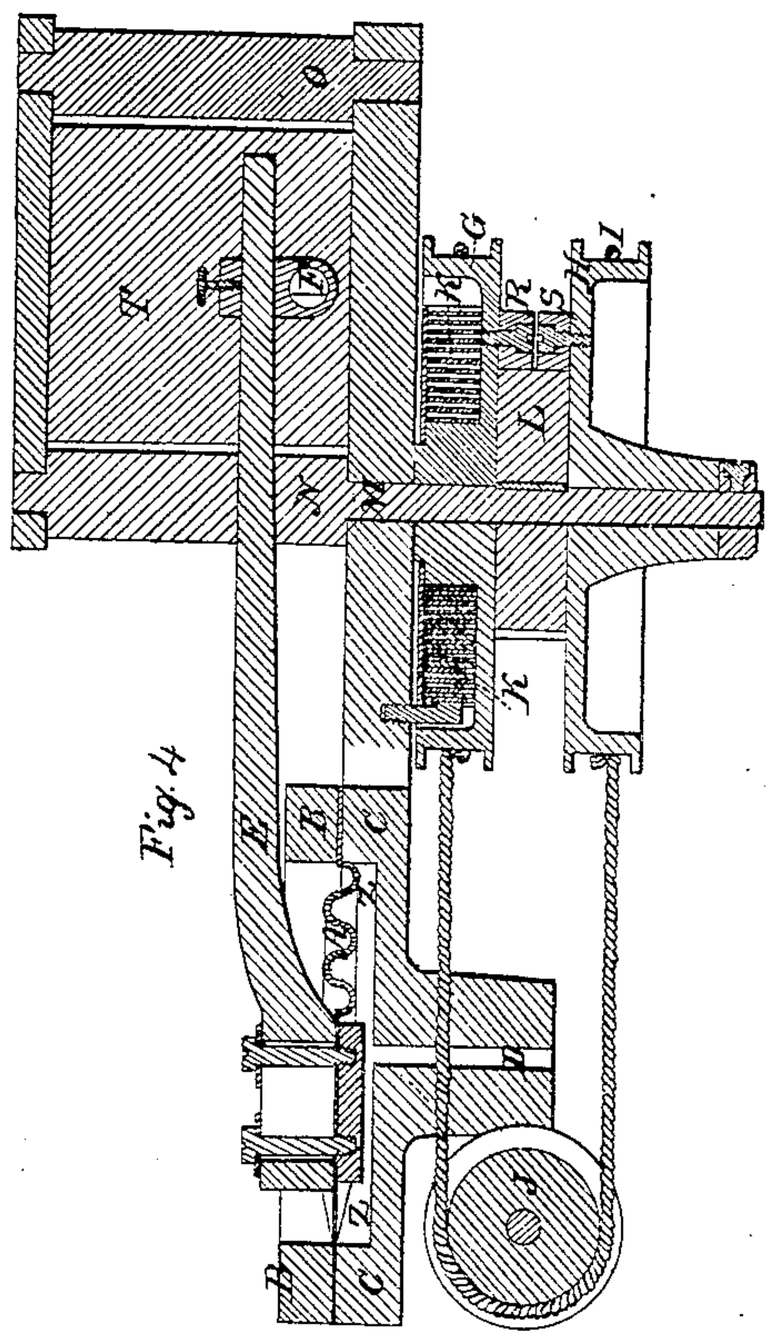


Fig. 4



Witnesses.

John R Bentley

John O'Reilly

Inventors.

S Lloyd Wiegand

W Barnet Le Van III

Wiegand & LeVan,

Steam Engine Indicator,

No. 41,182, Patented Jan. 5, 1864.

Fig. 7

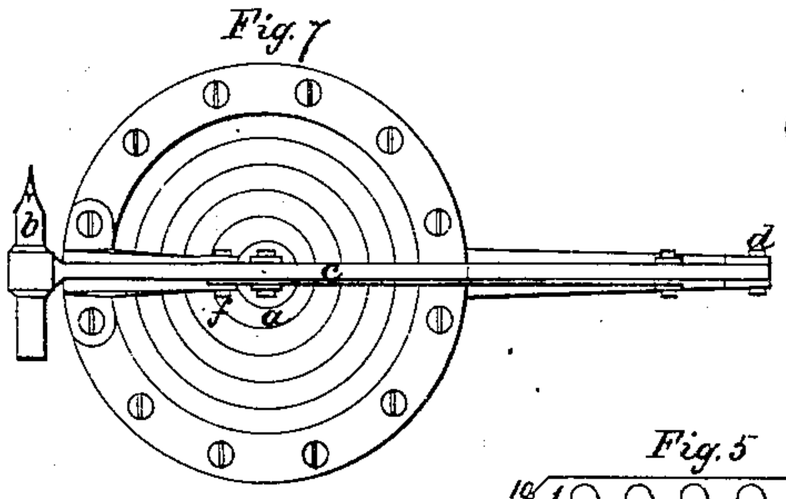


Fig. 11

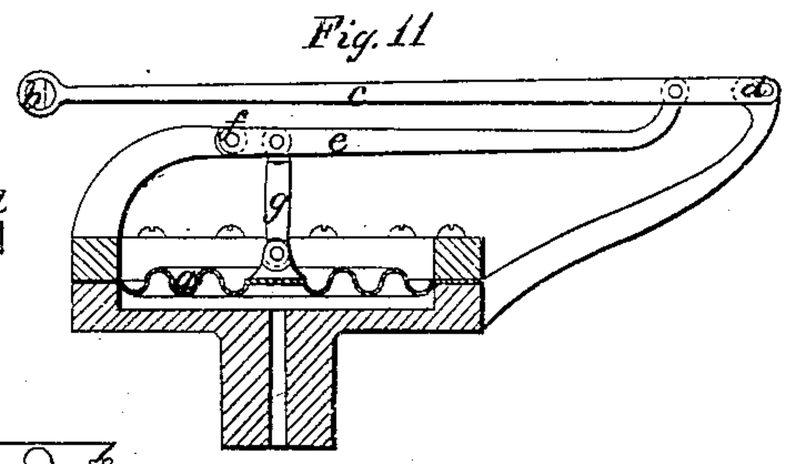


Fig. 5

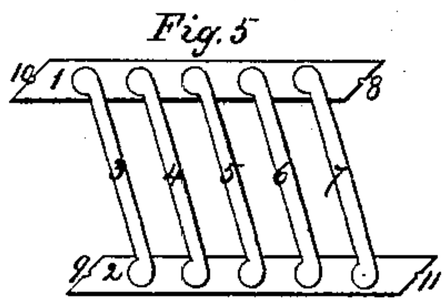


Fig. 8

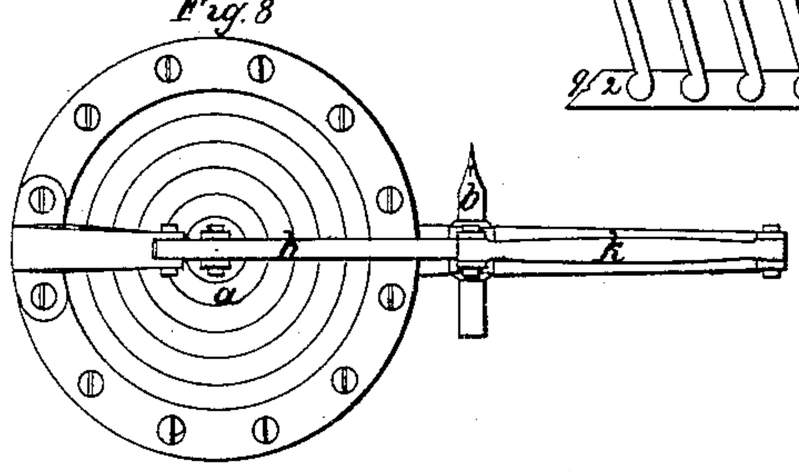


Fig. 12

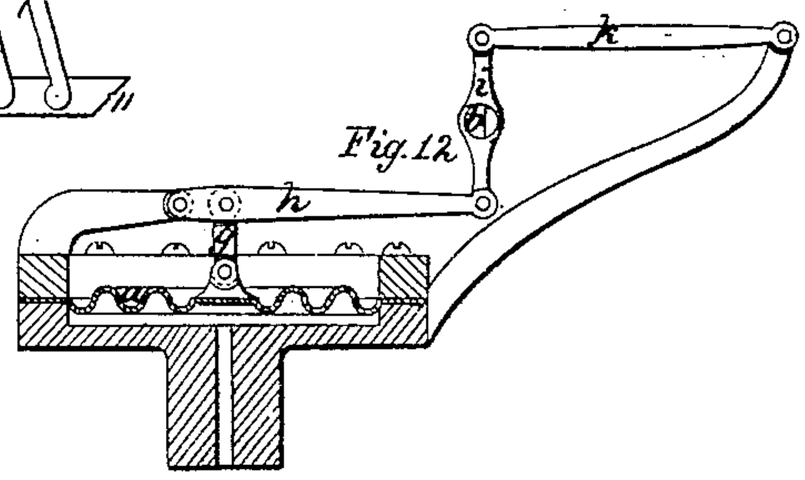


Fig. 6

Fig. 9

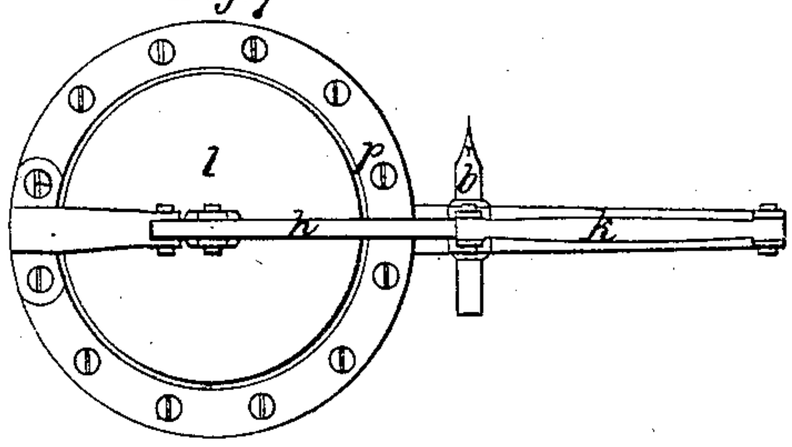


Fig. 13

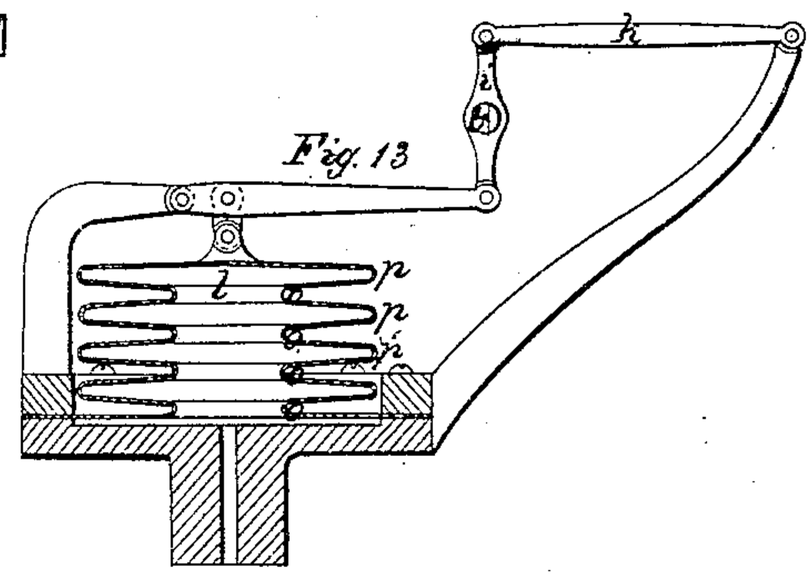


Fig. 10

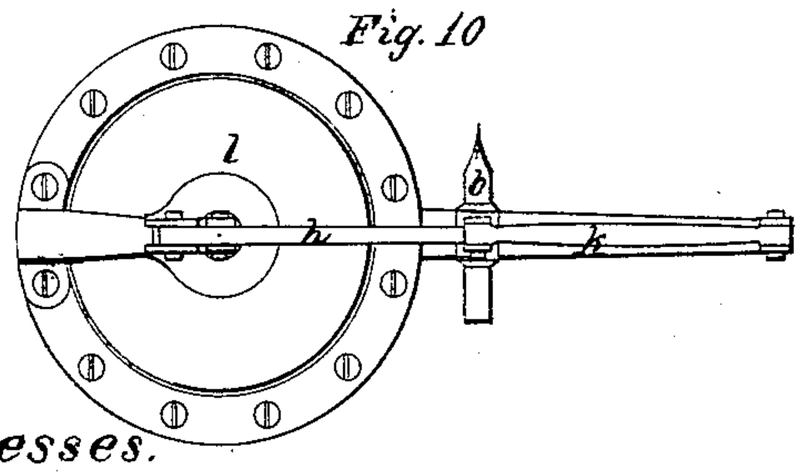
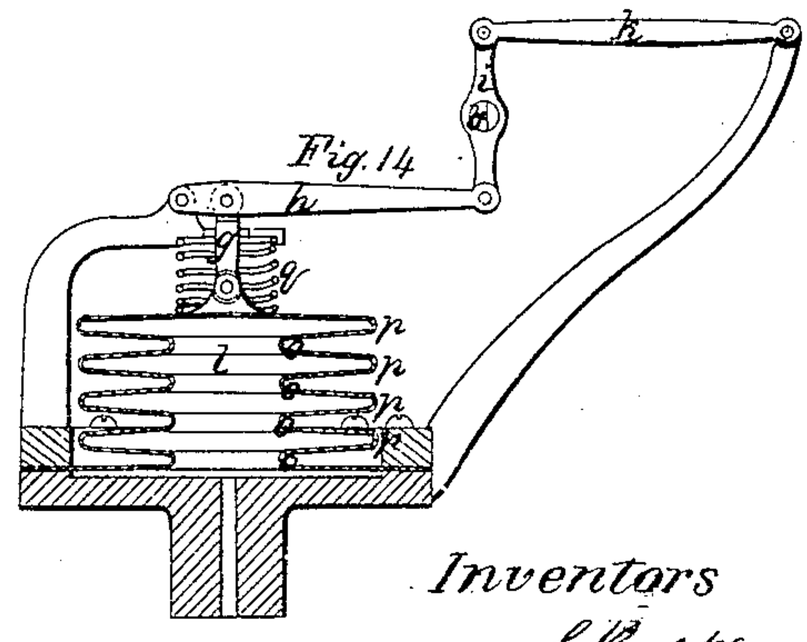


Fig. 14



Witnesses.

John R. Bentley

John White

Inventors

S. Lloyd Wiegand

W. Barrett LeVan

UNITED STATES PATENT OFFICE.

S. LLOYD WIEGAND AND WILLIAM BARNET LE VAN, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN STEAM-ENGINE INDICATORS.

Specification forming part of Letters Patent No. **41,182,** dated January 5, 1864; antedated December 21, 1863.

To all whom it may concern:

Be it known that we, S. LLOYD WIEGAND and WM. BARNET LE VAN, both of the city of Philadelphia, and of the State of Pennsylvania, have invented certain new and useful improvements in an instrument used by mechanical engineers, and known as a "Steam-Engine Indicator."

The nature of our invention consists in the use of a vessel having one or more of its sides made of some flexible material, which, by variations of internal pressure therein, changes its form and imparts motion to a pencil which describes lines upon a sheet of paper, moved by a connection from a working part of the engine-pump, or other hydraulic or pneumatic machine to which it may be attached, and thus records the changes in pressure in the vessel to which it may be connected during the several successive stages of the motion of the moving parts of the machine.

The precise construction and operation of this instrument may be understood by an expert mechanical engineer, by reference to the following description and the accompanying drawings annexed and making part of this specification.

Figure 1 represents a plan of this instrument. Fig. 2 represents an elevation of the end containing the flexible chamber. Fig. 3 represents an elevation of the end containing the paper-moving and diagram-marking apparatus. Fig. 4 represents a longitudinal sectional elevation exhibiting the internal arrangement of the apparatus. Fig. 5 represents a part of the apparatus used for marking the abscissa of the curves described by the instrument. Fig. 6 represents the scale used for measuring the ordinates of the curves described by the instrument.

The same letters of reference are affixed to the same parts in the several figures.

A diaphragm (lettered A in Figs. 1 and 4) forms the top of the chamber or vessel *z z*, which by means of the inlet-tube may be connected with the cylinder of the engine from which it is desired to take diagrams. In these figures the diaphragm A is made corrugated in such a manner that the part toward the right is susceptible of expansion or elevation by pressure applied internally, and of contraction or depression by exhaustion, while at the same time the end of the diaphragm to the left is susceptible of very little motion, other than sufficient flexibility to permit the inflation and depression of the diaphragm A toward the right or semicircular end. This diaphragm A is secured to the bed or body C C of the instrument by means of a ring, B B, which may be fastened on by means of soldering or riveting, but we prefer to screw it on. The diaphragm A when made of metal may be protected from oxidation by gilding, plating, or tinning, or by the interposition of a sheet of rubber, but this is not an essential feature in the contrivance. A beam, E, is attached to the diaphragm A, and carries a pencil, F, which describes lines upon any paper which may be interposed between the plate T and pencil F. It is obvious that the pencil F will be raised and lowered by the variations of fluid-pressure, which occur in the vessel *z z*. The motion of the pencil F is in a curved line. Motion is imparted to the paper, which is introduced in the form of a ribbon or continuous sheet similar to the paper used for magnetic-telegraph registers by means of the roller N, against which it is pressed by the roller P, which is held in place by the springs *a* and *a'*. The paper is kept tight and smooth upon the plate T by passing between the rollers O and Q in the direction of the blue line in Fig. 1. Motion is imparted to the roller N by means of a broad ratchet-wheel, L, placed and fastened upon the shaft M, which is an extension of the roller N. This ratchet-wheel is rotated by means of the pawls R and S, placed upon the grooved wheels G and H. The wheels G and H are moved by a cord, I, fastened on the periphery of the wheel G, and after wrapping around G is returned around the pulley J and wraps around the wheel H, from which it passes to some moving part of the machine whose operations it is designed to indicate and record. These pulleys G and H fit closely upon the shaft M, and impart motion to the shaft M only through the me-

dium of the pawls R and S and ratchet-wheel L. The roller N therefore rotates in one direction only with velocities proportionate to the velocity of the moving part of the engine or other machine to which the cord I is connected. The reverse or return motion of the wheels G and H is effected by means of the spring K K in the recess in the wheel G and fastened at one end to the bed of the instrument and at the other to the hub of the wheel G.

When it is desired to make diagrams from a machine having a continous rotary motion, as a rotary steam-engine or a rotary pump, the cord I may be unwrapped from the wheel H and an endless band, moved by the machine, be applied to impart continuous motion.

The combined operation of motion of the pencil and of the paper is to describe curves varying in form with the relative velocities of the paper and the pencil, from the measurement of which curves the operations in progress in the chamber of the machine to which the instrument is connected are made known and recorded. The neutral or atmospheric lines upon the diagrams described by this instrument are produced by a pencil, (marked U,) held in a socket or tube, V, supported by the screw W, and kept in contact with the paper by means of the spring Y, and susceptible of adjustment vertically by rotating the screw W by means of the milled head X. This portion of the apparatus is figured in red to distinguish it readily from the other parts.

Fig. 5 shows a part of the apparatus for dividing the diagrams so as to find the positions of the ordinates on the atmospheric line. It consists of two parallel bars, (marked 1 and 2,) of equal length, and having in each the same number of equidistant holes, arranged in right lines parallel with the edges of the bars. These two bars are united by a number of straight-edged and parallel links of equal length between the centers, marked in the figure 3 4 5 6 7. One edge of each of these links is made to a line coincident with a right line drawn through the centers of the rivets by which they are attached to the bars 1 and 2. Notches are made in the ends of the bars 1 and 2, as marked at 10 and 11, which notches are in right lines with the holes and rivets in 1 and 2, and at distances from the terminal rivets equal to the central distances between each two adjacent rivets. The several links being parallel and of equal central lengths, it is apparent that the parallel bars 1 and 2 can be moved in the same manner as the bars of an ordinary parallel rule. To use this instrument, the point marked 11 of the bar 2 is applied to one end of the line, and the point marked 10 of the bar 1 is applied to the other end of the line. Upon marking the intersections of the line with the straight edges of the links it will be found that the line is divided into equal parts. This part of the apparatus may be modified without departing from the essential principle of the device by making the distances between the terminal rivets and the notches 10 and 11 different from the distances between the other rivets, the effect of which alteration would be to make the terminal divisions of the line different in length from the intermediate ones.

The scale shown in Fig. 6 is divided, so as to show the number of pounds per superficial inch above and below atmospheric pressure, and is made with its graduated edge conforming in shape to the line described by the indicator-pencil upon a sheet of paper at rest.

Figs. 7, 11, 8, 12, 9, 13, 14, and 10 exhibit modifications of the forms of parts of this instrument. In Figs. 7 and 11 the corrugations of the diaphragm *a* are in concentric circles, and the pencil *b* is carried by the end of the lever *c*, which has its fulcrum at *d* and is operated by the lever *e*, which has its fulcrum at *f* and is moved by the link *g*, connecting it with the center of the diaphragm *a*.

Figs. 8 and 12 represent another form with a diaphragm, *a*, and link, *g*, similar to those exhibited in Figs. 7 and 11. The link is connected with a lever, *h*, and is connected with a link, *i*, bearing a pencil, *b*, which pencil-bearing link *i* is guided at the upper end by the radius-bar *k*, which causes the point of the pencil to describe approximately right lines.

Figs. 9 and 13 are similar to Figs. 8 and 12 in the link and pencil bearing apparatus; but instead of having the diaphragm or flexible vessel made of a corrugated plate, it consists of a vessel, *l*, whose walls are alternately contracted to necks *o o o*, and expanded into flange-shaped enlargements *p p p*.

Figs. 10 and 14 are similar in all respects to Figs. 9 and 13, excepting that the elasticity of the flexible vessel *l* is assisted by the spiral spring *q*.

We do not broadly claim the use of a parallel-motion apparatus for bearing the pencil of engine-indicators, nor do we claim, broadly, the use of flexible vessels to show variations in the internal pressure of other vessels to which they may be connected, such appliances being in common use in steam-gages. Nor do we claim any form of indicator combining a sliding piston and spring or springs, the same being already well known and in general use. Neither do we claim the use of continuous ribbons of paper to receive the record of of engine-indicators; but

What we do claim is—

1. The use of flexible vessels inflating and contracting with variations of pressure therein, in combination with a pencil-point for the purpose of describing or recording lines upon a moving sheet of paper, whether such vessels operate by the elasticity of their own walls or by the elasticity of the walls thereof, in combination with the elasticity of a spring or

springs, or if such flexible vessels are not at all elastic but are made to be so in effect by the combination of a spring or springs.

2. The use of the combination of rollers, ratchet-wheels, and cords, as drawn and described, for the purpose of moving the paper, when combined with the flexible vessel and pencil, as hereinbefore set forth.

3. The use of the second pencil for describing the neutral or atmospheric line, arranged substantially in the manner set forth.

S. LLOYD WIEGAND.
W. BARNET LE VAN.

Witnesses:
JOHN R. BENTLEY,
JOHN WHITE.