H. JUNKERS.

DOUBLE PISTON ENGINE.

APPLICATION FILED MAY 19, 1914.

1,386,062. Patented Aug. 2, 1921.

Fig. 1

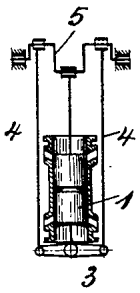


Fig. 2

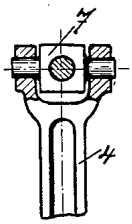


Fig. 3

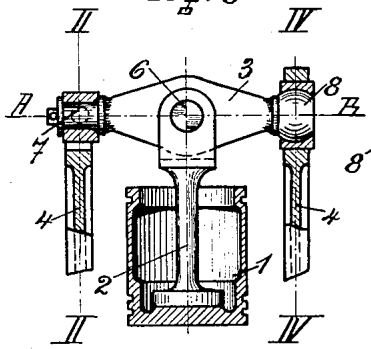


Fig. 4

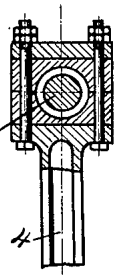


Fig. 5

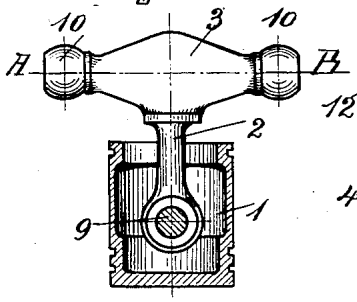


Fig. 6

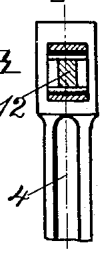


Fig. 7

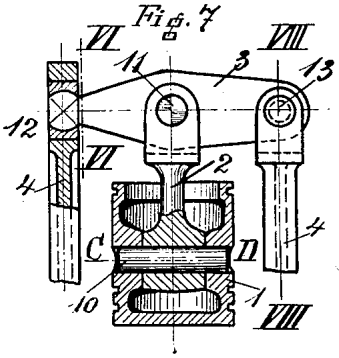


Fig. 8

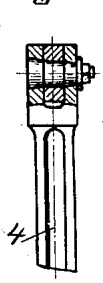


Fig. 9

Fig. 10

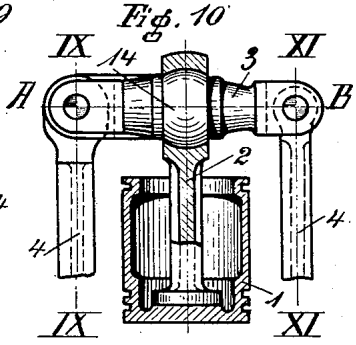


Fig. 11

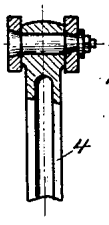


Fig. 12

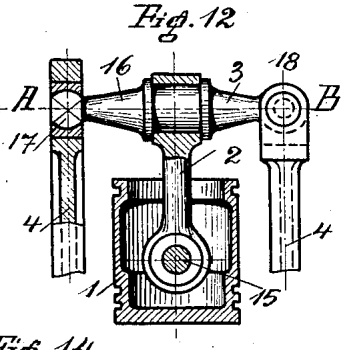


Fig. 13

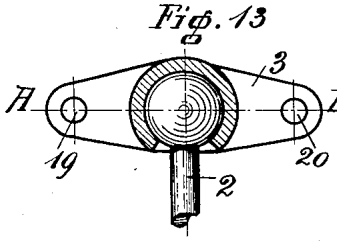
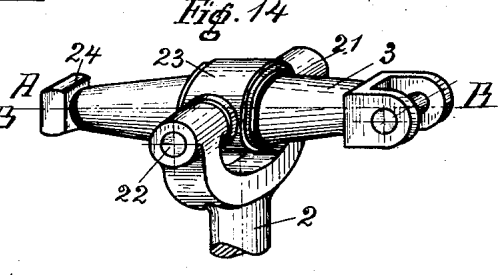


Fig. 14



Witnesses:

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Georg Schroeder

Inventor:

Hugo Junkers

UNITED STATES PATENT OFFICE.

HUGO JUNKERS, OF AIX-LA-CHAPELLE, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO OPPOSED PISTON OIL ENGINE CO., INC., A CORPORATION OF NEW YORK.

DOUBLE-PISTON ENGINE.

1,386,062. Specification of Letters Patent. **Patented Aug. 2, 1921.**

Application filed May 19, 1914. Serial No. 839,652.

To all whom it may concern:

Be it known that I, HUGO JUNKERS, a subject of the German Emperor, residing at Aix-la-Chapelle, 58 Bismarckstrasse, in the Kingdom of Prussia, Empire of Germany, have invented certain new and useful Improvements in Double-Piston Engines, of which the following is a specification.

My invention relates to an engine having two pistons which move in opposite directions in the same cylinder, and in which the piston remote from the shaft is directly connected with the shaft by two connecting-rods.

Engines of this type are known in which the piston remote from the shaft is directly connected with the latter by two connecting-rods, *i. e.*, without the interposition of a crosshead. In these engines a transverse beam is mounted to rock on the said piston and the connecting-rods are mounted to rock on the pivots of the transverse beam.

Such an arrangement has the disadvantage that the connecting-rods do not possess freedom of movement in two directions at right angles to one another, namely on the one hand in the direction of their principal plane of oscillation and on the other hand in a direction at right angles thereto. This is due to the fact that the connecting-rods are connected to the transverse beam by cylindrical pivots whose axis coincides with the axis of the transverse beam. The connecting-rods can consequently oscillate in only one plane, and not at right angles to this plane of oscillation. When the connecting-rods in such an engine become of unequal length owing to the bearings melting and having to be readjusted, or when the cranks are of different radii, the absence of provision for this second capacity for oscillation is a defect in that the pivots of the transverse beam bind in the bearings of the connecting-rods. As a result not only are considerable pressures in the bearings and, accordingly, excessive wear and tear occasioned, but also in extreme cases fractures of the connecting-rods or pivots may occur.

A primary object of my invention is to obviate this defect.

To this end, I connect the connecting-rods to the piston by means of the transverse beam in such a manner that freedom of movement in three directions is provided. The connecting-rods are free to oscillate in two directions relatively to the transverse beam and the transverse beam is free to oscillate in one direction, or the transverse beam is free to oscillate in two directions relatively to the piston and the connecting-rods are free to oscillate in only one direction. The freedom of oscillation in two directions can be obtained by means of a ball pivot or other form of universal joint.

The invention consists in the construction, arrangement and combination of parts described hereinafter and pointed out in the claims.

Several embodiments of my invention are diagrammatically represented by way of example in the accompanying drawing, wherein:—

Figure 1 is a diagrammatic side elevation showing the arrangement of an engine of the type described without a crosshead, in which the piston remote from the crankshank is connected with the latter by means of a transverse beam and two connecting-rods connected thereto;

Fig. 2 is an end elevation, partly in section on the line II—II in Fig. 3, showing the left-hand pivot of the transverse beam, Fig. 3 is a side elevation showing an arrangement in which the piston-rod is rigidly connected with the piston, and Fig. 4 is a section taken on the line IV—IV in Fig. 3 showing the right-hand pivot of the transverse beam;

Fig. 5 is a side elevation showing an arrangement the contrary of that shown in Fig. 3, *i. e.*, the piston-rod is movably connected with the piston but rigidly connected with the transverse beam;

Fig. 6 is an end elevation, partly in section on the line VI—VI in Fig. 7, showing the left-hand pivot of the transverse beam, Fig. 7 is a side elevation showing an arrangement in which the transverse beam and the piston are connected by a universal joint in which the two axes are at right angles to one another but do not intersect, and Fig. 8 is an end elevation, partly in section on the line VIII—VIII in Fig. 7, showing the right-hand pivot of the transverse beam;

Fig. 9 is an end elevation, partly in section on the line IX—IX in Fig. 10, showing the left-hand pivot of the transverse beam, Fig. 10 is a side elevation, partly in sec-

tion, showing an arrangement in which the transverse beam and piston are connected by a ball pivot, and Fig. 11 is an end elevation, partly in section on the line XI—XI in Fig. 10;

Fig. 12 is a side elevation showing an arrangement similar to that shown in Fig. 7 except that the transverse beam can rotate in the piston-rod,

Fig. 13 is an elevation, partly in section, showing the transverse beam connected with the piston-rod by means of a ball pivot, and

Fig. 14 is a perspective view showing the transverse beam connected to the piston rod by a universal joint in which the axes of the turning movements intersect.

Referring to the drawing, in all the views 1 designates the piston remote from the crank-shaft, 2 the piston-rod, 3 the transverse beam, and 4 the connecting-rods which connect the pivots of the transverse beam with the shaft 5.

In the embodiment shown in Figs. 2 to 4 the piston-rod 2 has one end rigidly connected with the piston 1, its other end being forked and connected to the transverse beam by a pivot 6 about which the transverse beam 3 can rock. The left-hand connecting-rod 4 is connected with a transverse beam 3 by a universal joint 7, (Fig. 2) and the right-hand by a ball pivot 8.

In the embodiment shown in Fig. 5 the piston-rod 2 can rock about a pivot 9 connecting it to the piston 1, but is rigidly connected with the transverse beam 3. The connecting-rods, not shown, will be connected with the ends of the transverse beam by ball pivots 10. Accordingly, as regards the connection of the piston with the transverse beam the arrangement is the opposite of that shown in Fig. 3.

In the embodiment shown in Figs. 6 to 8 the piston-rod 2 is connected by a pivot 10 with the piston and is rotatably connected with the transverse beam 3 by a pivot 11 disposed at right-angles to the pivot 10. The connecting-rod 4 at the left-hand end of the transverse beam is connected to a laterally flattened cylindrical pivot 12 (Fig. 6) and that at the right-hand end is connected by means of a fork to a pivot 13 journaled parallel with the pivot 12 (Fig. 8).

In the embodiment shown in Figs. 9 to 11 the piston-rod 2 is rigidly connected with the piston 1, while the transverse beam 3 is journaled in the piston-rod by means of a ball pivot 14. The stresses which arise incident to turning of the transverse beam about its axis are transmitted, in the joint shown in Fig. 9, by the two forks of the beam and in that shown in Fig. 11 by the pivot connecting the beam to the connecting-rod.

In the embodiment shown in Fig. 12 the ball pivot of the piston-rod has been replaced by a universal joint, in which however the axes of the two turning movements are at right angles but do not intersect one another. The piston-rod 2 rocks in the piston about the pivot 15, while the transverse beam can turn in the piston rod at 16. The left-hand connecting-rod is connected with the transverse beam by a laterally flattened cylindrical pivot 17, and the right-hand connecting-rod by a pivot 18 in the forked end of the connecting-rod.

In the embodiment shown in Fig. 13 the end of the piston-rod 2 is formed as a ball and the two connecting-rods, not shown, will be pivotally attached to the ends of the transverse beam 3 by means of pivots 19, 20, for example, as shown in Figs. 8, 9 and 11.

In the embodiment shown in Fig. 14 the transverse beam is connected to the rod 2 by a different form of universal joint. The one axis of the universal joint coincides with the axis of the beam 3, and the other axis passes through the trunnions 21, 22 formed on the sleeve 23 in which the beam 3 turns. At the left-hand end of the beam 3 is shown a laterally flattened cylindrical pivot 24 like that employed in the embodiment shown in Fig. 6 and at the left of Fig. 7, while at the right-hand of the beam is a pivotal connection like that shown in Fig. 11 and at the right-hand of Fig. 12.

If desired, however, a ball pivot such as that shown at the right of Fig. 3 and in Figs. 4 and 5, may be employed instead. As to these various forms of pivotal connections between the ends of the transverse beam 3 and the connecting rods 4, it will be noted that with the construction shown in Figs. 3, 5, 10, 12, 13 and 14, the oscillation of the connecting-rods in planes transverse to the crank-shaft incident to the normal operation of the engine, is an oscillation about the axis A—B (Fig. 5), that is, about the axis of the beam 3; on the other hand, with the construction shown in Fig. 7, the oscillation of the connecting-rods in planes transverse to the crank-shaft is an oscillation about the axis of the connection from the rod 2 to the piston 1, that is, on the line C—D of Fig. 7.

In all of the forms of my invention herein shown and described, it will be seen that provision is made for the usual oscillation of the connecting-rods 4 in planes transverse to the crank-shaft, and in addition to this, provision is made for relative movement of the rods 4 and the beam 3. This latter movement is a movement of the rods 4 and beam 3 relatively in the planes in which they lie, that is, in planes substantially parallel to the crank-shaft. The provision for this latter form of relative movement of these parts prevents binding, excessive friction and possible fracture resulting from uneven increase in the effective length of the rods 4 or the cranks to which they are connected, such for instance, as would

result from uneven wear in the bearings connecting the two rods 4 with their respective cranks of the crank-shaft. It will be noted that the rods 4 are pivotally connected to the beam 3, that the beam 3 is pivotally connected to the piston 1 and that in each instance one of these two pivotal connections is made by means of some form of universal joint affording freedom of movement in two or more directions. In Figs. 3 and 5, the universal joint is employed in connecting each rod 4 to the beam 3, whereas in Figs. 7, 10, 12, 13 and 14, the universal joint is employed in effecting the connection from the beam 3 to the piston 1. Whether the universal joint be employed at one point or the other, however, its function is the same in that it provides for such movements of the parts relatively as may be necessary in order to avoid binding and excessive friction resulting from uneven wear of the two connecting-rods and the bearings and cranks cooperating therewith.

I claim:—

1. In an engine of the type described, the combination of a cylinder, a crank shaft, a piston in the cylinder directly connected to the crank shaft, a second piston in the cylinder, a transverse beam, a power transmitting connection from the transverse beam to the second piston at a point intermediate the ends of said beam, connecting rods pivotally connected at one end to the crank shaft, and a power transmitting connection from the other ends of the said connecting rods to the ends of the transverse beam, one of said power transmitting connections being in a form permitting universal movement.

2. In an engine of the type described, the combination of a cylinder, a crank shaft, a piston in the cylinder directly connected to the crank shaft, a second piston in the cylinder, a transverse beam, a link pivotally connected at one end to the second piston and at the other end to the middle portion of the transverse beam, the axes of the two pivotal connections of the link being at right angles to each other, and two connecting rods pivotally connected at their ends both to the crank shaft and to the ends of the transverse beam; substantially as described.

3. In an engine, the combination of a cylinder, a crank shaft, a piston in the cylinder directly connected to the crank shaft, a second piston in the cylinder, a transverse beam pivoted to said second piston, a pair of connecting rods pivoted to opposite ends of said transverse beam and each connected to the crank shaft, the pivotal connections between the connecting rods and the transverse beam, and between the transverse beam and the piston, permitting relative movement of said connecting rods, said transverse beam and said piston, about at least three distinct axes.

In testimony whereof I affix my signature in presence of two witnesses.

HUGO JUNKERS.

Witnesses:
LUDWIG WAGEMEIL,
ALFRED MILLER.