(No Model.)

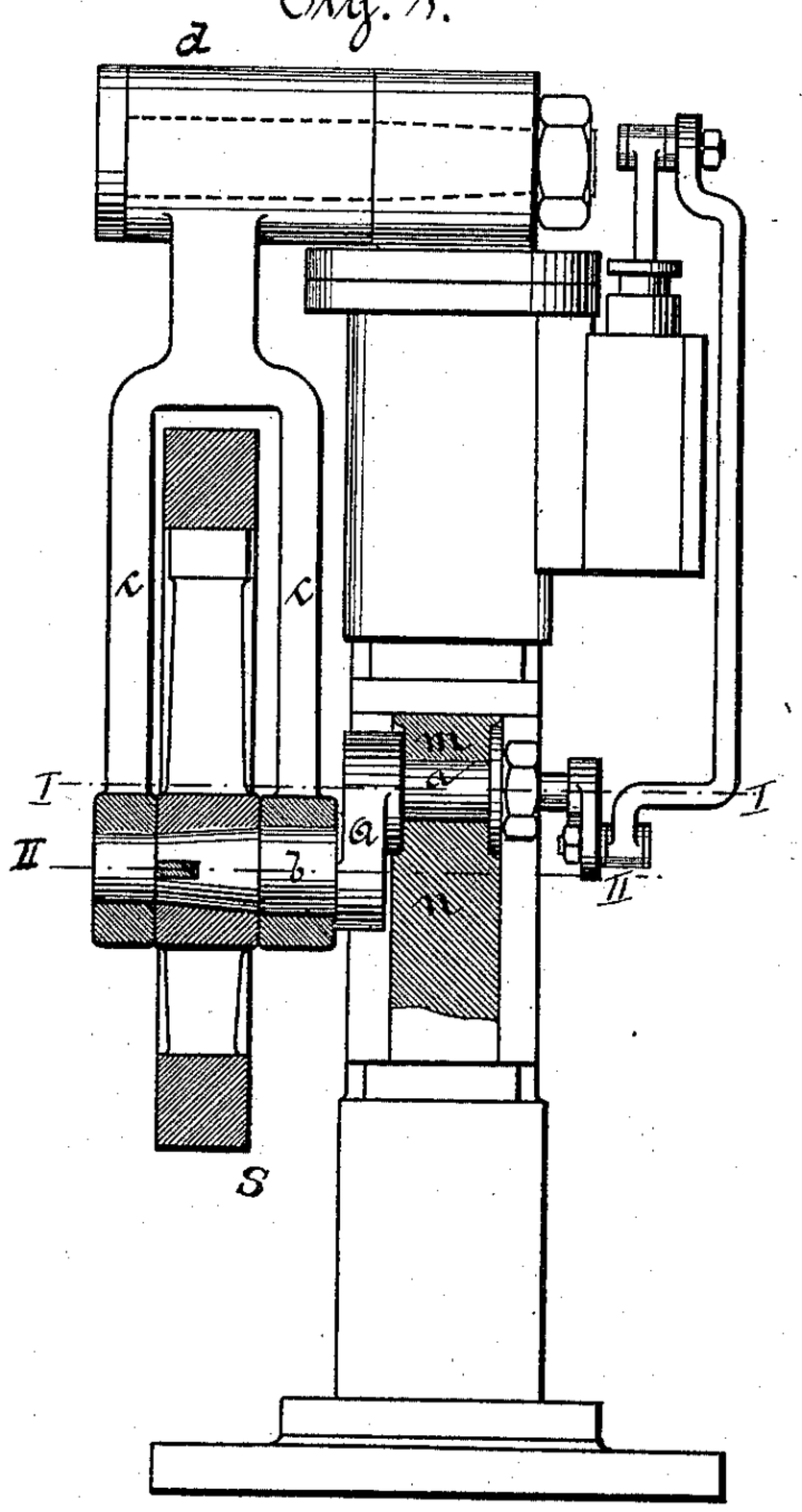
3 Sheets—Sheet 1.

K. F. W. HENSCHEL.

RECIPROCATING ENGINE.

No. 598,515. Patented Feb. 8, 1898.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

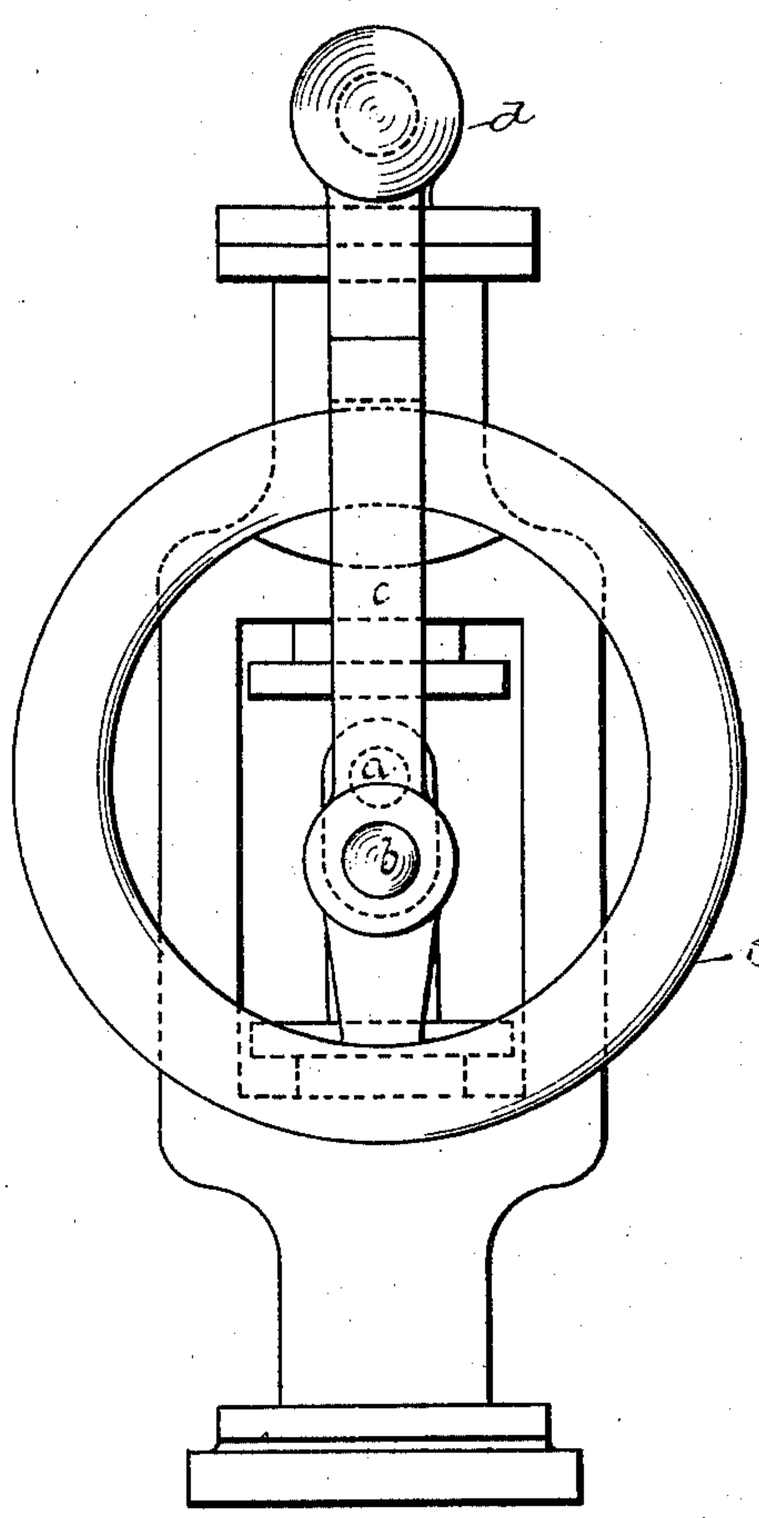
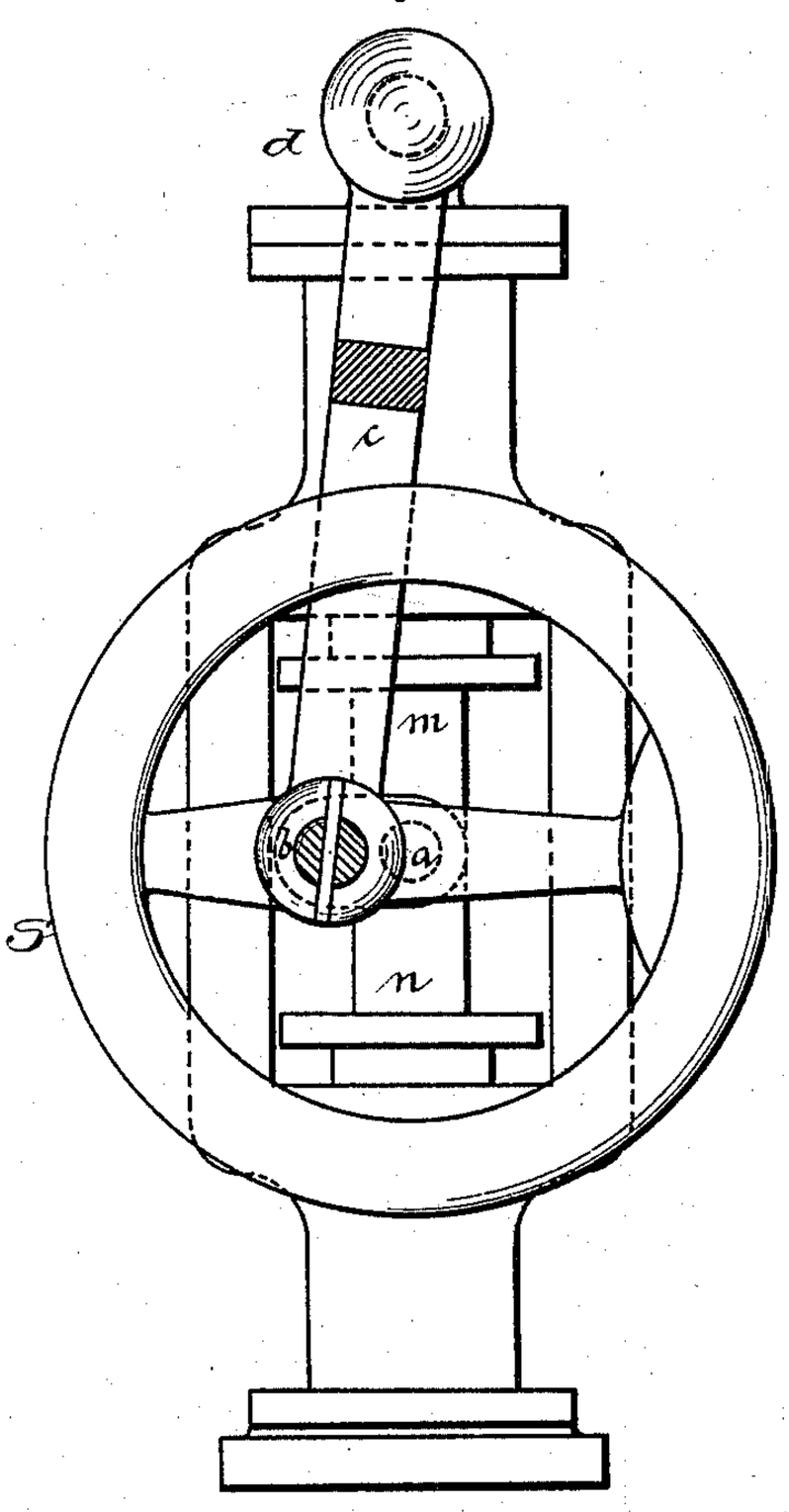


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 5.

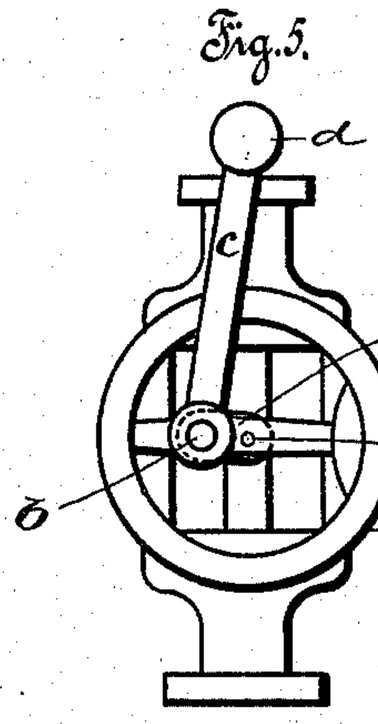


Fig. 6.

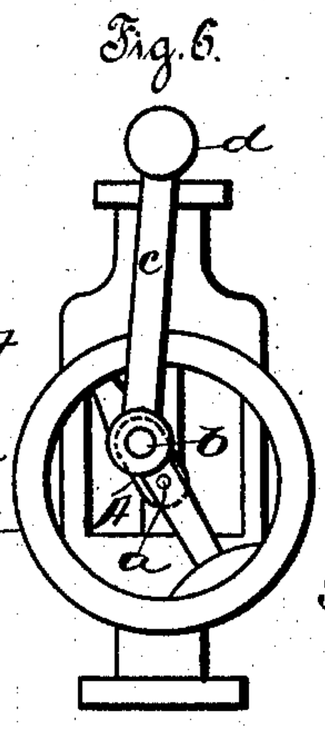


Fig. 7.

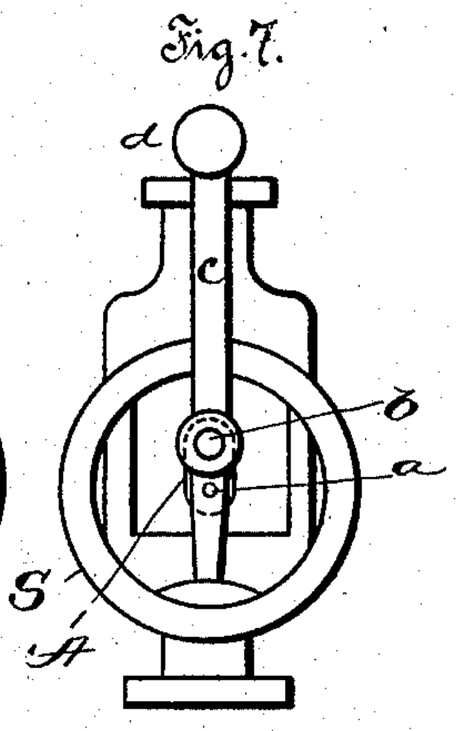


Fig. 8.

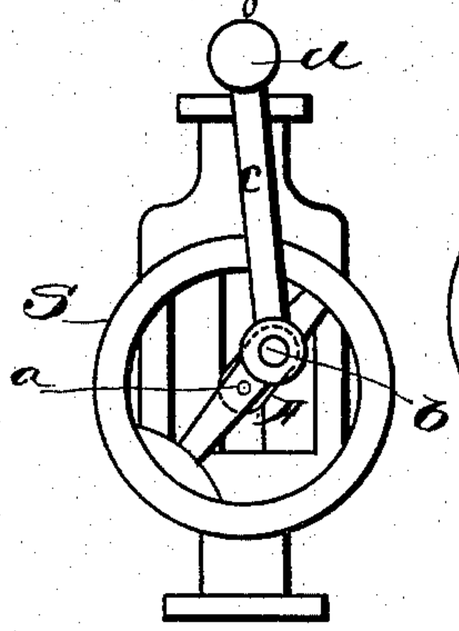


Fig. 9.

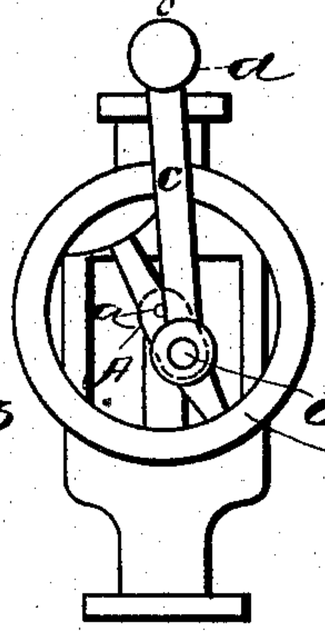


Fig. 10.

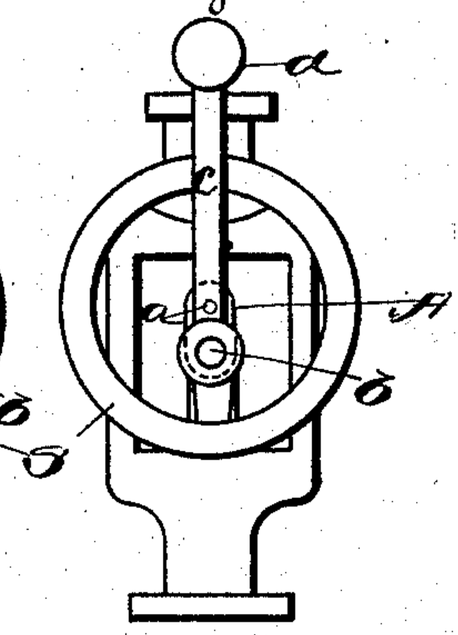
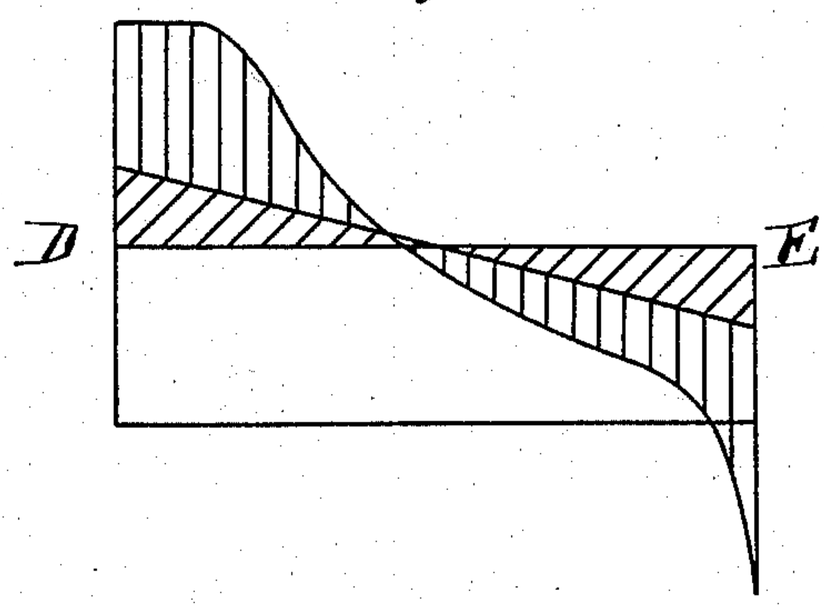


Fig. 4.



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UNITED STATES PATENT OFFICE.

KARL FRIEDRICH WILHELM HENSCHEL, OF DRESDEN, GERMANY.

RECIPROCATING ENGINE.

SPECIFICATION forming part of Letters Patent No. 598,515, dated February 8, 1898.

Application filed May 12, 1896. Serial No. 591,202. (No model.) Patented in Germany January 19, 1896, No. 89,209; in England April 28, 1896, No. 8,980; in Austria June 1, 1896, No. 46/2,150; in Italy June 17, 1896, No. 41,424/223; in France August 3, 1896, No. 255,845; in Switzerland December 31, 1896, No. 12,420, and in Belgium May 15, 1897, No. 121,121.

To all whom it may concern:

Be it known that I, KARL FRIEDRICH WILHELM HENSCHEL, engineer, a subject of the King of Prussia, Emperor of Germany, residing at Dresden, in the Kingdom of Saxony, German Empire, have invented certain new and useful Improvements in or Relating to Reciprocating Engines, (for which I have obtained Letters Patent in Germany, No. 89,209, dated January 19, 1896; in France, No. 255,845, dated August 3, 1896; in Switzerland, No. 12,420, dated December 31, 1896; in England, No. 8,980, dated April 28, 1896; in Austria, No. 46/2,150, dated June 1, 1896; in Italy, No. 41,424/223, dated June 17, 1896, and in Belgium, No. 121,121, dated May 15, 1897,) of which the following is a specification.

This invention relates to motors, pumps, and the like.

In the accompanying drawings, Figure 1 is a side elevation, partly in section, of a vertical single-acting steam-pump to which this invention is applied. Figs. 2 and 3 are views of the same pump at right angles to the position in which it is shown in Fig. 1 and with the working parts in different positions, so that the manner in which they operate can be clearly seen. Fig. 4 is a work diagram to be hereinafter explained, and Figs. 5, 6, 7, 8, 9, and 10 are views on a smaller scale than the other figures to illustrate the successive positions taken by the working parts.

Like letters indicate like parts throughout the drawings.

In engines having reciprocating parts and operated expansively the work done during the first half of the stroke is greater than the work done during the second half, as is well known and as is exemplified in Fig. 4 with reference to a steam-engine. The resistance to be overcome—as, for instance, in performing the operation of pumping—can be considered as being approximately uniform, as represented by the line D E. As a rule the excess of work during the first half of the stroke is stored up in the fly-wheel by the acceleration of the fly-wheel mass and given out again during the second part of the stroke during the retardation thereof.

The work to be stored up in the fly-wheel is reduced by that which is utilized in setting the reciprocating masses in motion. According to the present invention the fly-wheel itself is to be used as a reciprocating mass by communicating to it beside the usual rotary motion a reciprocating motion.

In the diagram Fig. 4 the area covered with inclined hatching represents the work taken up and given out by the fly-wheel as a reciprocating mass, so that only the work represented by the vertical hatching remains to be equalized by the rotary motion of the fly-wheel. The mass of the fly-wheel is therefore utilized in two ways.

The reciprocating motion of the fly-wheel and its simultaneous rotation is produced by causing it, by means of a pin *a*, carried by the piston-rod or plunger *m n* and placed in line with the axis I I of the fly-wheel A, to follow the motion of the piston-rod, while at the same time it rotates round a crank-pin *b*, carried at one end of a crank-arm A, the other end of that crank-arm being connected to the pin *a* in the plunger.

The reciprocating piston-rod connects, as is usual, the piston of the steam-cylinder with that of the pump, and the pin *a* is arranged so as to be capable of being rotated about an axis I I passing through its center and the center of the fly-wheel S. This pin *a* is connected by the crank-arm A with the crank-pin *b*, on which the fly-wheel S is keyed fast eccentrically. The crank-pin *b* is engaged by a forked connecting rod, link, or pendulum *c*, which oscillates about a pin *d*, fixed to the engine-frame. While, therefore, the crank-pin *b* freely swings to and fro in an arc in front of the pump, the fly-wheel is rotated by the crank A in consequence of the motion of the pin *a* on the plunger in a straight line with the plunger and in a circle relatively to the axis of the crank-pin *b*.

Figs. 1 and 2 show the mechanism in the "dead-point" position, and Fig. 3 shows it in the intermediate position. Figs. 5 to 10 show different positions which the mechanism consecutively occupies. Fig. 5 begins with the parts in the middle position, as in Fig. 3, in

which the pin *a* and therefore also the fly-wheel are being moved downward by the piston-rod *m n*, while the crank-pin *b* is kept in its arc by the rod *c*, whereby the fly-wheel is at the same time caused to rotate. The mechanism passes the dead-center in Fig. 7 by means of the rotary momentum of the fly-wheel and passes then successively through the positions represented in Figs. 8 to 10 before reaching the opposite dead-center. Owing to this double utilization of the fly-wheel mass the size of the fly-wheel can be reduced, and, further, the engine becomes simpler and considerably shorter than engines constructed in the usual manner. In the construction described there is an additional advantage that the small suction-resistance which is to be overcome in the upstroke of the pump is increased by the fly-wheel, which has to be lifted, whereas the resistance to forcing out the fluid which has to be overcome during the downstroke is easier to overcome owing to the descending fly-wheel. The present arrangement is therefore an equalizing device in this respect as well as in the respects hereinbefore indicated.

The utility of this invention is not limited to its application to pumps and steam-engines.

I claim—

1. In an engine or pump the combination of a reciprocating part *m n*, a fly-wheel S so pivoted to the part *m n* that the axes of pivot and fly-wheel are concentric a pin *b* on the wheel S at a point not concentric with those axes and a rod *c* pivoted at one end to a stationary part of the apparatus and engaging near its other end with the pin *b* whereby the fly-wheel will be reciprocated by the reciprocating part and rotated by means of the crank-pin *b*, said pin being kept in its arc by the rod *c*, substantially as set forth.

2. In an engine or pump the combination of a reciprocating part *m n* a fly-wheel S a crank *a* A *b* fixed to the fly-wheel by one pin *b* the other pin *a* being pivoted to the part *m n* so that the axes of the pivot and fly-wheel are concentric and the axes of the pin *b* and fly-wheel are eccentric to each other and a rod *c* pivoted at one end to a stationary part of the apparatus and engaging near the other end with the pin *b* whereby the fly-wheel will be reciprocated by the reciprocating part and rotated by means of the crank-pin *b*, said pin being kept in its arc by the rod *c*, substantially as set forth.

In witness whereof I have hereto set my hand in the presence of the two subscribing witnesses.

KARL FRIEDRICH WILHELM HENSCHEL.

Witnesses:

OTTO WOLFF,

HUGO SUMMER.