

(No Model.)

2 Sheets—Sheet 1.

J. BONICARD.

STEAM ENGINE.

No. 388,755.

Patented Aug. 28, 1888.

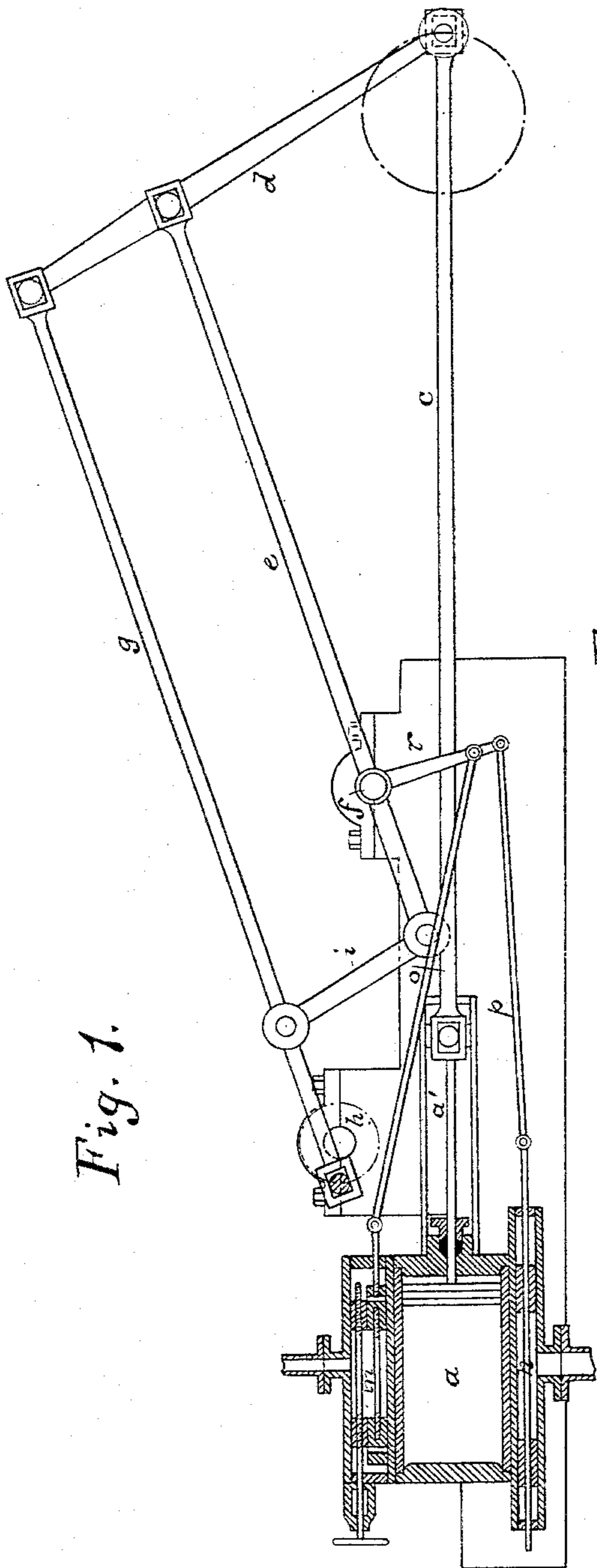
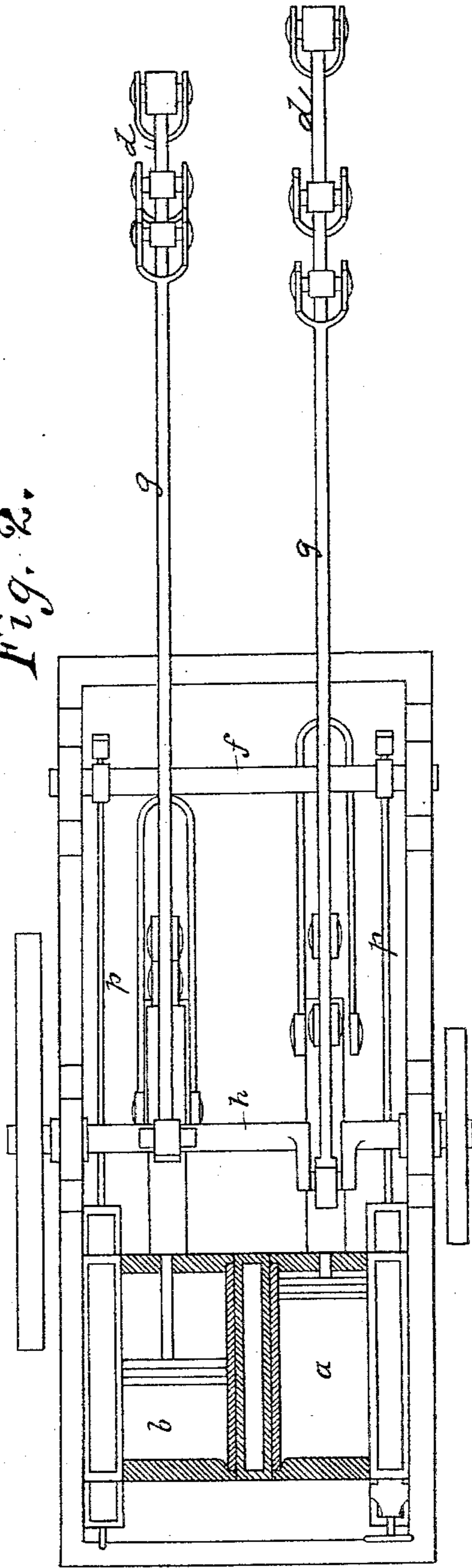


Fig. 1.

Fig. 2.



WITNESSES:
H. Caplinger
E. B. Bolton

INVENTOR:
Jean Bonicard
By *Henry Bonicard*
Attorney.

(No Model.)

2 Sheets—Sheet 2.

J. BONICARD.

STEAM ENGINE.

No. 388,755.

Patented Aug. 28, 1888.

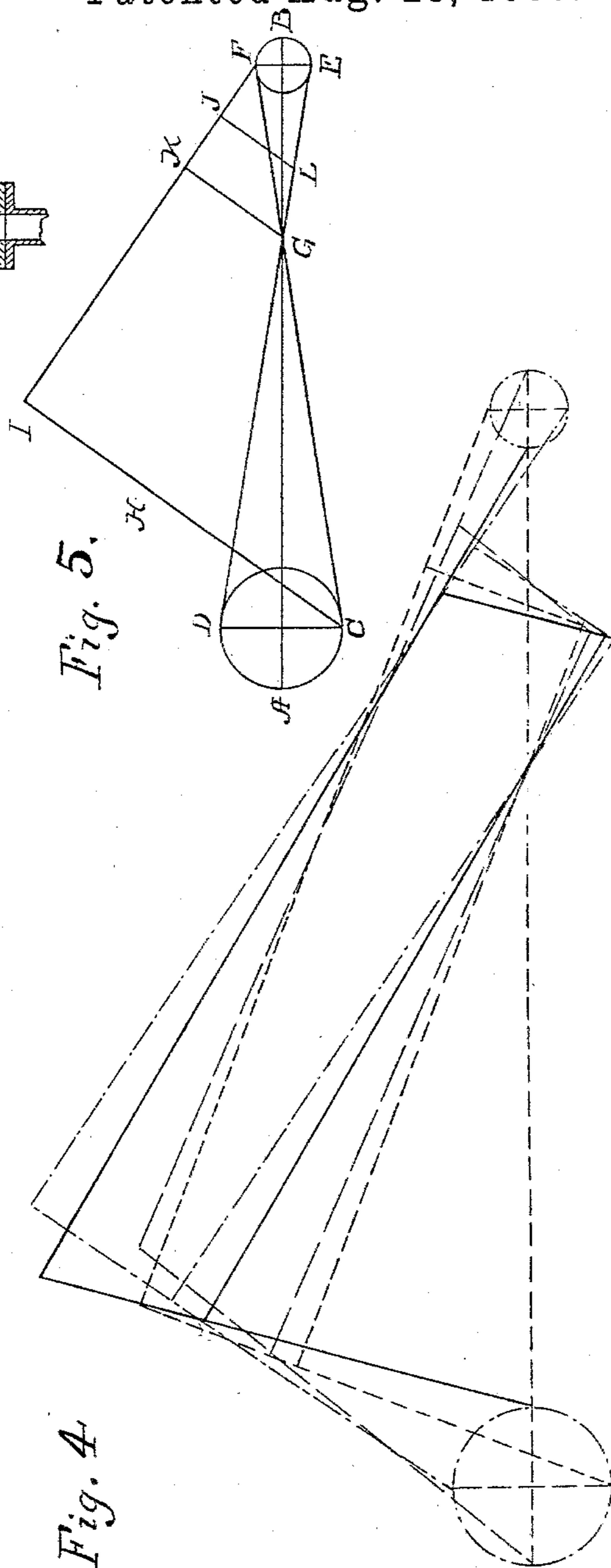
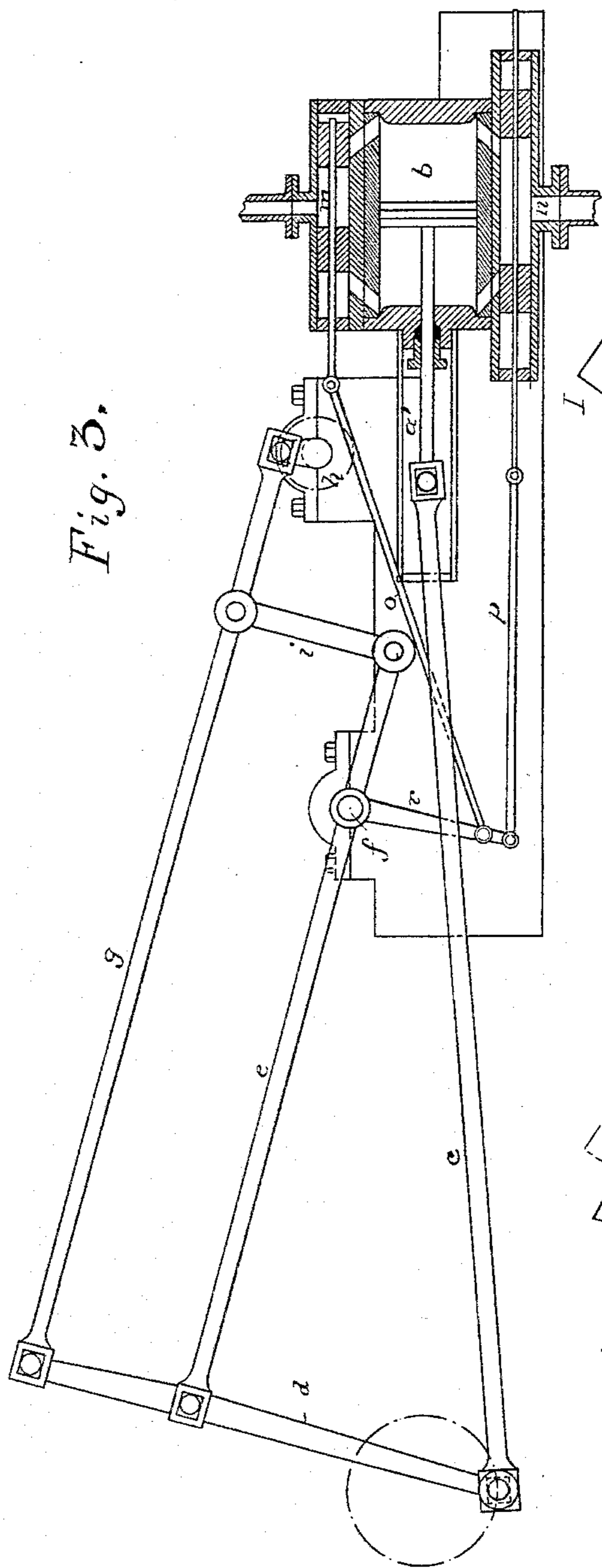
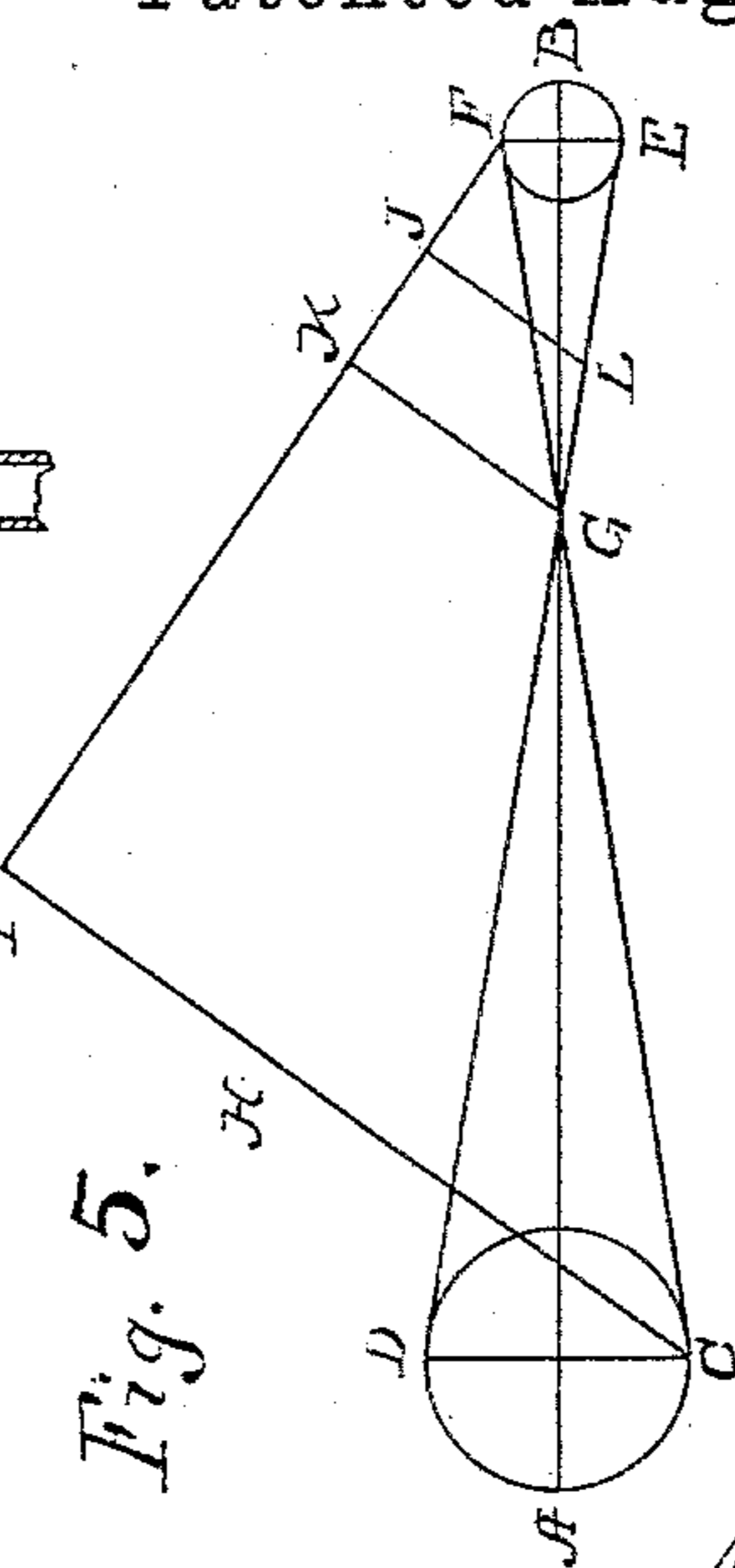


Fig. 5.



WITNESSES:
J. B. Bonnard
E. B. Bolton.

INVENTOR:
Jean Bonnard,
By *Henry Bonnard*
Attorney.

UNITED STATES PATENT OFFICE.

JEAN BONICARD, OF LANGON, GIRONDE, FRANCE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 388,755, dated August 28, 1888.

Application filed February 17, 1888. Serial No. 264,371. (No model.) Patented in France December 10, 1885, No. 172,749; in Belgium January 29, 1887, No. 76,131; in Austria-Hungary January 31, 1887, No. 5,691 and No. 24,331; in Italy February 4, 1887, XXI, 21,188, and XLII, 10, and in England February 14, 1887, No. 2,311.

To all whom it may concern:

Be it known that I, JEAN BONICARD, a citizen of France, residing at Langon, Gironde, France, have invented certain Improvements in Steam or other Engines, (for which patents have been granted in France, dated December 10, 1885, No. 172,749; in England, dated February 14, 1887, No. 2,311; in Austria-Hungary, dated January 31, 1887, No. 5,691 and No. 24,331; in Belgium, dated January 29, 1887, No. 76,131, and in Italy, dated February 4, 1887, Nos. XXI, 21,188, XLII, 10,) of which the following is a specification.

My invention relates to improvements in steam-engines or other motors; and its object is, first, to provide means simple and effective for increasing the power of the same by an arrangement of levers interposed between the engine and the driving-shaft, to which the power is to be transmitted; and, second, to do away with the valve-eccentrics and to employ in place thereof a crank keyed on the oscillating shaft of my improved lever mechanism.

My invention will be fully described hereinafter and its novel features carefully defined in the claims.

In the drawings which serve to illustrate my invention, Figure 1 is an elevation, and Fig. 2 a plan, both partly in section, of a two-cylinder steam-engine provided with my improved lever mechanism. Fig. 3 is a view similar to Fig. 1, showing my lever mechanism applied to an engine, only allowing of fixed expansion in the cylinder. Fig. 4 is a diagram showing the four principal positions taken by my improved lever mechanism during a complete stroke of the piston. Fig. 5 is a diagram illustrative of the principle of the invention.

In Figs. 1 and 2 I have designated the high-pressure cylinder by *a*, and the low-pressure cylinder by *b*. As each of the piston-rods of these cylinders is provided with like mechanism for increasing the power, a description of one mechanism will suffice for both.

a' represents the piston-rod, which is jointed to a connecting-rod, *c*, connected to another rod, *d*. To this rod *d* are jointed a lever, *e*, oscillating on a shaft, *f*, and a rod, *g*, working

a crank of the driving-shaft *h*, connected by a short rod, *i*, to lever *e*.

The valve mechanism of the low-pressure cylinder *b* is arranged to allow of variable expansion in this cylinder; but it is obvious that the expansion can be fixed, as is the case in the arrangement shown in Fig. 3.

The slide-valves *m n* are operated by rods *o p* and a crank, *r*, keyed on the shaft *f* at an angle of ninety degrees with the lever *e*. This arrangement allows of increasing the travel of the slide-valves, and consequently of varying the admission and the escape of steam into and from the cylinders by changing the positions of the joints of the rods *o* and *p* on the crank *r*.

I will now describe the method of executing the proportional diagram of my improved lever mechanism for increasing power which has just been described.

A horizontal line, A B, of indefinite length is drawn, which is supposed to pass through the center of the cylinder, Fig. 3, and at two points of this line are described two unequal circles, the distance between the centers of which is from five to six times the length of the stroke of the piston. Two vertical lines, C D and E F, are then drawn, passing through the centers of the circles. From the four points where these vertical lines cut the circles two diagonals, D E and C F, are drawn, cutting each other at C on the horizontal line A B. This point of intersection becomes the center of oscillation of the mechanism. From the point C an oblique line, H C, is drawn, which makes an angle of from twenty-five to thirty degrees with the vertical line C D, and from the point I is drawn a perpendicular, F I. From the point G is drawn a line, G K, parallel to C H. The line F K is bisected, and from the center J is produced the line J L, parallel to C H, which completes the diagram of my improved mechanism.

In the diagram, the construction of which has just been described, the inequality of the circumferences, the distance from their center, and the angle formed by the first lever with the vertical are not arbitrary, and can be increased or diminished; but the invention is based on the principles that the power of the mechanism is in direct ratio to the difference

in size of the two circumferences, and that upon the amplitude of the angle and the distance of the centers of circumference depends the distance apart of the twin levers, whence results
5 very little obliquity in the action, and consequently more effective working.

My improved mechanism for increasing power is applicable to all other motors, hydraulic wheels, and turbines, hydraulic motors
10 with pistons, air-engines, electric motors, &c.

Having thus described my invention, I claim—

1. The combination, with the piston-rod of a steam-engine, of the pitman *c*, rod *d*, lever *e*,
15 oscillating on fulcrum *f*, and rod *g*, coupled to a crank in the driving-shaft, and rod *i*, connecting said rod *g* and lever *e*, substantially as as and for the purposes set forth.

2. The combination, with the piston-rod of a steam-engine, of the pitman *c*, rod *d*, lever 20 *e*, oscillating on fulcrum *f*, and rod *g*, coupled to a crank in the driving-shaft, and rod *i*, connecting rod *g* and lever *e*, a rod, *r*, oscillating on fulcrum *f*, and valve-rods *o* and *p*, coupled to rod *r*, substantially as and for the purposes 25 set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JEAN BONICARD.

Witnesses:

ROBT. M. HOOPER,
AMAND RITTER.