No. 725,285. PATENTED APR. 14, 1903.

C. PHILLIPS.

DRIVING GEAR FOR ENGINES.

APPLICATION FILED OCT. 30, 1902.

NO MODEL.

Fig. 1.

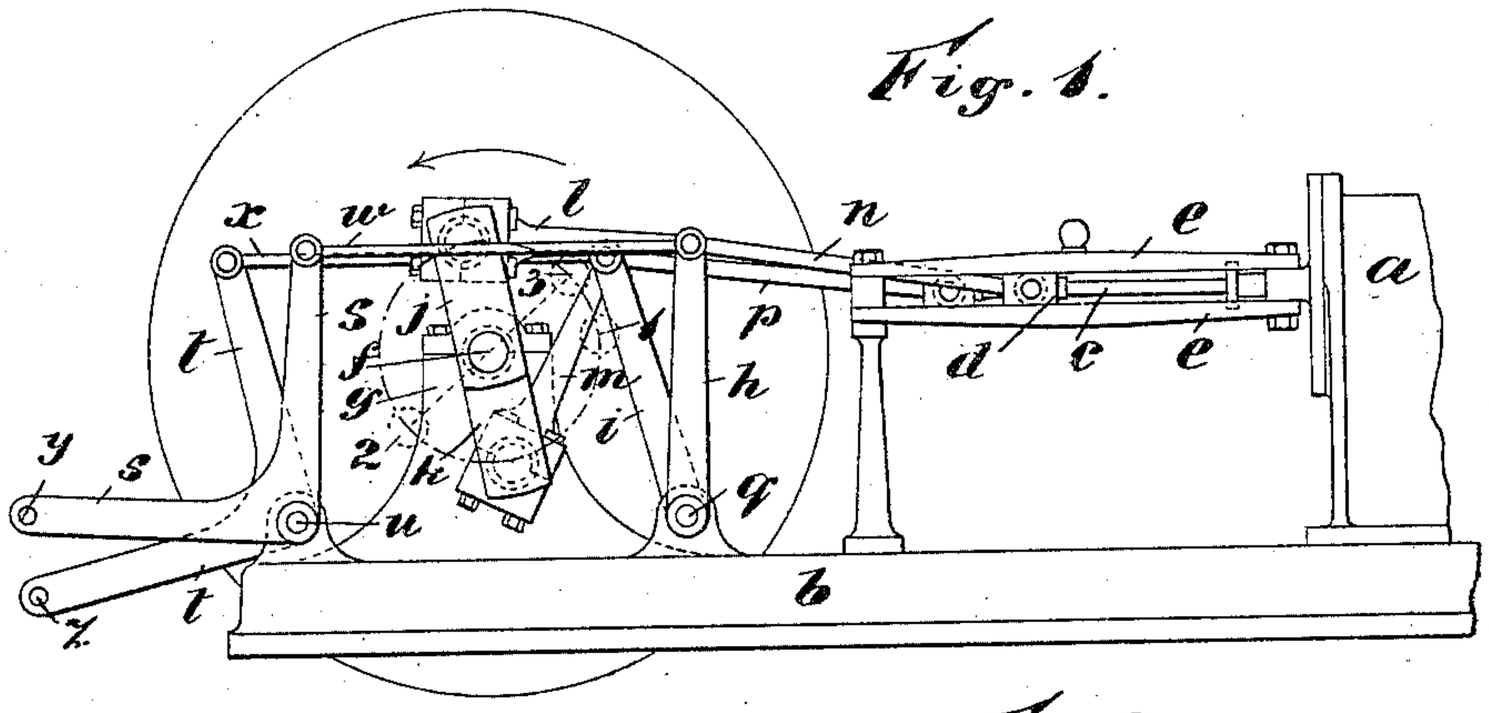
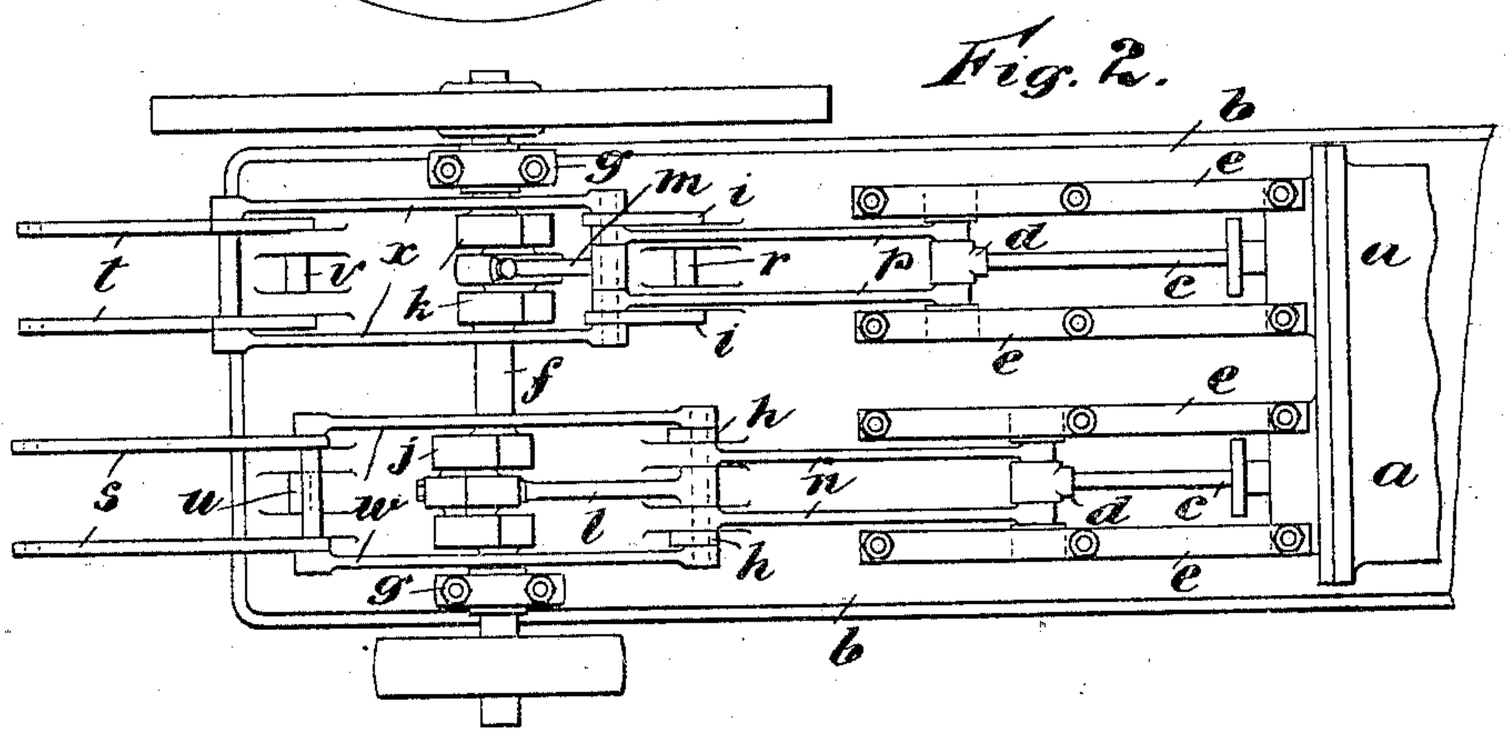


Fig. 2.



Witnesses.

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CHARLES PHILLIPS, OF NEW BUSHEY, ENGLAND.

DRIVING-GEAR FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 725,285, dated April 14, 1903.

Application filed October 30, 1902. Serial No. 129,455. (No model.)

To all whom it may concern:

Be it known that I, CHARLES PHILLIPS, inventor, a citizen of the United States of America, residing at New Bushey, county of Hertford, England, have invented certain new and useful Improvements in Driving-Gear for 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.

This invention consists in so combining certain radius-bars, links, and connecting-rods with the cranks and cross-heads, piston-rods, or pistons that dead-points are avoided and an increase of power obtained as compared with arrangements heretofore in use.

In order that the said invention may be fully understood, I will now proceed to describe the same with the aid of the accompanying sheet of drawings, in which—

Figure 1 is a side elevation of so much of a motive-power engine—such as a steam-engine, for example—with the invention applied thereto as is necessary for the elucidation of the said invention; and Fig. 2 is a corresponding plan of same.

a a represent the front ends of a pair of single-acting steam-cylinders bolted to the bed-plate *b*; *c c*, the piston-rods; *d d*, the cross-heads, working with their slide-blocks in guides *e e*, as usual, and *f* is the crank-shaft, rotating in suitable bearings *g*, fixed to or formed with the bed-plate *b*. It will be seen that the horizontal center lines of the cylinders *a a* do not pass through the axis of the crank-shaft *f*, but lie in a plane situated, preferably, about half the radius or length of the crank above it.

h and *i* are radius-bars pivoted at *q r*, respectively, to the bed-plate *b* below and behind the crank-shaft *f* and extending upward, so that their free ends stand above the crank-shaft.

j k are two cranks set opposite to each other—that is to say, one hundred and eighty degrees apart—on the crank-shaft.

l and *m* are connecting-rods pin-jointed to the upper ends of the radius-bars *h* and *i* and connecting them to their respective cranks *j* and *k*, and *n p* are other rods or links pin-jointed to the upper ends of the radius-bars *h* and *i* and connecting them to the cross-head pins of their respective cross-heads *d*.

The connecting-rods *l* and *m*, connecting the cranks to the radius-bars *h* and *i*, are preferably about the same length as the throw of the cranks they drive; but they may be longer or shorter, and the rods or links *n* and *p*, connecting the radius-bars *h* and *i* to the pins of the cross-heads *d d*, may be longer or shorter than the connecting-rods *l* and *m*, as may be found convenient.

The stroke of the pistons is longer than the throw of the cranks by reason of the considerable angularity of the connecting-rods *l* and *m* when the crank-pins are moving through the lower portion of their paths, as seen with reference to the connecting-rod *m* in Fig. 1, and the effect of this arrangement is that at each effective stroke of a piston power is applied to the corresponding crank-pin during more than the half-circle described by the latter—namely, while traveling from the position marked 1 to the position marked 2 in the direction of the arrow, Fig. 1—and consequently the opposite crank-pin is thereby carried beyond its dead-point to the position 3 in Fig. 1, and as this action applies to both cranks there is no moment when both cranks are on a dead-point at the same time, although they are placed one hundred and eighty degrees apart instead of ninety degrees, as usually practiced with two-cylindered engines. It will be understood that power is only applied to each crank-pin while it is traveling in the upper part of its path in the direction of the arrow from the position marked 1 to the position marked 2 in Fig. 1 and that no power is applied by its corresponding piston to either crank-pin while the latter is traveling in the lower part of its path from the position marked 2 to that marked 1; but, on the contrary, the movement of either crank-pin while traveling in the lower part of its path is effected by that of the other crank-pin while traveling in the upper part of its path from 1 to 2, so that the movement of a crank-pin from its dead-point at 2 to 1 merely effects the backward stroke of its own piston in readiness for the next forward power-stroke of the same.

It is obvious that instead of the engine being placed horizontally it may be placed ver-

tically or inclined, and in such cases the terms herein used "above" and "below" the crank-shaft will have their meanings correspondingly modified by the position. It is also obvious that instead of connecting the rods or links *n* and *p* to the pins of the cross-heads *d* they may be connected directly to the piston in cases where trunks are employed instead of piston-rods, as in the case of gas-engines, for example.

The above-described engines may be applied to the working of vertical pumps by means of bell-crank levers *s* and *t*, pivoted at *u* and *v* to the bed-plate *b*, and connected by pin-jointed rods or links *w* and *x* to the upper ends of the radius-bars *h* and *i*, the pump-rods being connected to the ends *y* and *z* of the said bell-crank levers *s* and *t*, or the bell-crank levers *s t* may be dispensed with and the links *w* and *x* be connected to the piston-rod cross-heads or to the plungers of pumps placed horizontally in front of the crank-shaft *f*, whereby more direct action will be obtained.

I have not shown any valve-gear in connection with the engines, because that may be arranged in any suitable manner and forms no part of my present invention.

In the engines as shown in the drawings the cranks are supposed to rotate in the direction of the arrow in Fig. 1, which presupposes that the steam or other motive fluid presses on the back of the pistons and causes them as they move from the back to the front end of the cylinders to move the respective crank-pins from the position 1 to the position 2; but it is obvious that if the steam or other motive fluid is caused to press on the front of the pistons instead of on the back the movement of the pistons from the front to the back end of the cylinders will move the respective crank-pins from the position 2 to the position 1 in a direction opposite to that indicated by the arrow in Fig. 1. It is therefore obvious that by properly arranging the valve-gear so that the motive fluid can be introduced into the cylinders either behind or in front of the pistons the engines may be reversed—that is to say, made to rotate in either direction at pleasure—but care must be taken in arranging the valve-gear that the motive fluid is so admitted that during the power-strokes of the pistons the corresponding crank-pins move through the upper part of their paths—that is to say, from position 1 to position 2 in the direction of the arrow in one case, and from position 2 to position 1 in the direction opposite to that of the arrow in the other case—it being understood that during the movement of the crank-pins through the lower part of their paths—namely, from position 2 to position 1, or vice versa—no power is transmitted to them by the motive fluid.

In the above description the engines are described as single-acting—that is to say, as having the steam or other motive fluid admitted at one end of the cylinders only, so as to apply pressure to the crank-pins while they are moving in either direction through the upper part of their paths, the movement of each in either direction through the lower part of its path being effected by the power applied to the opposite crank-pin; but it is obvious that, if preferred, steam or other motive fluid may be admitted alternately to both ends of the cylinders, so that power will be applied to the crank-pins while they are traveling through both the upper and lower parts of their paths—that is to say, the engines may be double-acting.

The engines may be provided with a fly-wheel or not, according to circumstances.

The above-described invention is applicable to any motive-power engine actuated by a fluid—such as steam, compressed air, gas, water, &c.—and in the case of an expansive motive-power fluid—such as steam or compressed air, for example—the engines may be compounded—that is to say, made high and low pressure.

I claim—

1. Means for overcoming dead-centers comprising movable or reciprocatory members, a crank-shaft, radius-bars pivoted below the crank-shaft and extending upward above the same, devices connecting said radius-bars to said movable members, and connecting-rods connecting said radius-bars to the crank-pins, whereby each said crank-pin is carried around by the effective stroke of its movable part more than the half-circumference of its path, thereby carrying the other crank-pin beyond its dead-point in readiness for the next effective stroke of its movable part, substantially as described.

2. A means for overcoming dead-centers comprising movable members, a crank-shaft, radius-bars pivoted below the crank-shaft and extending upward above the same, devices connecting said radius-bars to the movable members, and connecting-rods connecting said radius-bars to the crank-pins, whereby each said crank-pin is carried around by the effective stroke of its movable member more than the half-circumference of its path, thereby carrying the other crank-pin beyond both its dead-points, substantially as described.

3. In a device for overcoming dead-centers, the combination with the crank-shaft and movable members the center lines of which lie in a plane above the crank-shaft, with radius-bars pivoted below the crank-shaft but extending upward above the same, and connecting rods or links connecting the free ends of the radius-bars to the crank-pins on the one hand and to the movable members on the other, substantially as described and for the purposes specified.

4. In a device for overcoming dead-centers, the combination with the crank-shaft and movable members the center lines of which lie in a plane above the crank-shaft, with radius-bars pivoted below the crank-shaft but ex-

tending upward above the same, connecting rods or links connecting the free ends of the radius-bars to the crank-pins on the one hand and to the movable members on the other, and operating devices adapted to be connected to a mechanism to be operated from the said radius-bars, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

CHARLES PHILLIPS.

Witnesses:
STEPHEN EDWARD GUNGON,
WALTER J. SKERTEN.