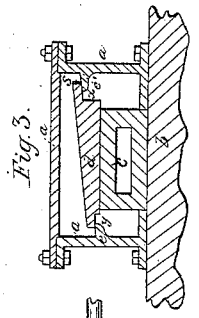
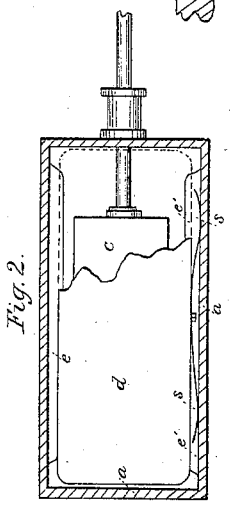
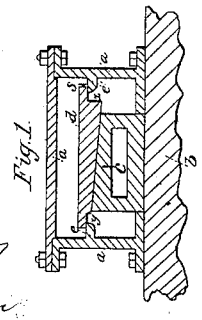
C. W. Crawford,

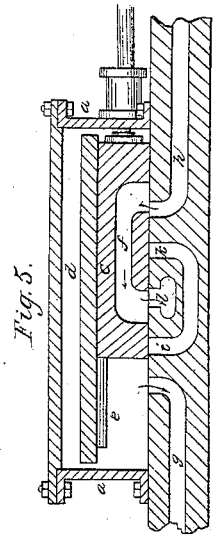
Steam Balanced Valve.

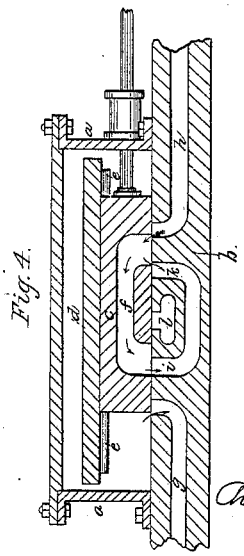
No. 51,023. Patented Nov. 21, 1865.











Witnesses.
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UNITED STATES PATENT OFFICE.

CHARLES W. CRAWFORD, OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN SLIDE-VALVES FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **51,023**, dated November 21, 1865.

To all whom it may concern:

Be it known that I, CHARLES W. CRAWFORD, of the city of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Balance Slide-Valves for Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a transverse section of a steam-chest and balance-valve with my improvement. Fig. 2 is a top view of a steam-chest with the cover removed. Fig. 3 is a transverse section of a steam-chest and valve, showing a modified arrangement. Figs. 4 and 5 are longitudinal sections of a steam-valve and valve-seat, showing an improvement for adapting a high-pressure engine to the use of a condenser.

In the several figures like letters denote similar parts.

The objects of my improvement are twofold, the first being to render the slide-valve of the steam-chest as nearly a perfect balance-valve as possible, by placing in close contact with the top of the sliding valve a plate supported by the steam-chest, and which will receive and sustain the pressure of the steam, excepting so much only as is necessary to keep the plate by gentle pressure in close contact with the upper surface of the valve, thereby avoiding the necessity of any arrangement for adjusting the plate from time to time, to keep it in contact with the valve, and rendering it in this respect self-adjusting; and, secondly, I design, by a peculiar arrangement of steam-ports and exhaust-openings in the valve and valve-seat of high-pressure engines, to allow a part of the steam to escape to a condenser, and thus combine with a high-pressure engine the advantages of a low-pressure or condensing engine.

In the drawings, *a* is a steam-chest, set on the valve-seat *b*, and constructed in the usual manner, excepting in the particulars hereinafter mentioned.

c is the sliding valve, also of ordinary construction, excepting that I sometimes make it higher on one side than the other, so as to cause the top or upper surface to incline at an acute angle to the valve-seat *b*, as in Fig. 1; or it may be made of rectangular cross-section, with parallel sides, as in Fig. 2—a modification of construction which I shall hereinafter explain, confining myself at present to a description of the valve as shown in Figs. 1 and 2.

Projecting inward from each side of the steam-chest *a* are two parallel ledges, *e e'*, on the upper surface of which, parallel with the valve-seat *b*, rest the sides of the pressure-plate *d*. The sides of the pressure-plate are of equal thickness, their under and upper surfaces being parallel; but on the under surface of the pressure-plate *d* is a cuneiform projection, somewhat wider than the top of the valve *c*, but not equal to the distance between the ledges *e e'* of the steam-chest, so that there is a space at *x* and *y* on either side of the cuneiform projection between its sides and the edges of the ledges *e e'*. The underside of the cuneiform projection of the pressure-plate *d* is inclined at an angle equal to the angle of inclination of the top of the valve *c*, so that when the pressure-plate *d* rests on the ledges *e e'* its under surface may be in close contact with the upper surface of the valve *c*. A leaf-spring, *s*, (see Fig. 2) is attached to that side of the pressure-plate above the ledge *e'* at which the edge *x* of the cuneiform projection is deepest, thus tending to push the pressure-plate sidewise, so as to press against the top of the valve *c* without raising it off the ledge *c'*, and to allow the steam in the chest to press equally on both edges of the plate *d* above the ledges *e e'*. The spring *s* also serves to keep the pressure-plate *d* in close contact with the valve *c* when the engine is not in operation, so that it may be in place when the steam is let into the steam-chest. The pressure-plate is so made, relatively to the steam-chest, as to permit of the steam passing under it.

The operation of the valve and pressure-plate thus constructed are as follows, the object being to prevent the steam from pressing upon or coming in contact with the upper surface of the sliding valve *c*. The pressure-plate *d*, being supported by the ledges *e e'*, sustains the pressure of the steam and relieves the valve; and if the top of the valve *c* be kept in close contact with the under side of the pressure-plate *d*, no steam can reach its upper surface. Owing to the cuneiform shape of the projec-

tion on the under side of the pressure-plate *d*, the side *x* of the projection is much deeper than its opposite parallel side, *y*, and therefore the pressure of steam on the side *x* will be so much greater than that on the side *y* as to press the plate *d* sidewise; and owing to the inclined surfaces of the valve *c* and plate *d*, it will keep them always in close contact, and this pressure, although sufficient for that purpose, will be so slight as not to offer any practical hinderance to the operation of the valve *c*. Thus it will be seen that the plate *d* is kept in contact with the valve *c* by the steam itself; and as the two surfaces wear, or expand, or contract, the plate *d*, being self-adjusting, will move sidewise to accommodate itself to such changes or variations.

Fig. 3 exhibits a modification of construction involving the same principle and mode of operation. The valve *c* is made with its upper and lower faces parallel to each other and to the valve-seat *b*. The plate *d* is made as in Fig. 1; but the ledges *e e'* on the inside of the steam-chest are set at different heights, with their surfaces in an inclined plane at an acute angle to the top of the valve, one edge, *e*, being lower than the other, *e'*. The effect of this is that any motion of the plate *d* sidewise, (in the direction of the arrow) caused by the greater pressure of steam on the larger side *x* of the cuneiform projection causes the descent of the plate *d* and its pressure in close contact with the top of the valve *c* with the same result as before.

The other feature of my invention is shown in Figs. 4 and 5. Fig. 4 represents the position of the valve relatively to the valve-seat and its steam-openings when the cylinder begins to take steam, and Fig. 5 at the end of the stroke. The valve *c* has the usual passage, *f*, to conduct the steam from one opening in the valve-seat to another. In the valve-seat *b*, *g* is the steam-port to one end of the cylinder and *h* to the other end. The openings *i* and *k* in the valve-seat are the exit or exhaust pipes conducting the spent steam to the external air, and between these two is a third exhaust-pipe, *t*, which connects with a condenser. This arrangement is designed to be applied to high-pressure engines. When the cylinder takes steam at the commencement of a stroke, as in Fig. 4, the live steam enters the pipe *g*, as indicated by a red arrow, and the spent steam exhausts through the pipe *h* and the passage *f* in the valve *c* and the openings *i* and *k* in the valve-seat to the external air, as indicated by black arrows, until the pressure of steam is relieved, when, on the further advance of the valve *c* to the position shown in Fig. 5, the exhaust-pipes *i* and *k* being closed and the opening *l* uncovered by the valve, the remaining steam exhausts into a condenser. The same takes place on the return-stroke of the engine. By this arrangement I am enabled to combine in one engine the advantages of a high and low pressure engine.

I am aware that balance slide-valves have been used in which the valve has been made of a wedge shape, or covered with a wedge-shaped or inclined plate, for the purpose of relieving the valve from the resistance caused by the pressure of the steam upon it or to equalize that pressure; but in none of these valves, so far as I know, has the covering-plate been supported over the slide-valve in such a manner as to be capable of self-adjustment to the valve. In such valves as heretofore used the cover is either fitted in between the top of the steam-chest and the valve, so as to be in contact with both, or is in some way held in place in the steam-chest, so as to be adjustable only from without, thereby rendering it impossible to secure a proper adjustment without repeated trials and constant alteration.

By my improvement the valve-cover is self-adjusting and is constantly kept in close contact with the top of the slide-valve without pressing with too much force upon it.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with the slide-valve of a steam-engine, of a wedge-shape pressure-plate so constructed and arranged, substantially as hereinbefore described, as that it shall be sustained and supported in the steam-chest and yet not attached either to the steam-chest, or slide-valve, so as to be susceptible of self-adjustment to the surface of the slide-valve without the need of any adjustment from without.

2. In combination with a slide-valve and pressure-plate constructed substantially as hereinbefore described, a spring operating on one side of the pressure-plate for the purpose of keeping it in contact with the valve, and preventing its displacement when the engine is not in operation.

3. The arrangement, in high-pressure engines, of an exhaust-passage for the escape steam from the cylinder, in addition to the exhaust pipes or passages which communicate with the external air, such additional exhaust-passage communicating with a condenser, and being so arranged, relatively to the passage in the slide-valve, as to exhaust the remaining steam toward the end of the stroke, with a condenser, substantially as and for the purposes hereinbefore described.

In testimony whereof I, the said CHARLES W. CRAWFORD, have hereunto set my hand.

C. W. CRAWFORD.

Witnesses:

A. S. NICHOLSON,

EDWARD KAYLOR.