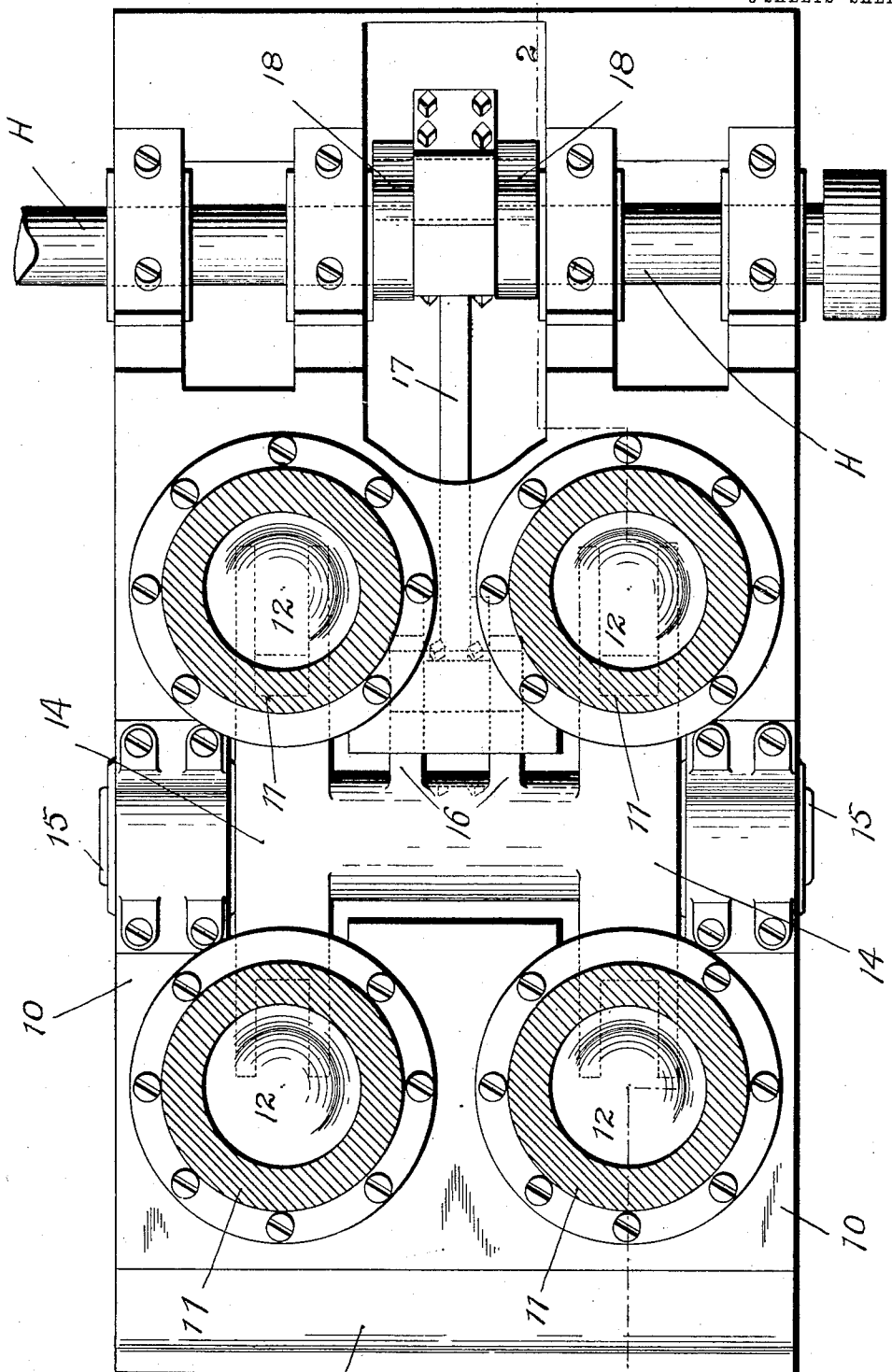


A. J. GIFFORD.
CRANK SHAFT CONNECTION FOR ENGINES.
APPLICATION FILED AUG. 14, 1901.

931,750.

Patented Aug. 24, 1909.

3 SHEETS—SHEET 1.



Witnesses.
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M. C. Regan.

Fig. 1.

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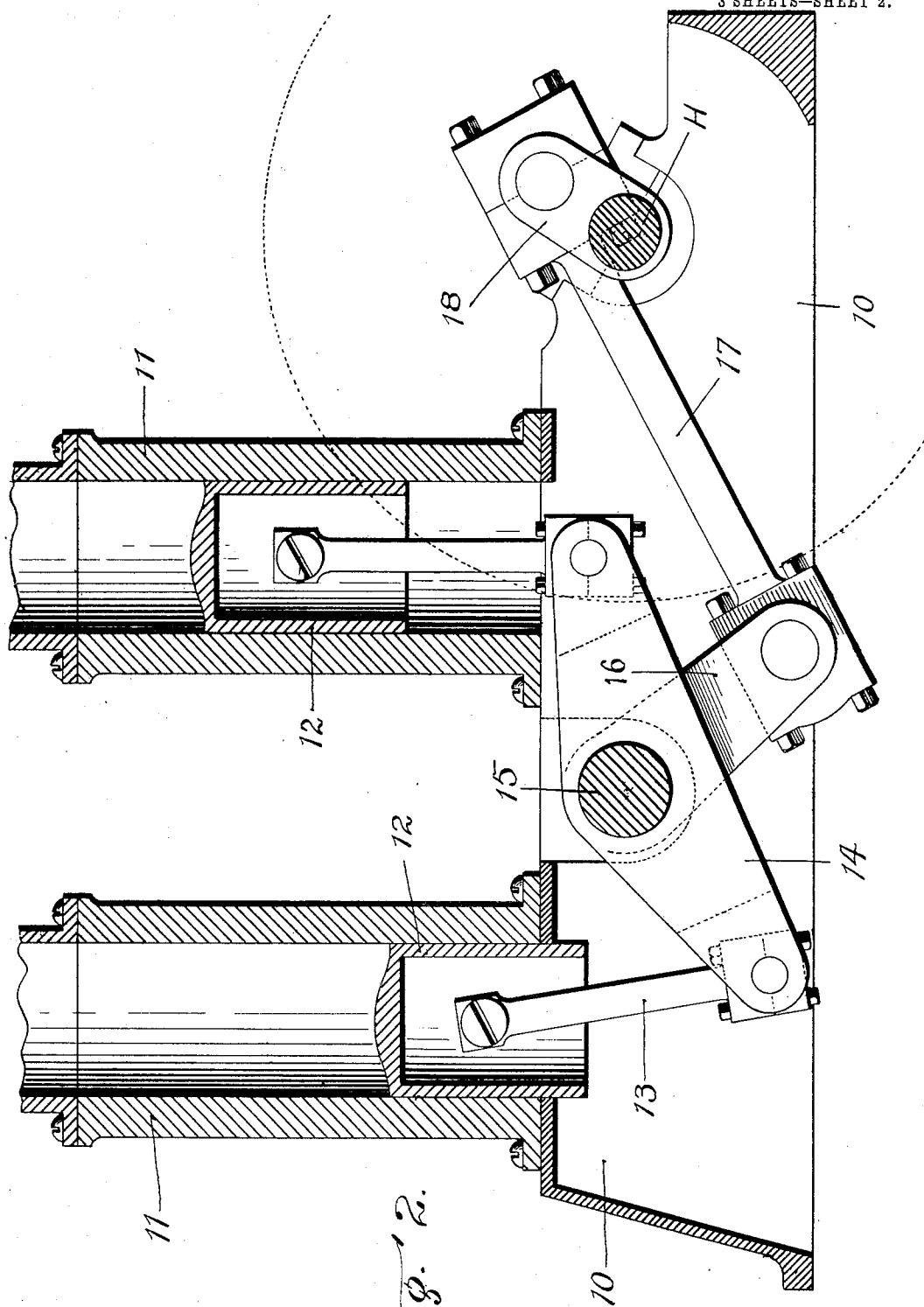


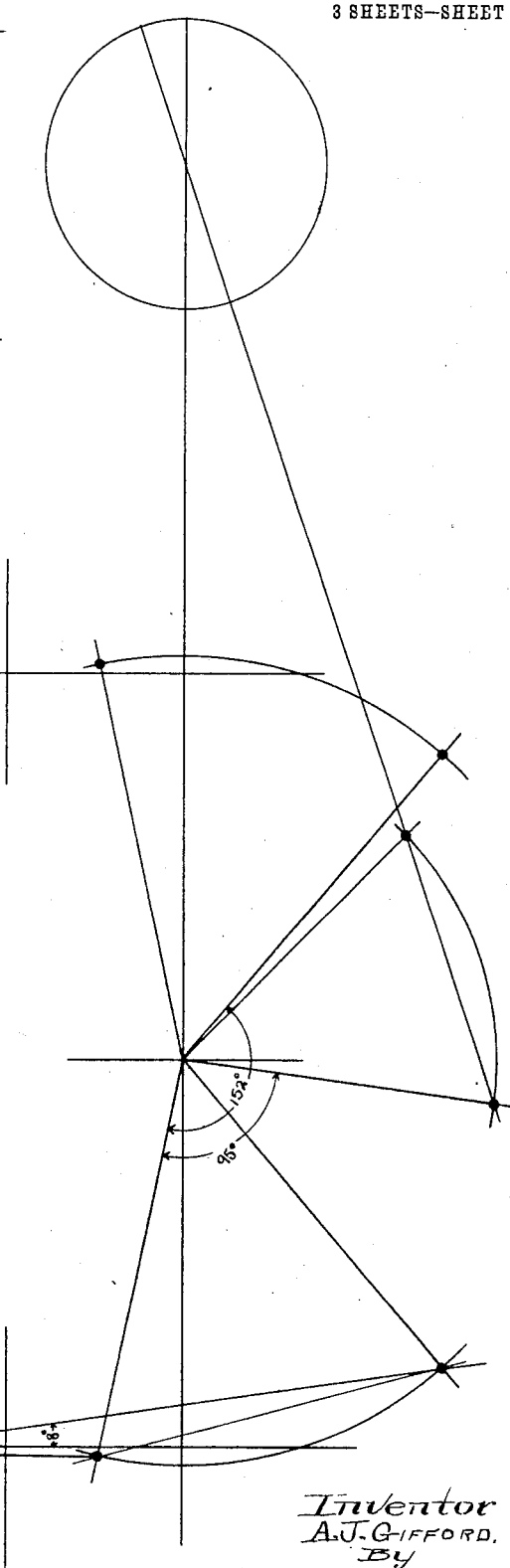
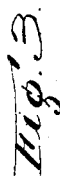
Fig. 2.

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3 SHEETS--SHEET 3.



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UNITED STATES PATENT OFFICE.

ALBERT J. GIFFORD, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO CHARLES H. MORGAN, OF WORCESTER, MASSACHUSETTS.

CRANK-SHAFT CONNECTION FOR ENGINES.

931,750.

Specification of Letters Patent.

Patented Aug. 24, 1909.

Application filed August 14, 1901. Serial No. 71,992.

To all whom it may concern:

Be it known that I, ALBERT J. GIFFORD, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Crank-Shaft Connection for Engines, of which the following is a specification.

This invention relates to a construction for connecting an engine piston, or a number of engine pistons, to turn a main shaft.

The especial object of this invention is to provide an efficient engine construction having a minimum amount of piston friction. To accomplish this result, the piston connecting-rod of an engine constructed according to this invention occupies a position substantially parallel to the line of movement of the piston during the major part of the travel of the piston, so that during the time of highest temperature and pressure in the cylinder, and during the time of highest piston traveling speed, there will be no side thrust or pressure tending to crowd the piston against the side of its cylinder.

To these ends, this invention consists of the construction and combinations of parts, as hereinafter described, and more particularly pointed out in the claims at the end of this specification.

In the accompanying three sheets of drawings, Figure 1 is a plan view partially in section of an engine constructed according to my invention. Fig. 2 is a sectional view of the same taken on the line 2—2 of Fig. 1. Fig. 3 is a diagrammatic view illustrating the relative positions occupied by the parts, Fig. 4 is a diagrammatic view illustrating the different angular positions of directly connected piston connecting rods of different lengths in ordinary practice, and Fig. 5 is a typical indicator diagram of an explosive engine.

In ordinary engine practice in which the pistons are directly connected to their cranks by a connecting rod, the resulting angularity between the piston connecting-rod and the line of travel of the piston causes comparatively heavy lateral pressures between the piston and the side walls of the cylinder.

The lateral pressures between the piston and side cylinder walls of an engine greatly increase the difficulty of maintaining perfect fits and satisfactory lubrication in the cylinder. These difficulties are especially noticeable in gas engines where high temperatures and pressures are produced in the engine cylinders, and where great attention must be given to lubrication, inasmuch as the explosive mixture of gas and air frequently contains a considerable amount of dust and grit, for example, when explosive engines are supplied with producer or blast furnace gas.

For good engine practice, where the piston and crank are directly connected, it is necessary that the connecting rod should be at least five cranks long. It is preferable if possible, to use a connecting rod even longer than this, the best practice frequently giving a connecting rod length of six cranks. In the use of a directly connected connecting rod five cranks long, the connecting rod will be swung or turned at each revolution of the fly-wheel through an angle of about 23°, while a directly connected connecting rod six cranks long, which is practically the maximum length of directly connected connecting rods now employed, the connecting rod will swing through an angle of about 19°. Although the angularity of a directly connected connecting rod with respect to the line of travel of its piston is zero at the dead point, this angularity increases very rapidly, and reaches its maximum during the second and third quarters of the piston stroke. Indicator diagrams from explosive engines, as illustrated for example in Fig. 5, show the pressures to be very high throughout the second and third quarters of the stroke.

The especial object of my present invention, is, therefore, to provide a form of connection which will reduce the total angular swing of the connecting rod, and which will have its centers of motion so located that the connecting rod will occupy a position substantially parallel with the line of movement of its piston during the part of the travel of the piston when the heaviest pressures are being transmitted thereby. To accomplish these objects, an engine constructed accord-

ing to my invention comprises one or more engine pistons, and a beam pivoted at a point adjacent to the end of the cylinder or cylinders and between the end thereof and a line drawn perpendicular to the line of travel of the piston, through the central point of the curve on which the pivotal connection of the beam with the connecting rod travels whereby the connecting rod will be substantially parallel with the line of movement of the piston during the first three quarters of travel of the piston.

Referring to the accompanying drawings, and in detail, I have illustrated my invention as applied to a quadruple cylinder engine of the type employed for explosive or gas engines. It is to be understood, however, that my invention is applicable to other types of engines than the quadruple type herein illustrated.

Referring to said drawings, and in detail, the engine herein illustrated, comprises a base-piece or casting 10, mounted on which are the four vertical cylinders 11. In each of the cylinders 11 is a trunk piston 12, which is connected by a connecting-rod 13 to one of the arms of the pivotally mounted beam 14 carried by a rock-shaft 15, which rock-shaft 15 is provided with an arm 16 connected by a pitman 17 to turn the crank 18 of the main shaft H. These parts may be of substantially the ordinary construction which have been employed in engines of this class, except that the pivot of the beam 14, or axis of the rock-shaft 15, is located out of line with, and between the end of the cylinder and a line connecting the points at which the connecting rods 13 are attached to the beam. It will be seen also that the axis of the rock shaft 15 is at a point adjacent to the end of the cylinder and between said end and a horizontal line drawn from the central point of the arc through which the end of the beam travels. The arms of the pivoted beam are of such a length, that the connecting rods 13 will have only a slight outward inclination when in their highest position.

The relative angular movements of the parts as I preferably construct them is most clearly illustrated in Fig. 3. I preferably arrange the parts so that the piston connecting rod will have an angularity of about one degree at the instant of explosion, when the maximum pressure of nearly two hundred and fifty pounds to the square inch is applied to the piston. When the piston having a stroke of twenty inches has traveled five inches, or the first quarter of its stroke, the angularity of the piston rod will have increased to about one and three-quarters degrees, after which it will decrease, so that when the piston has traveled eleven and one-half inches, the connecting rod will occupy an exactly vertical position. In the last part of the stroke of the piston, the

angularity of the connecting rod increases on the other side until it amounts to about eight degrees at the end of the twenty-inch stroke. The increasing angularity of the connecting-rod during the very last part of the stroke of the piston is of no disadvantage whatever, as the temperatures and pressures within the cylinder, and the speed of piston travel are at a minimum during this part of the movement. In fact, in many gas engine constructions, the exhaust relief passage is wide open during all of the last quarter of the piston travel, so that during this part of the movement no working pressure is maintained in the cylinder.

I am aware that changes may be made in the relative proportion and arrangement of parts without departing from the scope of my invention as expressed in the claims. I do not wish, therefore, to be limited to the construction herein shown, but

What I do claim and desire to secure by Letters Patent of the United States is:—

1. In a piston compression gas engine, the combination of a pivotally mounted beam, two engine pistons, piston connecting rods connecting said pistons directly to the ends of the beam, the point at which the beam is pivoted being located materially at the side toward the pistons of a line connecting the points of attachment of the piston connecting rods with the beam whereby the piston connecting rods will each occupy positions substantially parallel with the line of movement of their pistons during the greater part of their stroke while the pistons are under pressure of explosion, and also during the greater part of the return stroke thereof while the fresh charge is being compressed.

2. In a piston compression gas engine, the combination of a pivotally mounted beam, an engine piston movable vertically to compress a charge, a cylinder therefor, and means for connecting the end of the beam with the piston, said beam being pivoted at a point adjacent to the end of the cylinder and between the end of the cylinder and a horizontal line drawn from the central point of the arc through which the end of the beam travels.

3. A piston compression gas engine of the type having a piston, a cylinder, a beam, and a connecting rod pivotally connected directly with the piston and with the beam, in which the beam is pivoted at a point between the end of the cylinder and a line drawn perpendicular to the line of travel of the piston, through the central point of the curve on which the pivotal connection of the beam with the connecting rod travels, whereby the rod is located at a slight angle to the axis of the piston at the beginning of the working stroke, the angle being slightly increased during the first part of the working stroke, then gradually decreased to zero un-

til the rod is brought across said axis during
the third quarter of the stroke and the angle
of the rod is materially increased on the
other side of the axis, said operations being
5 reversed during the corresponding parts of
the return stroke occupied by a compression
of a fresh charge.

In testimony whereof I have hereunto set
my hand, in the presence of two subscribing
witnesses.

ALBERT J. GIFFORD.

Witnesses:

LOUIS W. SOUTHGATE,
PHILIP W. SOUTHGATE.