No. 694,552. Patented Mar. 4, 1902.

H. JUNKERS.

GAS ENGINE.

(Application filed June 7, 1901.)

(No Model.)

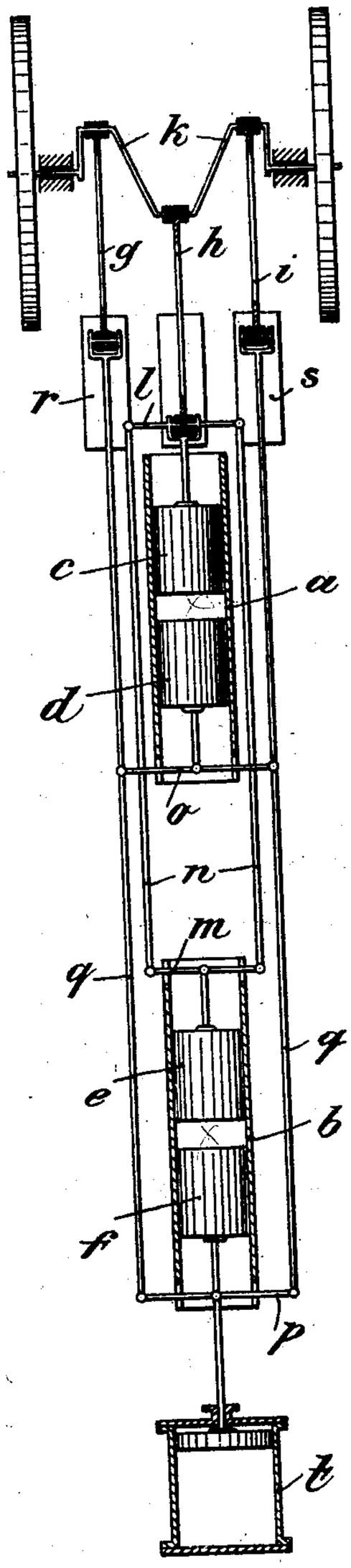

Fig. 1.

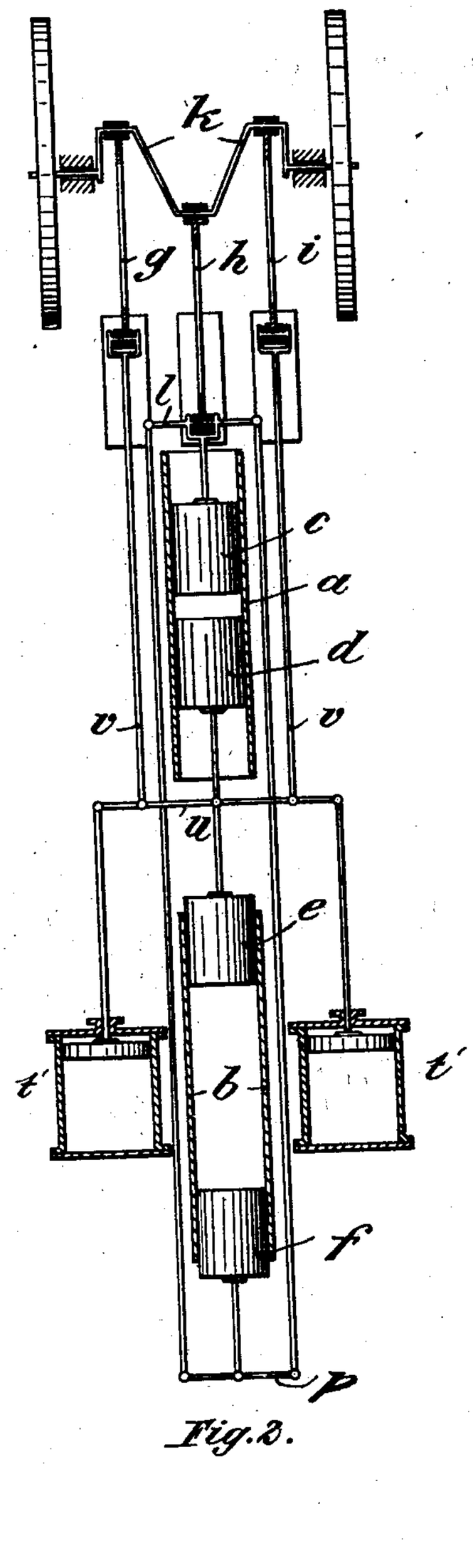

Fig. 2.

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HUGO JUNKERS, OF AIX-LA-CHAPELLE, GERMANY.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 694,552, dated March 4, 1902.

Application filed June 7, 1901. Serial No. 63,632. (No model.)

To all whom it may concern:

Be it known that I, HUGO JUNKERS, a subject of the Emperor of Germany, and a resident of Aix-la-Chapelle, Germany, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to gas-engines in which two pistons are so arranged in a common cylinder as to work in opposite directions, and has for its object to attain double the power of a gas-engine of the same kind without increasing the number of parts of the driving-gear required in engines working with only one piston.

This invention substantially consists in the arrangement of two cylinders tandemwise, each containing two oppositely-moving pistons and at the same side of the crank-shaft, their axes being in the same straight line. The pistons are rigidly connected in pairs, the one of one cylinder with one of the other cylinder, and they are coupled to the crank-shaft, which has three bends, by means of three connecting-rods.

The invention will be described with reference to the accompanying drawings, in which—

Figure 1 represents diagrammatically such an improved engine, partly in section. Fig. 2 is a similar illustration of another arrangement of the improved engine.

The improved engine has two cylinders *a b*, arranged tandemwise, with their axes in the same straight line. In each of these cylinders work two pistons *c d* and *e f*, respectively, the pistons closing the open ends of the said cylinders. One of the pistons of the pair in the one cylinder is connected with one of the pistons of the pair in the other cylinder, and similarly for the other pistons, by means of rigid systems of rods which transmit their movement to the three bends of the crank-shaft *k* by three connecting-rods *g h i*.

In the example of the engine represented in Fig. 1 the two pistons *c* and *e*, both situated at the ends of the cylinders toward the crank-shaft *k*, are connected together by means of cross-heads *l* and *m* and rods *n*, attached to the ends of the cross-heads, so as to form therewith a rigid frame. Similarly the two pistons *d* and *f* are connected together by the cross-heads *o p* and rods *q*, the latter rods being extended toward the crank-shaft *k* and working in rectilinear guides at *r* and *s*, where they are coupled to the rear ends of the connecting-rods *g* and *i*, respectively, through which the motion of the pistons *d* and *f* is transmitted to the crank-shaft *k*. The two outer bends of the crank-shaft *k*, to which these connecting-rods are coupled, are situated at an angle of one hundred and eighty degrees to the middle crank, to which the two pistons *c* and *e* are coupled by the central connecting-rod *h*, so that the two pistons *c* and *d* are compelled to move in their cylinders *a* and *b*, respectively, in opposite directions to the two pistons *e* and *f*.

The gaseous mixture is introduced into the gas-engine by the usual means between the two pistons of each cylinder, where it is exploded.

The air or gas mixture pump usually required for working this sort of gas-engine is preferably connected with the engine so that its piston is directly actuated by the system of rods. Thus, for instance, the piston-rod of the pump *t* may be rigidly connected with the last cross-head of the piston *f*, as shown in Fig. 1.

The arrangement shown in Fig. 2 differs from that shown in Fig. 1, inasmuch as the piston which in the one cylinder is toward the crank-shaft is rigidly connected with the piston which in the other cylinder is remote from said shaft and, conversely, the two middle pistons *d* and *e* being connected together by a rod which by a cross-head *u* is connected to two rods *v*, coupled to the outer connecting-rods *g* and *i* and through them to the corresponding cranks, the pistons *c* and *f* being connected through the cross-heads *l* and *p* and a pair of rods *w*, which transmit motion by means of the middle connecting-rod *h* to the middle crank.

In the engine shown in Fig. 2 two pumps *t'* for supplying air and gas mixture to the cylinders have their pistons connected with

the common cross-head *u* of the two middle pistons *d* and *e*.

The operation of the engine shown in Fig. 2 is similar to that of the one shown in Fig. 1, except that in Fig. 2 the two pistons of one cylinder approach one another when those of the other cylinder recede from one another, while in the engine shown in Fig. 1 the pistons of both pairs simultaneously approach or recede from one another.

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

1. A gas-engine, comprising a crank-shaft, two power-cylinders arranged in tandem on the same side of said shaft, two reciprocally-moving pistons in each of said cylinders, said pistons rigidly connected in pairs, and means for connecting each pair of pistons with the crank-shaft, substantially as set forth.

2. A gas-engine, comprising a crank-shaft, two power-cylinders arranged in tandem on the same side of said shaft, two reciprocally-moving pistons in each cylinder, the first and third pistons and the second and fourth pistons rigidly connected in pairs, and means for connecting each pair of pistons with the crank-shaft, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

HUGO JUNKERS.

Witnesses:
H. CRUADFLIEG,
E. CRÜTYEN.