G. H. BABCOCK.
Steam-Engines.

No. 133,741. Patented Dec. 10, 1872.

Fig. 3.

Diagram.

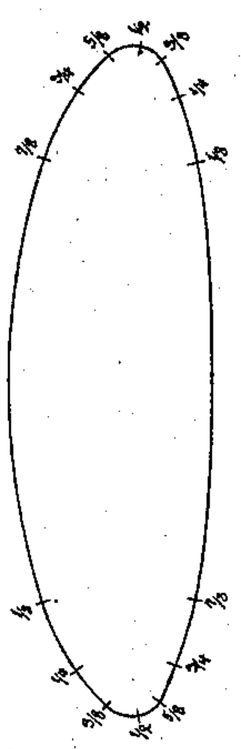

Fig. 2.

Fig. 1.

Witnesses;

C. Raetig.

Wm C. Gray

Inventor,

Geo. H. Babcock

by his attorney A. S. Nelson

UNITED STATES PATENT OFFICE.

GEORGE H. BABCOCK, OF PLAINFIELD, NEW JERSEY.

IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. **133,741**, dated December 10, 1872.

To all whom it may concern:

Be it known that I, GEORGE H. BABCOCK, of Plainfield, Union county, New Jersey, have invented a certain Improvement in Valve-Motions for Steam-Engines, of which the following is a specification:

I will describe the invention as applied to a small upright stationary-engine regulated by an ordinary centrifugal governor.

One of the advantages, which will be appreciated by engineers as due to this invention, is the equalization of the action on the up-and-down strokes—that is to say, it compensates for the changing angle of the connecting-rod in different portions of the stroke. The point of the cut-off is the same in the up-stroke as in the down-stroke under all conditions; and so of the point of exhausting, compression, &c. Only one eccentric is employed.

The accompanying drawing forms a part of this specification.

Figure 1 is an end elevation, and Fig. 2 is a side elevation. Fig. 3 is a diagram, showing the motion of one of the parts on a large scale.

Similar letters of reference indicate like parts in both the figures.

A is the fixed frame, and A′ the fixed vertical guides cast therein, which perform the ordinary function of guiding the cross-head. B is the cylinder, and C a belt, which communicates motion to the governor F through beveled gearing, as will be understood. D is the main shaft, receiving the action of the engine through a crank and connecting-rod; which, as also other parts of the engine not represented, it will be understood may be of the ordinary or any suitable construction. A single eccentric, *d*, operates a stout encompassing part formed in two pieces and bolted together, which I will term an eccentric strap. The lower part I will mark M^1 and the upper part M^2, referring to the whole, when necessary, by the single letter M. The lower part M^1 has a groove, which, as the eccentric *d* revolves, is traversed up and down in a constantly-changing inclination on a block, N, which is free to swivel a little on a pin, *n*, fixed firmly in the framing. The arrangement causes the upper arm M^2 to describe a path somewhat analogous to an ellipse, with its transverse axis horizontal, but with the lower side of the ellipse flattened. The upper end of the arm M^2 carries a block, m^2, provided with adjustable gibs and adjusting nuts and screws. This block, with its gibs, takes hold slightly but firmly of a slightly-curved piece marked E, which is smoothly finished, and allows the block m^2 to traverse smoothly from its one extremity to the other. As the shaft D revolves the center of the block m^2 describes a path in space which is indicated on a large scale in the diagram, Fig. 3. This path is invariable under any given adjustment of the pin *n*. Its effect, however, on the valve, both with regard to the amount of throw and the time in which the valve arrives at any given point, is greatly modified according as the piece E is inclined more or less. The valve may be an ordinary slide-valve. G is the valve-stem, connected adjustably to the yoke G′, to which the adjustable curved piece E is pivoted, so that it rises and sinks therewith as the valve is worked. Some portion of the benefit of my invention may be realized by fixing the piece E in an invariable position on the yoke G′, or directly upon the valve-stem, and holding the valve-stem by some suitable guide against any lateral motion, allowing the motion of the block m^2 to be communicated invariably to the valve-stem G. I have, however, added provision for conveniently adjusting the point of cut-off, and for effecting this with great perfection by means of a governor. The piece E is pivoted upon a yoke, G′, so that it can be easily turned into various degrees of obliquity. The piece E has an arm, E′, extending upward at right angles therefrom. On the center of motion of the piece E E′ on the pivot *e*, which connects the piece E E′ with the yoke G′, is carried a lever, H, which turns on a fixed point, *h*, in the framing, by means of which lever extending beyond the pivot *h* a heavy ball, H′, is supported, which tends to balance the weight of the slide-valve and its connections. As the valve is worked the lever H rocks, and the pivot *e*, instead of describing an exactly-vertical line, traverses up and down in an arc, of which the center is *h*. The upper end of the arm E′ is connected by a rod, I, to the upper arm J^1, of a bell-crank lever which is mounted on the same center *h* as the lever H. The lower arm J^2 of this lever is connected by a rod, K, to a slide, K′, the position of which is controlled by the governor at rapidly-recurring intervals; while it is also held

very strongly against any movement except such as the governor shall indicate. The action of the block m^2 on the curved piece E tends to disturb the position of the piece E and of the several connections I J K. At each revolution the rod K is pressed upward, and then again downward with considerable force. Such force would tend to disturb the action of the governor but for the provisions which I have introduced. The slide K′ is guided so that it is only capable of a strictly vertical motion. It carries a pin, k^2, which is received in an oblique slot, l, in a horizontal slide, L, which latter is operated to the right or left by the bell-crank lever P, according as the governor-balls rise or sink, as will be obvious. As the center of the block m^2 revolves in its distorted elliptical path there are four points where there is no tendency to disturb the position of those parts. Two of these points are at the opposite ends of the throw of the valve. Here the block exerts no tendency to disturb anything, for obvious reasons. There are also two points in its traverse when the center of the block m^2 is coincident with the prolonged axis of the pivot e. Here any force exerted by the eccentric, and, consequently, by the block m^2, however great it may be, in the upward or downward direction is evidently unfelt by the arm E′ and by the connections I J K, because it is exactly on the center of the turning piece E E′. When the engine is cutting off at its shortest these points nearly coincide with the points before named—viz., those at the end of the motion of the valve. When the steam is allowed to follow further these points may come in widely-differing parts of the circuit. The rod K is provided with an adjusting-nut, k^3, as represented, by which the length of the rod can be very nicely adjusted at will.

Operation.

The engine being supposed to be working with a uniform load at a uniform speed, there is no change in the rate of expansion, and the piece E maintains a fixed and uniform amount of inclination, but rising and sinking with each turn of the engine. If the piece E is in a horizontal position, or as nearly so as its curvature will allow, the valve receives an amount of up-and-down motion only equal to the conjugate axis of the imperfect ellipse described by the center of the block m^2. This motion is only sufficient to allow for the lead and loss, and will give very little steam to the engine. In other words, it cuts off at the beginning of the stroke. When the governor-balls sink and the slide moves, in consequence, to the left, so that the slide K′ and the rod K sink a little, the arm E′ is inclined more to the right and the piece E is inclined, and is thereafter held firmly in an oblique position. In this oblique position the valve gets a greater throw by reason of the fact that the block m^2, in making its long traverse laterally, induces a motion in the piece E and its connections additional to and peculiarly combined with the motion which is due simply to the vertical travel of the block m^2 before referred to. It may not be necessary to give in this specification a prolonged mathematical analysis of the action. What I consider the best proportions are shown in the drawing; and as the obliquity of the piece E is increased or diminished the throw of the valve is increased or diminished.

The parts are so related that, as before remarked, any change of cut-off is felt equally on the up-stroke and down-stroke; and the same with the other changeable points, the point of admission, compression, and exhaust.

Some of the advantages due to certain features of the invention may be realized by the employment of only a portion of the combination; but I prefer the whole, as described. There may be little advantage in making the pin n adjustable. I, in fact, prefer to determine accurately the best position for this pin and its connected block N, and to fix it permanently in the frame A. A slightly-differing effect, but nearly as good, may be produced by fixing the pin n on the lower arm M^1 of the eccentric-strap and allowing the block M to traverse vertically in ways carried on the frame.

The arm E′ extending upward from the curved piece E is of exactly the same length as the upper part or arm J′ of the bell-crank lever J. The rod I is also of exactly the same length as the corresponding part of the lever H. These relative proportions are important. They form a figure which, however it may be changed to be more or less diamond-shaped instead of square or rectangular, is always a parallelogram; and, however obliquely the curved piece E is set, it moves always in a position parallel to itself.

I claim as my invention—

1. The piece E attached to the valve-moving mechanism, in combination with a block, m^2, as specified, and caused to describe an approximate ellipse so as to operate therewith, substantially as herein set forth.

2. The eccentric-strap M^1 M^2, controlled on one side by the pin n and block N, and carrying on the other side a block, m^2, adapted to operate in combination with a properly-curved piece, E, as and for the purposes herein specified.

3. The adjusting-arm E′ and controlling-rod I, with suitable means for adjusting the latter, arranged to serve relatively to the piece E, valve-stem G, and block m^2 on the eccentric-strap M^1 M^2, as herein specified.

4. The lever H connected to the valve-stem G, and guiding the latter, in combination with the block m^2, operated as shown, and with the piece E E′ and connections I J K, or their equivalents.

In testimony whereof I have hereunto set my hand this 28th day of August, 1872, in the presence of two subscribing witnesses.

GEO. H. BABCOCK.

Witnesses:
S. WILCOX,
ARNOLD HÖRMANN.