No. 634,973. Patented Oct. 17, 1899.

G. L. WOODWORTH.

GOVERNING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

(Application filed Aug. 4, 1897.)

(No Model.) 2 Sheets—Sheet 1.

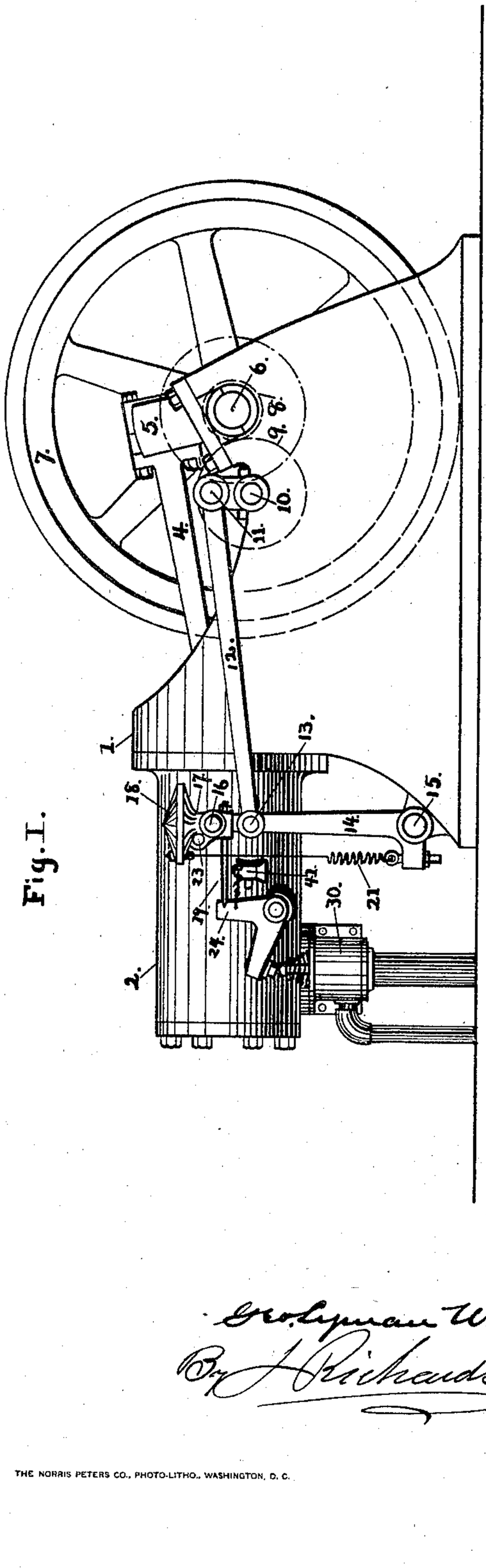

Fig. 1.

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L. M. Hoskins

Inventor:
Geo. Lyman Woodworth,
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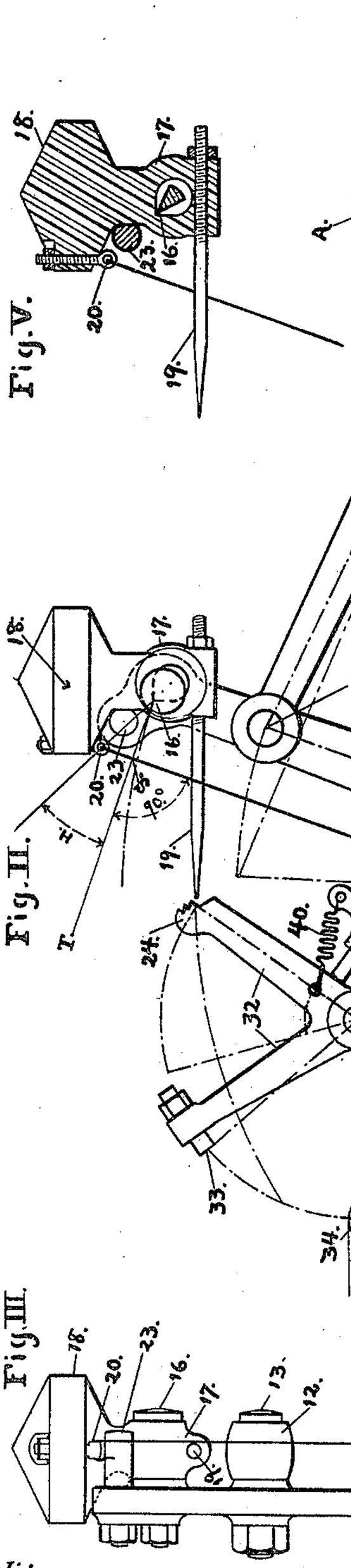

Fig. V.

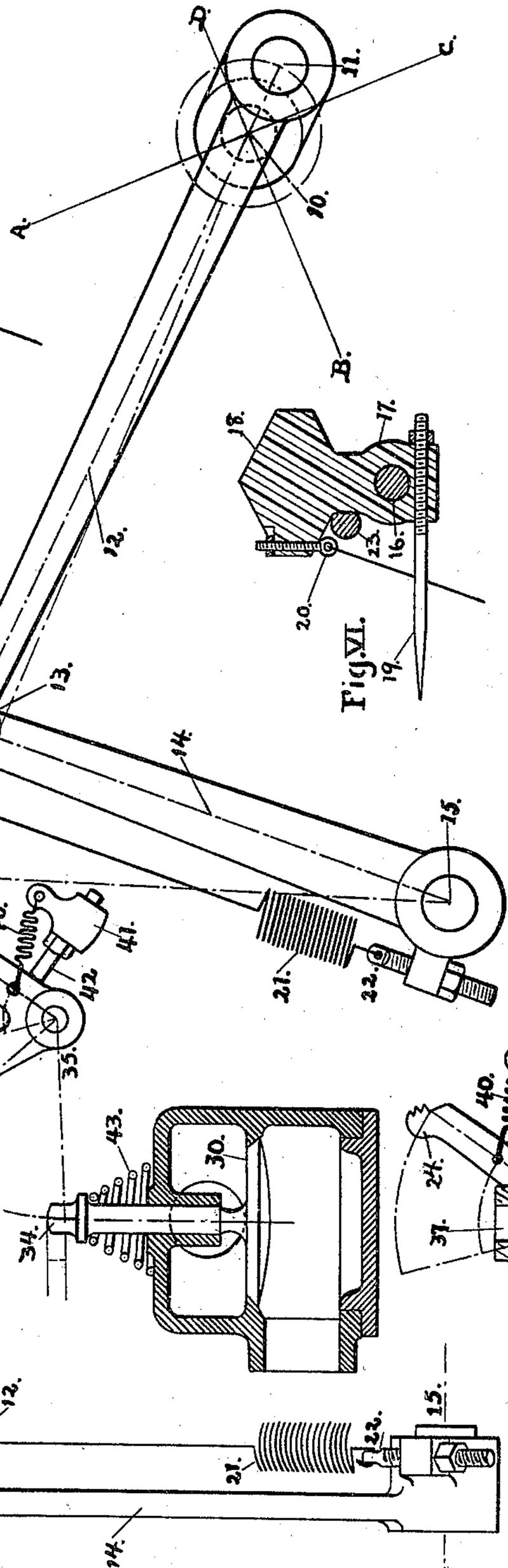

Fig. VI.

Fig. III.

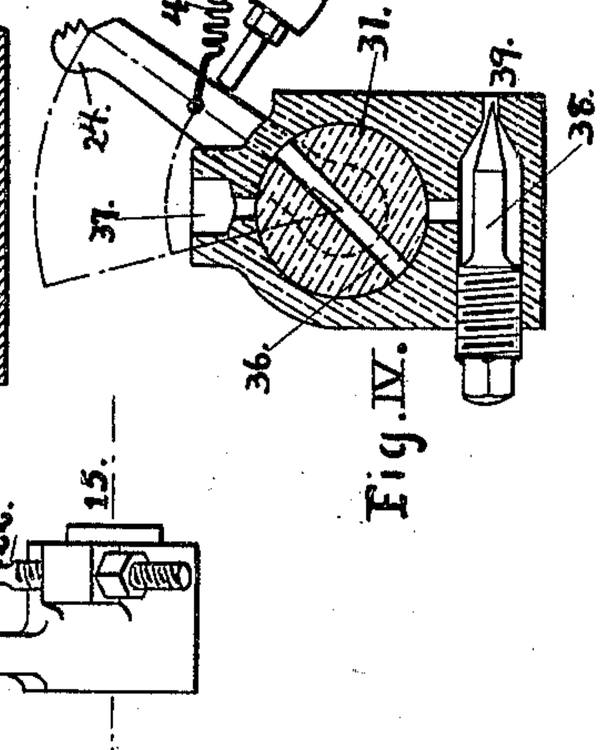

Fig. IV.

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UNITED STATES PATENT OFFICE.

GEORGE LYMAN WOODWORTH, OF STANFORD UNIVERSITY, CALIFORNIA.

GOVERNING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

SPECIFICATION forming part of Letters Patent No. 634,973, dated October 17, 1899.

Application filed August 4, 1897. Serial No. 647,044. (No model.)

To all whom it may concern:

Be it known that I, GEORGE LYMAN WOODWORTH, a citizen of the United States, residing at Stanford University, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Governing Mechanism for Internal-Combustion Engines, of which the following is a specification.

This invention relates to gas, oil, or other heat engines operating by internal combustion and to controlling or governing mechanism for such engines.

My invention consists in an oscillating member constrained by a spring and a stop and mounted on a fulcrum set on a vibrating support and so made and so placed thereon that there is a resultant turning moment due to inertia, said oscillating member containing a part that operates a piece which controls the admission of fuel or working fluid to the engine, and, furthermore, consists in the peculiar mode of mounting the oscillating member, so as to make it extremely sensitive to changes in speed, thus giving the engine a correspondingly close regulation. To these ends I construct the governing mechanism as shown in the accompanying drawings, in which—

Figure I is a side view of a gas or oil engine provided with my improved governor. Fig. II is a side elevation of the governing mechanism, separate and on a larger scale, with a diagram of motions, also a valve shown in section operated thereby. Fig. III is a partial edge view of Fig. II. Fig. IV is a section of a valve for oil operated by the same regulating-gearing. Fig. V is a section through the oscillating member. Fig. VI is a section through the oscillating member, showing a less sensitive modification of the same mechanism.

The engine shown in Fig. I is of the usual construction and marked with numerals of reference hereinafter described. Such numerals apply throughout the several views to corresponding parts.

In Fig. I the engine-frame is marked 1; the cylinder, 2; the connecting-rod, 4; the crank-shaft, 6, and the fly-wheel, 7. The shaft 10 is driven by means of gear-wheels 8 and 9, (indicated by dotted circles,) so as to revolve at half the velocity of the crank-shaft 6 when the engine works on the four-stroke cycle. The link 12 is connected at one end to crank or eccentric 11 and at the other end to a vibrating support 13, formed by a lever 14, fulcrumed at 15, or a block sliding on guides can be employed.

In Fig. II the oscillating member 17 is supported at fulcrum 16, set on the lever 14 or its equivalent. The inertia part (marked 18) and the governor-stem 19 are integral or affixed to member 17, and are constrained by the spring 21, attached at 20 and 22, and by the stop 23, set on lever 14, the said spring urging the oscillating member 17 against the said stop. As the vibrating lever 14 starts forward the resultant turning moment of the force produced by accelerating the member 17 is opposed by the moment of the spring 21, so that at the normal speed of the engine the said member 17 is held against the stop 23, and the stem 19 engages piece 24, letting in a charge of fuel or fuel and air to the engine; but should the speed increase the spring 21 is overpowered by mass 18, the oscillating member 17 turns about fulcrum 16, and the stem 19 is deflected and engages with piece 24 at a different notch therein or passes without engaging, so that the charge is reduced or cut out to suit the demand for power. In order to compensate for wear, I prefer to make the stem 19 adjustable lengthwise. The engaging portion of stem 19 is best made chisel-edged. The piece 24, supported at 35, is returned to stop 42, preferably by means of a spring 40, which is secured to a lug 41 on the engine-cylinder.

Referring to the gas-valve 30, this is opened by the adjustable pin 33, moving with piece 24, forcing down the valve-stem 34. The valve 30 is returned to its seat by spring 43.

In the case of an oil-valve, as shown in Fig. IV, the piece 24 turns the circular valve 31, so that passage 36 will admit oil from the supply 37 to the chamber 38, and thence through the needle-valve 39 to the engine, other operations being the same as in the case of the gas-valve 30. (Shown in Fig. II.)

The constraining-spring 21 of the governor is made and attached in a peculiar manner, so as to be extremely sensitive. Said spring is so made and attached that it suffers or undergoes a minimum change in constraining

effect for a given angular displacement of its point of attachment 20 on the member 17 about the fulcrum-axis 16 of the governor. To illustrate this peculiar point by a special example, let the force exerted by the said spring equal γ sin. χ, and its lever-arm equal γ cos. χ, then its moment equals γ sin. $\chi \times \gamma$ cos. χ. Solving the above equation for the critical angle at which the moment is a maximum, forty-five degrees is the answer. In practice, however, I prefer to make and attach the said spring so that an elongation or stretch equal to γ sin. H gives the requisite tension to act at lever-arm γ cos. H to counterbalance the mass 18, when the length 16 to 20 equals γ and the angle H (see diagram Fig. II) is two or three degrees less than the critical angle.

The moment of the oscillating member about fulcrum-axis 16 is determined precisely by considering the resultant effect of all the portions or parts composing the said member; but for purposes of design and construction the said moment equals approximately the product of the mass of part 18 by its acceleration times the length from axis 16 to the center of gravity of part 18.

Referring again to Fig. II, the extremity 22 of the spring 21 is shown attached near fulcrum 15 on rocking lever 14, where there is little if any motion. Hence the tension can be adjusted when running; also, the inertia effect of the said spring has no disturbing action on the governor. Obviously said end 22 can be otherwise attached; but the place and mode shown I deem best. The lug 20 for the spring 21 can be made integral with member 17, though I prefer to make it an eyebolt to provide for slight adjustment. The fulcrum marked 16, upon which is mounted the oscillating member 17, can be a round pin or spindle, as shown in Fig. VI; but a more sensitive modification of the same is deemed preferable—namely, a knife-edge bearing.

In Fig. V is shown a suitable knife-edge bearing to mount the oscillating member upon, and it will be observed this construction obviates friction.

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

1. In a governing mechanism for internal-combustion engines, the combination with the fuel-admission valve of a vibrating lever driven by the engine, a weight pivoted upon said vibrating lever, a stem adjustably secured to said weight, a stop mounted upon said vibrating lever, against which said weight impinges, a spring attached to said vibrating lever and to said weight as described, urging the latter against said stop, and an oscillating member having a notched arm in the path of said stem against which the latter impinges as it vibrates, said oscillating member provided with an adjustable stop engaging with the fuel-admission valve intermittently, substantially as specified.

2. In a governing mechanism for internal-combustion engines, the combination with the fuel-admission valve of a vibrating lever driven by the engine, a weight pivoted upon said vibrating lever, a chisel-edged stem secured to said weight, a stop mounted upon said vibrating lever, against which said weight impinges, a spring attached to said vibrating lever and to said weight as described, urging the latter against said stop, and an oscillating V-shaped member having a notched arm in the path of said stem, and an arm with an adjustable stop, moving in a path encountering the fuel-admission valve of the engine, substantially as specified.

3. In a governing mechanism for internal-combustion engines, the combination with the fuel-admission valve of a vibrating lever driven by the engine, a weight pivoted upon said vibrating lever, a stem adjustably secured to said weight, a stop mounted upon said vibrating lever, against which said weight impinges, a spring attached at one end to said vibrating lever by a lug near the fulcrum of the said lever, and at the other end to a lug near the pivot of the oscillating weight, whereby the constraining action of said spring on said weight suffers a minimum change for a given displacement, and an oscillating member having two arms, one in the path of the said vibrating stem, and the other moving in a path encountering the fuel-admission valve of the engine so as to operate the same, substantially as specified.

4. In a governing mechanism for internal-combustion engines, the combination of a vibrating lever driven by the engine, a weight pivoted upon said vibrating lever, a chisel-edged stem adjustably secured to said weight, a stop mounted upon said vibrating lever, against which said weight impinges, a spring attached at one end to said vibrating lever by a lug near the fulcrum of said lever, and at the other end to an adjustable lug near the pivot of the oscillating weight, whereby the constraining action of said spring on said weight suffers a minimum change for a given displacement, and an oscillating member having two arms, one in the path of the said vibrating stem, and the other moving in a path encountering the fuel-admission valve of the engine, substantially as specified.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GEO. LYMAN WOODWORTH.

Witnesses:

JAMES L. KING,

H. SANDERSON.