No. 631,463. Patented Aug. 22, 1899.

W. H. HARRISON.

STEAM ENGINE INDICATOR.

(Application filed Dec. 14, 1896.)

(No Model.)

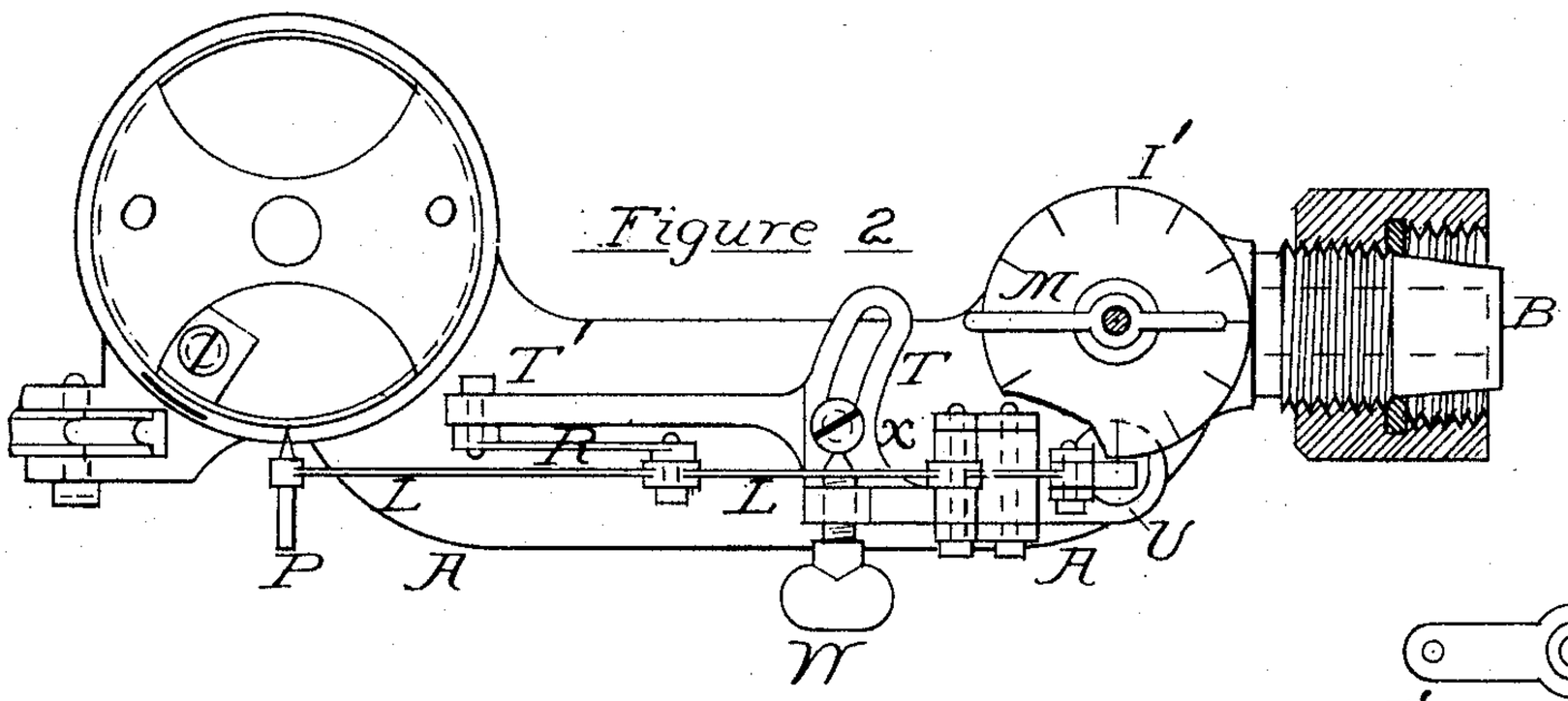

Figure 2

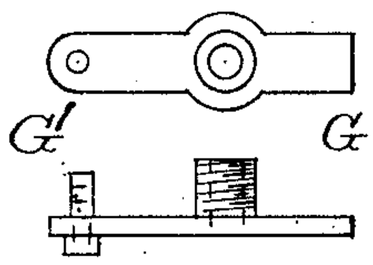

Figure 4

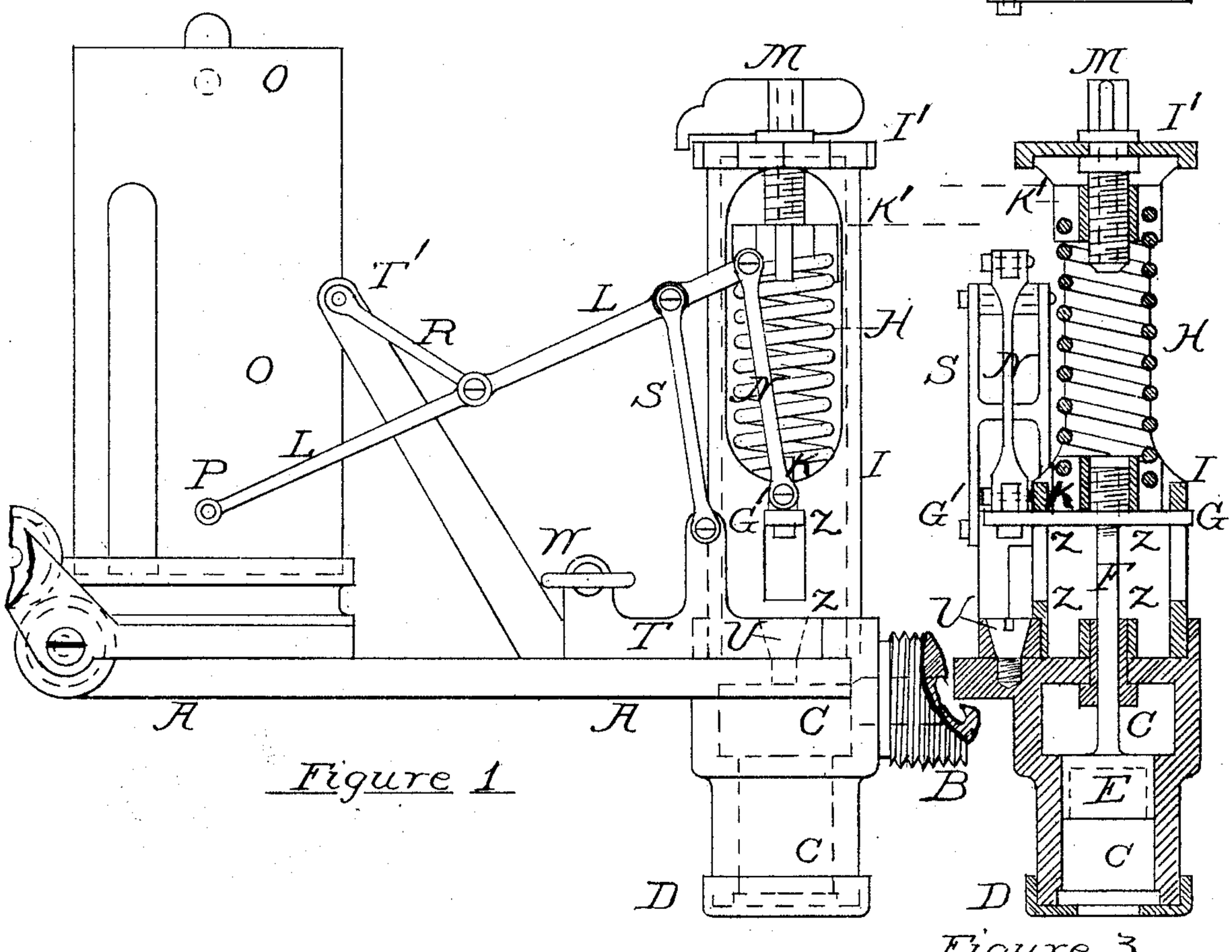

Figure 1

Figure 3

WITNESSES:

William C. Harrison.

Richard C. Harrison.

INVENTOR

William H. Harrison

UNITED STATES PATENT OFFICE.

WILLIAM H. HARRISON, OF BRAINTREE, MASSACHUSETTS.

STEAM-ENGINE INDICATOR.

SPECIFICATION forming part of Letters Patent No. 631,463, dated August 22, 1899.

Application filed December 14, 1896. Serial No. 615,667. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HENRY HARRISON, of Braintree, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Engine Indicators, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to that class of steam-engine indicators in which the range of the piston movement made small to avoid false vibrations is multiplied by a lever combined with a parallel motion, causing the pencil to move up and down through a much greater distance and in an approximately straight line.

On the said accompanying drawings, Figure 1 represents an elevation; Fig. 2, a plan, and Fig. 3 a vertical cross-section, taken through cylinder and spring in my improved indicator. Fig. 4 is a detached view from the same, showing the cross-head G G′.

All the views are full size; but I do not limit myself to the dimensions or proportions there shown or given in the description.

A A is the principal piece or base, having the cylinder C C at the right-hand end and the paper drum O O and the grooved wheel and the small pulleys for the cord at the left hand.

B is a pipe by means of which steam or fluid pressure is brought into the cylinder C C above the piston E, forcing it down and causing a tension upon the spring H. The pipe B is fitted with the usual cone-joint or union for connecting with an engine or pump and may be formed on the base A A in the manner and location shown in the drawings or different, if required.

The piston E has its rod F passing up through the bush and is threaded into the cross-head G G′, which is guided from turning by the slots Z Z and Z Z, and limited in its vertical motion to the height of said slots.

The cross-head G G′ is threaded into the nut K on the lower end of spring H, which has an upper nut K′ threaded on the range-screw M.

The range-screw M is supported in the hole at the upper end of the spring-case I I′ and has a wing-head to facilitate turning.

The spring-case I I′ is of open form, as shown, to preserve comparative coolness for the spring H and is supported firmly on the base A A.

The cross-head G G′ has its end G′ made long, so as to project through the front slot Z Z, and is provided with a small eye, in which are mounted a swivel and a knuckle-joint connection with the link N, which carries the motion of the cross-head G G′ to the multiplying-lever L L, which has its vibrating fulcrum S mounted on the swing-arm T T′, which swings horizontally on the base A A, with screw V for a pivot, having its center directly under the center of the eye at G′ on the cross-head G G′.

W is an adjusting-screw pointing on stud X, Fig. 2, and is the means for a fine adjustment of the pencil P.

The parallel motion for the pencil P on the long end of the lever L L, I have shown as obtained by the use of the radius-bar R, which is connected to the lever L L and to the swing-arm at T′, the lengths of the parts being properly proportioned.

The drawings show the vibrating fulcrum S located between the ends of the lever L L and near to the link M. Consequently when the cross-head G G′ goes down by the action of the steam or fluid upon the piston E the pencil P moves up and with an increased range of motion determined by the lever ratio.

The downwardly-acting piston E enables the hot water of condensation to leak freely around the piston E and pass quietly away from the lower end of cylinder C C through the large hole in the cap D.

If the piston E become clogged, the cap D is easy to remove, as well as the piston E, and the cylinder C C is easy to clean and this without dismounting the instrument or changing any of its adjustments. The spring H may also be tested by hanging suitable weights to the piston E or the cross-head G G′, the indicator being at the same time kept hot through the inlet B, which is attached to an engine.

The cross-head G G′ brings the lever L L clear of the spring H and enables me to readily adjust the range-screw M.

I call the screw M a "range-screw," because by its use I can increase the range of comparatively weak springs and coarse scales up to twice the pressure they have been previously used for.

With indicators as previously constructed engineers are limited in their high-pressure diagrams to springs and scales of eighty or one hundred pounds per inch of height, and the diagram is unsatisfactory on account of its smallness.

On the drawings, Fig. 1 shows the pencil P at the bottom of the drum O O and the cross-head G G′ at the top of its slot Z Z and the spring H without strain. Consequently if the drum is moved the line drawn on the paper will be the line of atmospheric pressure from which it is usual to measure the other lines and points. Turning the range-screw M in the proper direction, the spring H is carried bodily downward without strain and the atmospheric-pressure line will be carried up on the paper.

Comparing Fig. 1 with Fig. 3 of the drawings, it will be noticed that the top nut K′ stands one-fourth of an inch higher on Fig. 3 than on Fig. 1; but the cross-head G G′ stands at the top of the slots Z Z and Z Z in both figures. A tension has been put upon the spring H, while the cross-head G G′ and the pencil P remain at the same level as in Fig. 1, and a base-line can be drawn on the diagram, the value of which may be calculated as follows: With the lever ratio six, as shown by the drawings, and the spring H, for instance, at forty—that is, one that gives a pencil movement of one inch for a range of pressure of forty pounds per square inch of steam or fluid—this base-line will represent sixty pounds per square-inch pressure above the atmosphere—that is, one-fourth multiplied by six multiplied by forty equals sixty. I have two and one-half inches clear height on the paper, which, with the forty spring, gives me one hundred pounds range above the base-line, or together one hundred and sixty pounds above the atmosphere, and is ample height for taking diagrams from the high-pressure cylinders of triple-expansion engines when the pressure does not exceed one hundred and sixty pounds and does not fall below sixty pounds and using the forty spring and scale. If the pitch of the range-screw M be, for example, four-hundredths of an inch or one twenty-fifth, the extension of one-fourth inch on the spring H (shown in Fig. 3) is obtained by making six and one-fourth turns on screw M. The fractions of turns are easy to obtain on the graduated head I′ of the spring-case I I′. The drawings, Figs. 1 and 2, show it divided into twelve equal parts. One-twelfth of a turn on the range-screw M will give the pencil P, if free, a motion up or down of two-hundredths of an inch, which will correspond to a change of pressure of one pound per square inch for a fifty spring and scale, eight-tenths of a pound for a forty, and six-tenths of a pound for a thirty. This ability to locate the base-line with reference to the atmospheric line is very useful when comparing the diagrams taken at the same time from the different cylinders of multiple-expansion engines and multiple-cylinder compressors. The diagrams may be taken, using equal springs and scales for all and losses of pressure between the cylinders noted by inspection of the actual diagrams.

In diagrams taken for use in power calculations or for setting valves there is no need to draw or use or determine the valve of the base-line. When the indicator is connected, we can loosen or tighten the spring H by the range-screw M until the cross-head G G′ has a free motion without touching either end of the slots Z Z and Z Z. The rate or scale for any spring will not be changed by the different strains. There is another method by which this range-screw M may be used which will still be subject to this part of my invention, although I have not shown it in the drawings. If the steam or fluid pressure is brought into the bottom of the cylinder C C and the order of the multiplying-lever L L changed, so that the pencil P will move coincident with the cross-head G G′ and the spring H made to work in compression by the upward motion of the piston E, the range-screw M can still be used and with the same advantages as hereinbefore described.

I claim as my invention in a steam-engine indicator—

1. The piston E and piston-rod F in the cylinder C C, in combination with the cross-head G G′, the spring H, and the pencil-moving mechanism consisting of the link N the vibrating fulcrum S the lever L L the radius-bar R and the swing-arm T T, having the pivot-screw V concentric with the eye at G′ on the cross-head G G′.

2. The piston E and piston-rod F in the cylinder C C, in combination with the cross-head G G′, the spring H, the pencil-moving mechanism consisting of the link N the vibrating fulcrum S the lever L L the radius-bar R the swing-arm T T′, having the pivot-screw V concentric with the eye at G′ on the cross-head G G′, and the drum O O for paper.

3. The piston E and piston-rod F in the cylinder C C, in combination with the cross-head G G′, the spring H, the pencil-moving mechanism consisting of the link N the vibrating fulcrum S the lever L L the radius-bar R and the swing-arm T T′, having the pivot-screw V concentric with the swivel at G′ on the cross-head G G′, the drum O O for paper, and the range-screw M.

4. The piston E and the piston-rod F in the cylinder C C having at its closed top an inlet B above said piston E for the working fluid and at the bottom a free passage to the atmosphere.

5. The piston E and piston-rod F in the cylinder C C having at its closed top an inlet B above said piston E for the working fluid and at the bottom a free passage to the atmosphere in combination with the cross-head G G′ the spring H and the pencil-moving mechanism consisting of the link N the vibrating fulcrum S the lever L L the radius-bar R and

the swing-arm T T′, having the pivot-screw V concentric with the eye at G′ on the cross-head G G′.

All substantially as shown and described and for the purposes hereinbefore set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 16th day of November, A. D. 1896.

WILLIAM H. HARRISON.

Witnesses:
THOMAS P. HARRISON,
RICHARD C. HARRISON.

Corrections in Letters Patent No. 631,463.

It is hereby certified that in Letters Patent No. 631,463, granted August 22, 1899, upon the application of William H. Harrison, of Braintree, Massachusetts, for an improvement in "Steam-Engine Indicators," errors appear in the printed specification requiring correction, as follows: On page 2, line 30, the word "at" should read *a*, and same page, line 75, the word "valve" should read *value;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 29th day of August, A. D., 1899.

[SEAL.]

WEBSTER DAVIS,
Assistant Secretary of the Interior.

Countersigned:

A. P. GREELEY,
Acting Commissioner of Patents.