(No Model.) 3 Sheets—Sheet 1.

E. J. WOOLF.

VALVE GEAR FOR ENGINES.

No. 444,563. Patented Jan. 13, 1891.

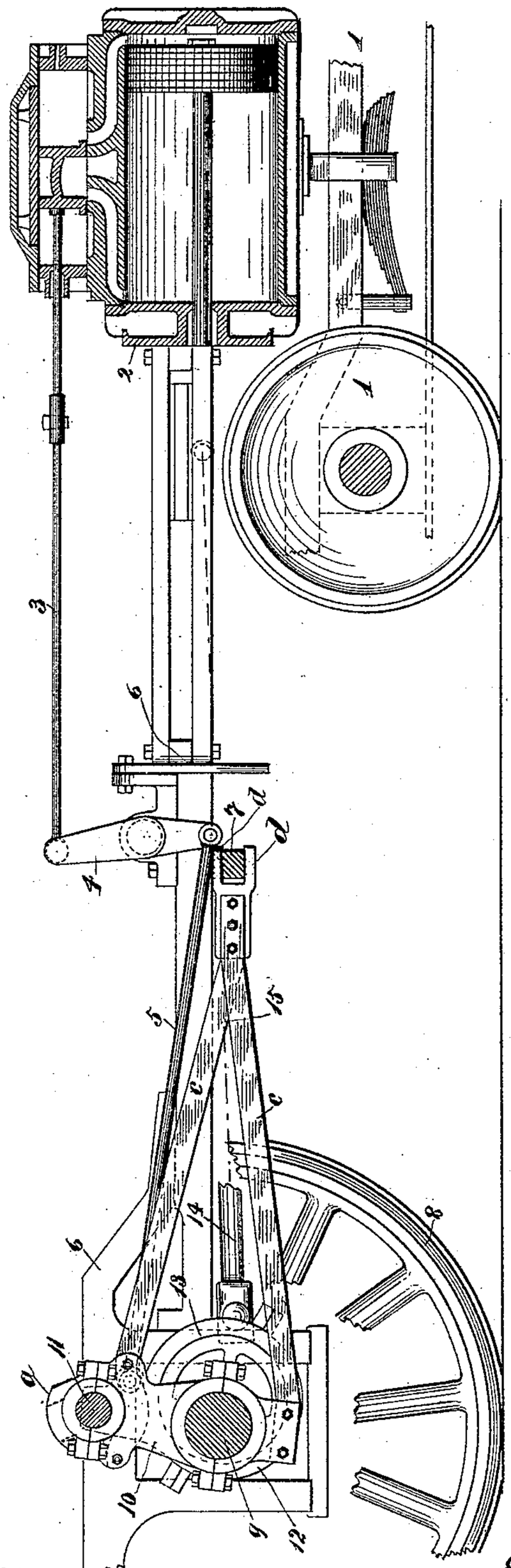

Fig. 1.

Witnesses.
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Inventor.
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(No Model.)

3 Sheets—Sheet 2.

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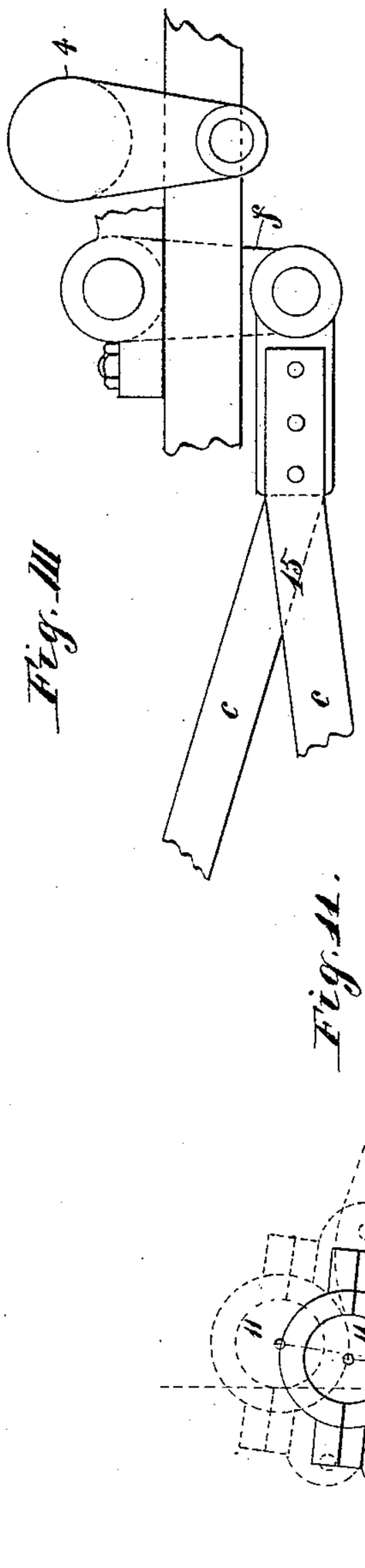

Fig. III.

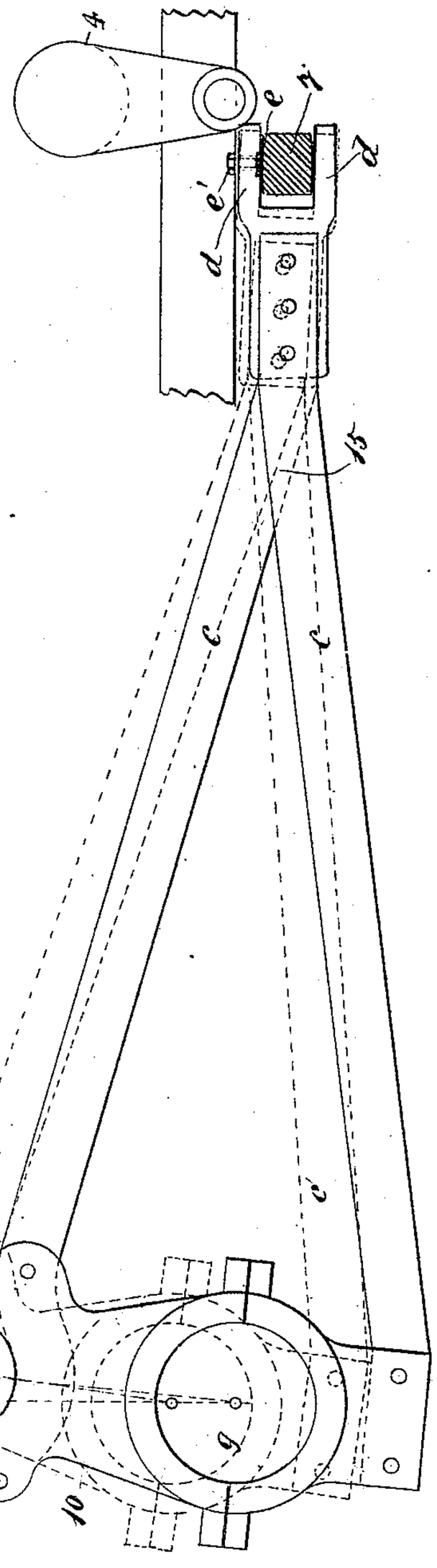

Fig. IV.

Witnesses

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(No Model.) 3 Sheets—Sheet 3.

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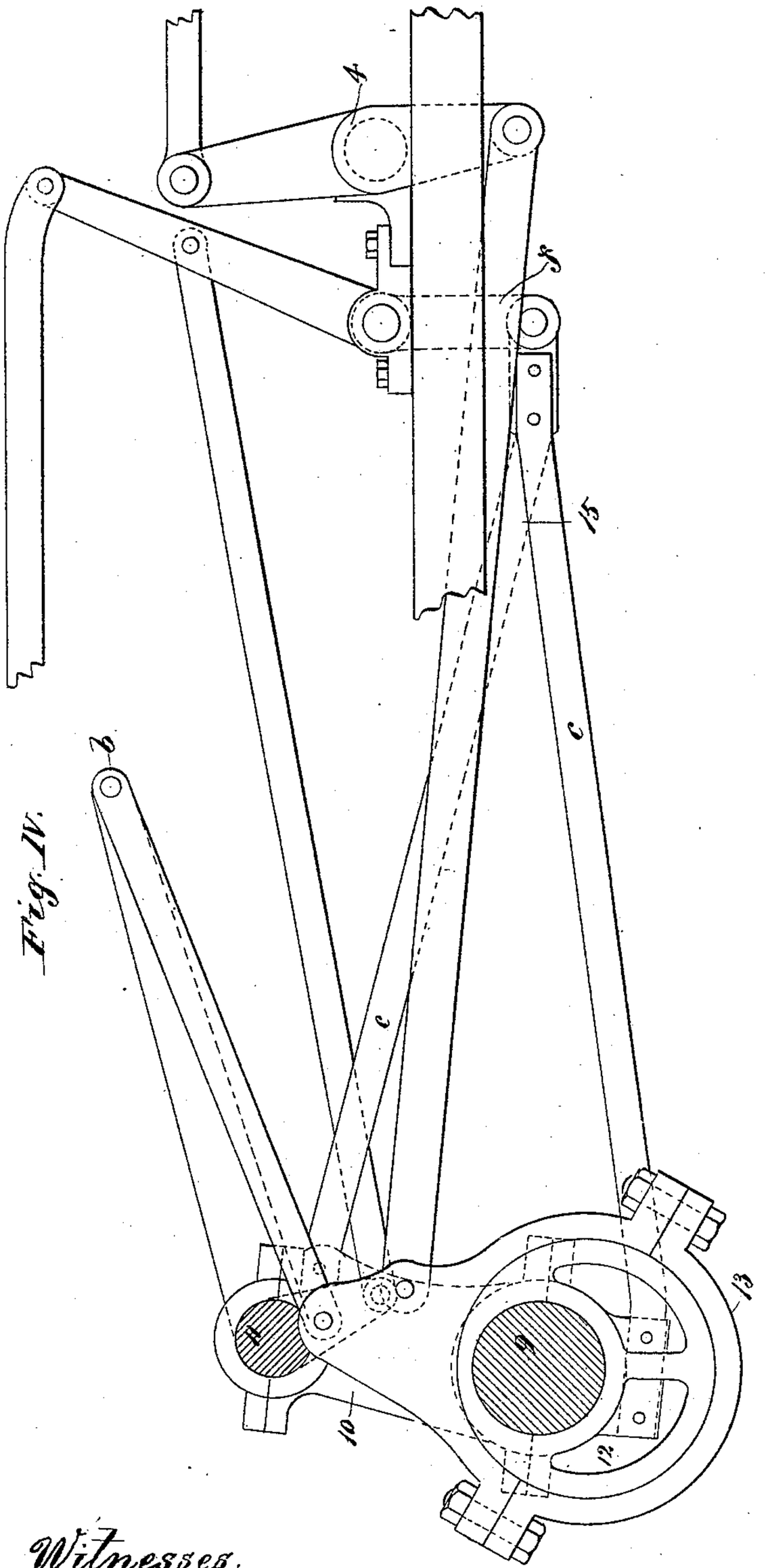

Fig. IV.

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Emma F. Elmore
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Ellis J. Woolf
By his Attorneys.
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UNITED STATES PATENT OFFICE.

ELLIS J. WOOLF, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO THE WOOLF VALVE GEAR COMPANY, OF SAME PLACE.

VALVE-GEAR FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 444,563, dated January 13, 1891.

Application filed April 19, 1890. Serial No. 348,662. (No model.)

To all whom it may concern:

Be it known that I, ELLIS J. WOOLF, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Valve-Gear for Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to radial valve-gear. It was especially designed for use in connection with the valve-gear described in United States Letters Patent issued jointly to myself and John Peebles, of date July 30, 1889, numbered 407,806, but is capable of use on other forms of radial gear wherein the restraining device for constraining the outer end of the strap to pursue a definite path is mounted on a standard or carrier supported on the eccentric-shaft.

The leading feature of the invention has for its object to provide a carrier for the restraining device which will automatically adjust itself to the relative movements of the axle and the frame and which will always present a rigid base of resistance to the valve-thrust.

The devices hitherto designed to permit the rising and falling of the axle have never, so far as I am aware, been rigid with reference to the valve-thrust. More or less loose joints have always intervened, impairing the motion and injuring the engine. For example, guide-pins fixed to the frame or boiler have been employed in co-operation with perforated lugs on the head of the standard, as shown in said former patent. Radius-bars have also been used pivotally connected at one end to the upper end of the standard and at the other to the frame. In both cases the necessary play at the joints—namely, between the pin and the lug in the one case and at the pivots in the other—permits the standard to move with every thrust of the valve, progressively increasing in degree with usage. This imparts a succession of blows to the standard, the restraining device, the strap, and the engine-frame. The frame and all parts supported thereby are kept in a continuous tremble, greatly to the discomfort of the engineer and fireman and increasing the wear and tear on the entire locomotive. The lost motion at the joints of the carrier becomes cumulative at the restraining device and strap. The effect on the valve is to delay its movement, increasing with usage, rendering the engine loggy and impairing the distribution of the steam.

The necessity for an automatically-adjustable carrier which should be free from the above-noted defects led to this feature of my invention, the efficiency of which for the purpose has been demonstrated by extensive usage. To these ends I construct the carrier in the form of a rigid bell-crank lever, the two arms of which are preferably of unequal length. The short arm or standard proper is loosely mounted on the axle and supports the restraining device, while the long arm is connected at its outer end to some support independent of the axle, preferably some part of the frame, in such a manner as to be permitted a limited to-and-fro motion in the direction of its length upon the rising and falling of the axle, but no motion whatever at an angle to its to-and-fro motion, and hence no motion whatever under the thrust from the valve. The carrier is therefore pivotal with reference to the relative movements of the axle and the frame, but is rigid with reference to the valve-thrust. I have shown two means of effecting the connection between the long arm of the carrier and the fixed support, so as to permit the requisite to-and-fro motion, one being a pair of jaws on the outer end of the arm embracing a cross-bar on the frame and the other a pivotal connection with a pivoted hanger on the frame. Both will work well; but the latter is my preferred construction. The long arms of the carrier may be of any suitable construction so long as it is rigid with the short arm or standard.

In the drawings I have shown the invention as applied to locomotives, with the eccentric on the main driving-axle. Of course it will be understood that the gear might be driven from some other shaft.

In the drawings, like notations referring to

like parts throughout, Figure I is a view, partly in elevation and partly in section, of a locomotive embodying my invention, some parts being removed, the view being taken from the center, looking toward the left side. Fig. II is a side elevation of the standard and holder detached. Fig. III is a similar view of part of same, showing modified means for connection with the frame or other fixed support; and Fig. IV is a view partly in side elevation and partly in section, showing the invention as applied to a locomotive with a modified form of restraining device for directing the outer end of the eccentric-strap.

1 is a part of the front truck.

2 is the cylinder; 3, the valve-stem; 4, the rocker; 5, the eccentric-rod; 6, a part of the frame; 7, a cross-bar secured to frame adjacent to the rockers, and 8 a driver.

9 is the driving-axle.

10 is the standard or short arm of the carrier boxed on the axle.

11 is the reverse shaft mounted on the standard and carrying a restraining device, as *a* or *b*, for outer end of eccentric-strap arm.

12 is the eccentric, and 13 the eccentric-strap having its outer end held and guided by the restraining device.

14 is part of the connecting-rod.

15 is the long arm of the carrier, composed, as shown, of the two rigid bars *c*, rigidly belted at their divergent ends to the extremities of the standard and united at their convergent ends.

As shown in Figs. I and II, the long arm of the carrier is provided with jaws *d* at its forward or free end, which engage opposite sides of the bar 7. One of the jaws *d* may be recessed and provided with a movable strip *e* and a set-screw *e'* to take up any lost motion between the jaw and the bar 7.

As shown in Figs. III and IV, the forward end of the long arm 15 is pivotally connected to a pivoted hanger *f*.

The form of restraining device *a* shown in Figs. I and II is identical with that in my former patent, consisting of a guide rigidly secured on the shaft 11, in which moves a roller or block (not shown) to which the outer end of the eccentric-strap is connected.

In Fig. IV is shown a different form of restraining device *b* of my invention, consisting of a pair of arms, one of which is rigid with the rock-shaft and the other is pivotally connected to the rigid arm and to the outer end of the eccentric-strap.

With the shaft 11 and either form of restraining device *a* or *b* the path of the outer end of the eccentric-strap may be shifted at will, as may be required, to reverse the engine or to vary the cut-off and other actions of the valve.

The operation or effect of the carrier is evident. It cannot possibly turn on the axle unless one or the other of its arms can rise or fall. Neither of its arms can rise or fall so long as the axle and frame preserve the same relative position. The thrust from the valve would tend to tilt the carrier; but it cannot tilt, because its forward end can neither rise nor fall on the frame. Hence the base of resistance to the valve-thrust is always absolutely rigid. The pivotal motion of the carrier on the axle is only possible when the axle rises and falls, changing the relative levels of the axle and frame, and is exactly sufficient to compensate therefor, thus preserving a constant relation between the restraining device and the valve-driving rocker-arm or any other given point on the frame. Hence there is never any time when the carrier can tilt or give under the valve-thrust. The strain from the same falls chiefly on the axle. Whatever portion of the same falls on the outer end of the long arm of the carrier is in an up-and-down direction on the frame. In virtue of the relative lengths of the two arms, this is so slight as to be without any detrimental effect whatever either in the way of vibration or wear and tear on the connection. Whatever slight lost motion might develop at the connection would be divided many times in virtue of the relative leverage before it reached the head of the standard or the restraining device. Hence the valve-movement is never impaired, but is always preserved at its initial value, regardless of hard usage, and the general efficiency and durability of the locomotive are greatly improved.

Of course it will be understood that the invention is applicable to all forms of engine wherever there is any occasion to compensate for relative movements of the gear-driving shaft and the engine-frame.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. A carrier for a valve-gear, consisting of a rigid bell-crank lever having one arm loosely mounted on the eccentric-shaft and the other connected to some independent support, with freedom for a limited movement in the direction of its length, but without freedom to move at an angle to the line of its to-and-fro motion, whereby, while automatically adjusting the gear to the rising and falling of the shaft, the carrier always presents a rigid base of resistance to the valve-thrust.

2. In a locomotive, the combination, with the driving-axle, the eccentric, and the strap, of a restraining device for directing the outer end of the strap in a definite path variable at will, and a rigid bell-crank lever having one arm loosely mounted on the axle and supporting the restraining device and the other arm connected to the engine-frame, with freedom for a limited to-and-fro motion to compensate for the rising and falling of the axle, but always constant and rigid with reference to the valve-thrust.

3. In a locomotive, the combination, with the driving-axle, eccentric, and strap, of a restraining device adapted to constrain the outer end of the strap to pursue a definite

path variable at will, and a rigid bell-crank carrier for supporting said restraining device, having one of its arms loosely mounted on the axle and the other connected to the frame by a pivoted hanger, substantially as and for the purpose set forth.

4. In a locomotive, the combination, with the axle, the eccentric, and the strap, of the standard boxed on the axle, the arm or lever rigid with the standard and angularly extended therefrom, of greater length than the standard, the pivoted hanger pivotally connecting the outer end of said arm with the frame, and a restraining device for the outer end of the strap mounted on said standard, substantially as and for the purpose set forth.

5. In a radial valve-gear, a restraining device for constraining the outer end of the eccentric-strap to pursue a definite path variable at will, consisting of a rock-shaft provided with a rigid arm and a bar pivotally connected at one end to said arm and at the other to said strap.

6. In a locomotive, the combination, with the eccentric-shaft, of the eccentric-strap, the standard loosely boxed on said shaft, a support for said standard, a rock-shaft on said standard provided with a rigid arm, and a bar pivotally connecting said arm and the outer end of the said strap, substantially as and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

ELLIS J. WOOLF.

Witnesses:
JAS. F. WILLIAMSON,
E. F. ELMORE.