

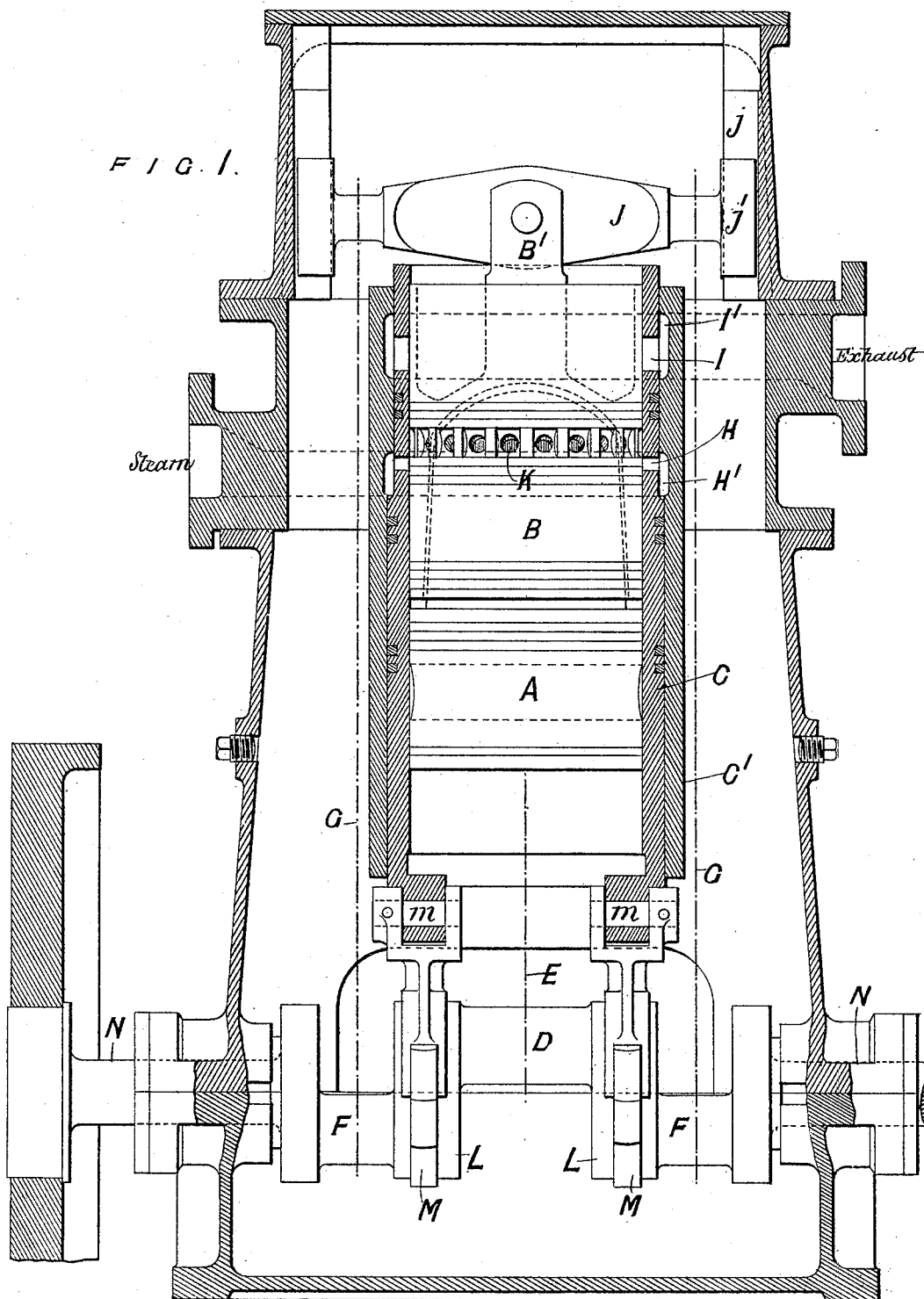
(No Model.)

3 Sheets—Sheet 1.

H. GRAFTON.
STEAM ENGINE.

No. 460,129.

Patented Sept. 29, 1891.



Witnesses
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H. E. E. E. E. E.

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his Attorneys

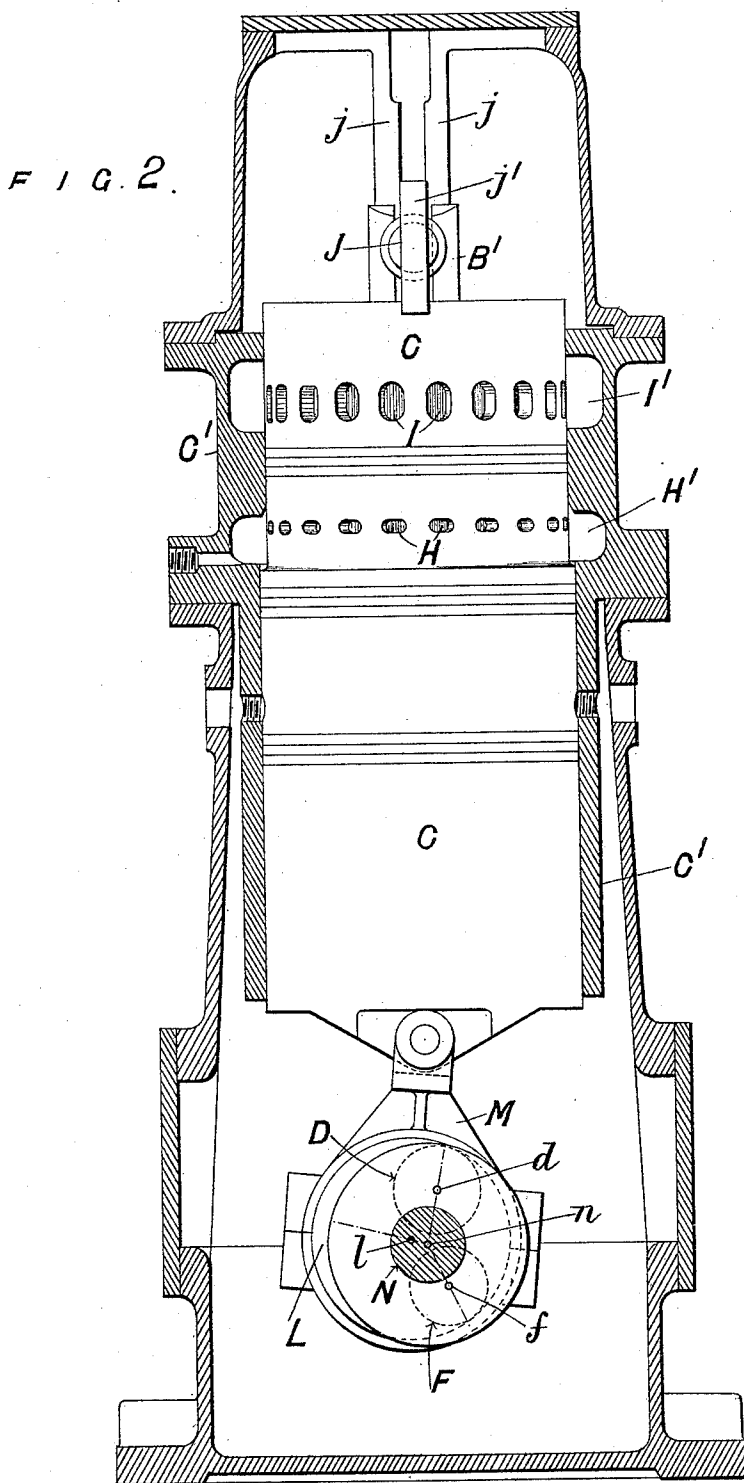
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3 Sheets—Sheet 2.

H. GRAFTON.
STEAM ENGINE.

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Patented Sept. 29, 1891.



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(No Model.)

3 Sheets—Sheet 3.

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FIG. 3.

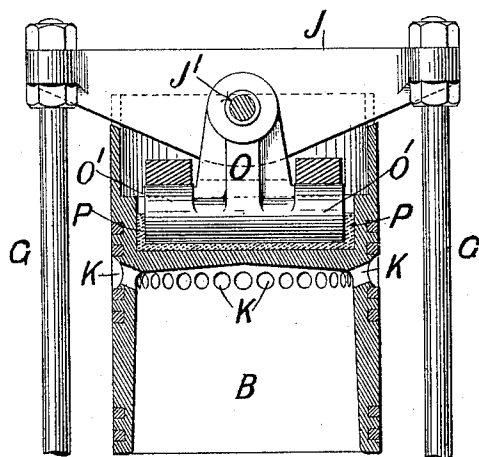


FIG. 4.

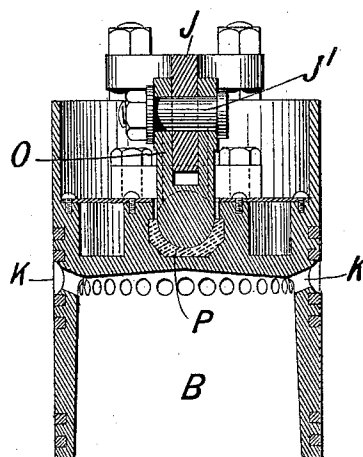
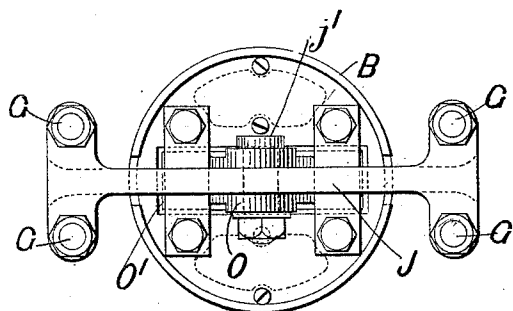


FIG. 5.



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UNITED STATES PATENT OFFICE.

HENRY GRAFTON, OF LONDON, ENGLAND.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 460,129, dated September 29, 1891.

Application filed December 17, 1890. Serial No. 374,971. (No model.)

To all whom it may concern:

Be it known that I, HENRY GRAFTON, engineer, of Wardrobe Chambers, Queen Victoria Street, in the city of London, England, have invented new and useful Improvements in Steam and other Engines, of which the following is a full, clear, and exact description.

My invention relates to improvements in the high-speed engine for which Letters Patent of the United States were granted to me, dated May 6, 1890, No. 427,231, in which there are two pistons working in the same cylinder and coupled to cranks on the same shaft placed at such angular distance apart that the pistons move for the most part in opposite directions, while their strokes are so timed that the one piston is able to fulfill the double function of piston and of distribution-valve to wholly control the admission and exhaust, as hereinafter referred to. Such engine is nearly but not quite balanced, and my present improvements have for their object to still more perfectly balance it, so as to avoid vibration as far as possible when running at very high speeds.

To this end the invention consists in imparting reciprocating motion to the cylinder or a liner thereof, such that it will balance the otherwise unbalanced component of the mass of the pistons and parts moving therewith, such reciprocating motion being imparted from the crank-shaft, and the relative arrangement of the centers of the cranks and eccentrics to that of the shaft-journals being such that the relative times and extent of the strokes of the pistons in regard to the cylinder or liner may be the same at all points of the effective stroke of the engine as in the partially-balanced engine described in the specification of my previous patent aforesaid.

My improvements have, secondly, for their object to dispense with the guides for the cross-head of the valve-piston and the journals for the side connecting-rods and to substitute a universal pivotal connection of the cross-head to the said piston.

Reference is to be had to the accompanying drawings, forming part of this specification, wherein—

Figures 1 and 2 represent an engine embodying my first improvement, Fig. 1 being a central vertical section in the plane of the

crank-shaft, and Fig. 2 a central vertical section in a plane perpendicular to the crank-shaft, the said shaft being in section at one of its journals. Figs. 3 to 5 illustrate my second improvement, Fig. 3 being a vertical section of the valve-piston in the plane of the cross-head, Fig. 4 a similar section at right angles thereto, and Fig. 5 a plan.

The same letters of reference denote like parts in all the figures.

A is the piston; B, the valve-piston. C is the reciprocating cylinder or liner, in which the pistons work, as in a fixed cylinder, said liner or cylinder reciprocating in a fixed guide-cylinder C'. Piston A is coupled to the middle crank D by a connecting-rod E, (represented only by its center line,) and piston B is connected to the side cranks F and connecting-rods G (represented only by their center lines) by cross-head J, pivoted to a central stem B'.

K are the ports in piston B.

H are the live-steam ports, and I the exhaust-steam ports, in the reciprocating cylinder or liner C, I' and H' being annular passages in the stationary or guide cylinder C', with which the ports I and H are always respectively in communication, notwithstanding the reciprocating motion of the liner-cylinder. The admission and exhaust, which are controlled by one valve-piston, are as follows: The valve-piston B descends until the ports K K coincide with the live-steam ports H, thereby allowing steam to be admitted between the pistons. After the cranks have fully passed by their dead-centers the pistons are separated by the pressure of the steam. When the piston B has moved upward far enough, the ports K K coincide with the ports I, thereby allowing most of the steam to exhaust, cutting off enough, however, to act as a cushion to prevent a shock to the mechanism. For the purpose of imparting this motion to the said cylinder or liner C it is connected by links and straps M, jointed to the cylinder at m, with the disk-shaped cheeks L of the middle crank D, which cheeks act as eccentrics; but in order that the relation between the pistons and the reciprocating cylinder or liner C necessary for the efficient action of the piston B as a distribution-valve shall be preserved the centers *d f* of the crank-

pins are in the same position relatively to center *l* as the centers of the cranks are to the axis of the shaft in the partly-balanced engine before referred to, the axis *n* of the crank-shaft being so situated between the centers *d f l* that the movements of the parts are always in equilibrium about the axis of the crank-shaft.

I have represented in Figs. 1 and 2 the old form of cross-head J, whose ends *j* work in guides *j'* in the hood of the casing. In order to dispense with these guides and with the two journals for the connecting-rods G, the cross-head J, instead of being pivoted to a stem B', rigidly fixed to the piston B, is pivoted at J', as before, to an L-shaped intermediate link O, of which the lower member forms journals O', whose axes are at right angles to the axis J', and which are seated in a bearing P on the piston B. These two axes being both diametrical to said piston and at right angles to one another, the whole constitutes a sort of universal-joint connection between the rods G and piston B, which admits of the rods G being bolted to the ends of the cross-head J, so that in operation the L-piece O, rocking on its journals O', admits of the necessary angular movement of the connecting-rods, while the pivot J' permits of compensation for unequal wear, as before. This improvement, although shown separately for the sake of perspicuity, is applicable to the engine shown in Figs. 1 and 2.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In the herein-described engine, in which two pistons connected to the same crank-shaft move for the most part in opposite directions, while the one piston acts also as a distribution-valve to wholly control the admission and exhaust, the combination, with said pistons and their crank-shaft, of a cylinder or cylindrical

liner connected with the same crank-shaft so as to receive reciprocating motion therefrom, the extent and timing of such motion, with regard to the timing of the strokes of the pistons, being such that the reciprocating parts will always be in equilibrium, as specified.

2. In the herein-described engine, in which two pistons connected to the same crank-shaft move for the most part in opposite directions, while the one piston acts also as a distribution-valve to wholly control the admission and exhaust, the combination, with said pistons and their crank-shaft, of a cylinder or cylindrical liner connected by links and straps with the disk-shaped cheeks of the middle crank of the same shaft, said cheeks being eccentric to the shaft-journals to such an extent and the geometrical center being so situated with regard to the geometrical centers of the crank-pins that the reciprocating part will always be in equilibrium, as specified.

3. In the herein-described engine, wherein two pistons connected to the same crank-shaft move for the most part in opposite directions, while the one piston acts also as a distribution-valve to wholly control the admission and exhaust, the combination, with the valve-piston and the cross-head, of an intermediate L-shaped piece, its transverse member being journaled to the said piston to admit of the angular movement of the connecting-rods attached to the cross-head and the cross-head being pivoted to its upright member to permit of compensation for unequal wear, as described.

The foregoing specification of my improvements in steam and other engines signed by me this 28th day of November, 1890.

HENRY GRAFTON.

Witnesses:

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Notary Public, London.

JOSEPH LAKE,
17 Gracechurch Street, London.