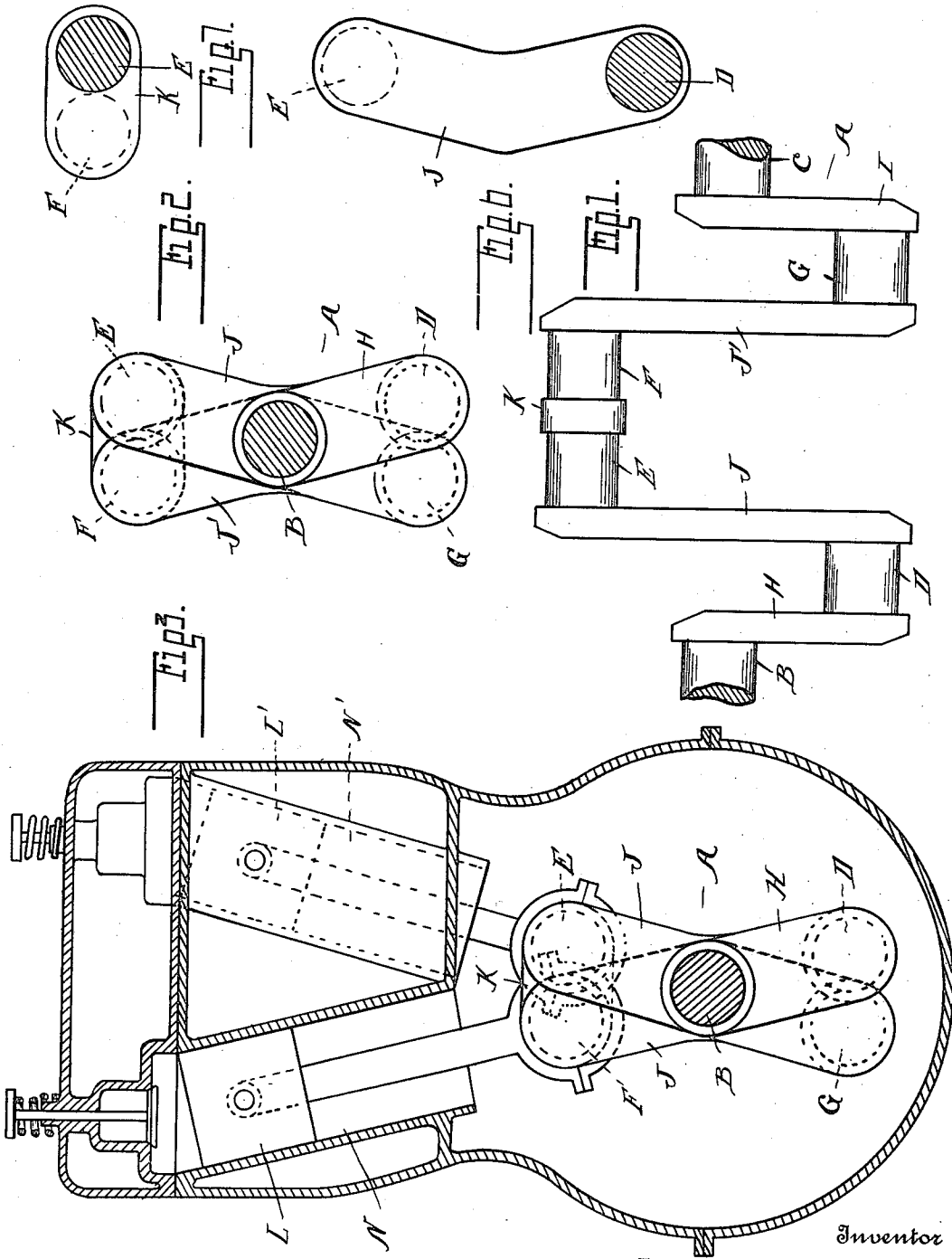


L. C. KENEN.
CRANK SHAFT CONSTRUCTION.
APPLICATION FILED MAR. 31, 1916.

1,322,579.

Patented Nov. 25, 1919.
2 SHEETS—SHEET 1.



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Fig. 1.

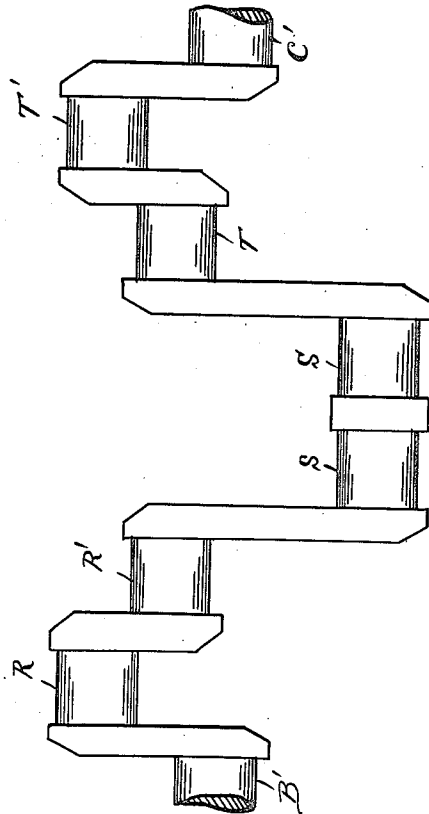
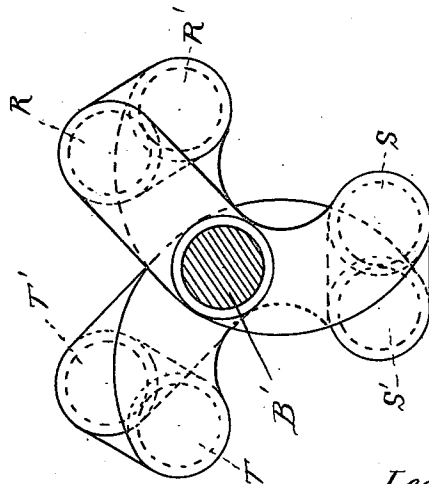


Fig. 2.



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UNITED STATES PATENT OFFICE.

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CRANK-SHAFT CONSTRUCTION.

1,322,579.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, LEONARD C. KENEN, a citizen of the Republic of France, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Crank-Shaft Construction, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to crank shafts, and refers more particularly to crank shafts employed in multi-cylinder engines, the cylinders of which are arranged in series and with the axes of the cylinders of one series positioned in angular relation to the axes of the cylinders of the other series.

Among the objects of the invention are to provide an improved crank-shaft construction and arrangement for use in multi-cylinder engines having the V-shaped cylinder arrangement. The invention further resides in such features of construction and arrangement and combination of parts as will more fully hereinafter appear.

In the drawings:—

Figure 1 is a side elevation of a crank shaft embodying my invention;

Fig. 2 is an end view of the shaft shown in Fig. 1.

Fig. 3 is a vertical cross sectional view showing the shaft employed with the V-type cylinder construction.

Fig. 4 is a side elevation of a crank shaft for a six cylinder construction of the V-type.

Fig. 5 is an end view of the shaft shown in Fig. 4.

Figs. 6 and 7 are views of one of the crank arms and cheek plates respectively.

The present invention contemplates a novel construction of crank shaft which when employed with the V-type of engine will permit the cylinders to be arranged at very acute angles, thus allowing the use of a single *en bloc* construction while at the same time rendering possible the perfect synchronism of power impulses. In general I have obtained this result by a novel construction of crank shaft in which the pins are arranged in pairs or series, and the individual pins of each pair or series offset so as to simultaneously lie in the plane of the axes of their respective cylinders.

In the particular embodiment of my invention shown in the drawings I have illus-

trated in Figs. 1 and 2 a crank shaft A of the four-throw type having simply the end main journals B and C, though the invention is not necessarily limited to a two-bearing crank shaft. In detail the crank shaft A is provided with crank pins D, E, F and G positioned upon substantially opposite sides of the main crank. The pin D is connected to the shaft A by a cheek-plate or arm H and the pin G by a similar arm I. The pins D and E are connected by an arm J and the pins G and F by an arm J'. The connection is such, however, that the pins D and G as shown in Fig. 2 lie in different radial planes, while the pins E and F are connected by an offset cheek-plate K, so as to also lie in different radial planes. The arrangement is preferably such that the pins D and F at the extreme limit of movement of the pistons L will lie in the plane of the axes of the cylinders N while the pins G and E at the extreme limit of movement of the pistons L' to which they are connected will lie in the plane of the axes of the cylinders N'. By this arrangement the clearance of the pistons L and L' in the respective cylinders N and N' will be equal and the cycle of operations maintained the same as if all the cylinders were arranged in alinement. Thus by the present novel arrangement of parts I retain the short engine length which is one of the advantages of the V-type motor, and at the same time obtain a construction which is relatively narrow in width. This latter feature has the further advantage that the pair or pairs or series of cylinders N and N' can be cast *en bloc* if desired.

While I have shown and described the invention as particularly adapted for use in a four cylinder engine, it is obvious that in its broader aspects, the invention is not limited to such use, and that the novel features would also be applicable to other multi-cylinder engines such as a six-cylinder engine of the type which normally has its crank pins arranged in three equi-distant radial planes. A shaft suitable for the six cylinder engine is shown in detail in Figs. 4 and 5 in which B' and C' designate the main journals and R R', S S' and T T' designate the crank pins. As shown in Fig. 5 the pins of each pair are off-set in a manner similar to that described in connection with Figs. 1 and 2.

The invention, however, is not limited to use with any particular number or arrangement of cylinders except as ultimately set forth in the claims, and various changes in the details of construction and arrangements and combinations of parts can also be made within the scope of my invention.

What I claim as my invention is:—

1. In a multi-cylinder engine, the combination with a plurality of cylinders arranged in series with the axes of the cylinders of one series inclined in relation to the axes of the cylinders of the other series, of a four-throw crank-shaft therefor having two pins on one side and two pins on the opposite side of the crank-shaft, the first-mentioned two pins being offset to correspond with the inclined relation of the cylinders and the other two pins being similarly offset from each other and spaced longitudinally to embrace the first-mentioned pair.

2. In a multi-cylinder engine, the combination with a plurality of cylinders arranged in series with the axes of the cylinders of one series inclined in relation to the axes of the cylinders of the other series, of a four-throw crank-shaft therefor having two pins arranged on one side of the crank-shaft and offset to simultaneously lie substantially in the plane of the axes of their respective cylinders, and two pins on the opposite side of the crank-shaft arranged so that at the same time they simultaneously lie substantially in the plane of the axes of their respective cylinders, one pair of pins being spaced longitudinally to embrace the other pair.

3. In a multi-cylinder engine, the combination with a plurality of cylinders arranged in series with the axes of the cylinders of one series inclined in relation to the axes of the cylinders of the other series, of a crank-shaft therefor having pins arranged in pairs, the pins of each pair being offset rearwardly from the direction of

rotation of the crank-shaft an amount equal to the angle of inclination of the axes of the cylinders and the pins of one pair being spaced longitudinally to embrace those of the other pair.

4. In a multi-cylinder engine, the combination with a plurality of cylinders arranged in series with the axes of the cylinders of one series inclined in relation to the axes of the cylinders of the other series, of a crank-shaft therefor having four pins disposed in different longitudinal parts of the crank-shaft, two of the pins being arranged on one side of the crank-shaft and the other two on the opposite side of the crank-shaft each of the pins being offset with relation to another of the pins an amount corresponding to the angle of inclination of the cylinders and one offset pair being spaced longitudinally to embrace the other pair.

5. In a multi-cylinder engine, the combination with a plurality of cylinders arranged in series with the axes of the cylinders of one series inclined in relation to the axes of the cylinders of the other series, of a four-throw balanced crank-shaft therefor arranged to maintain a perfect synchronism of power impulses irrespective of the angle of inclination of the cylinders, said crank-shaft having end journals, crank-pins arranged adjacent said end journals but at one side of the center thereof, said pins being offset out of alinement with each other to correspond to the angle of inclination of the cylinders, and a pair of crank-pins connected by crank-arms or the like to the first pair of pins and located longitudinally intermediate thereof but on the opposite side of the center of said journals, said last-mentioned crank-pins being also offset out of alinement with each other to correspond to the angle of inclination of the cylinders.

In testimony whereof I affix my signature.
LEONARD C. KENEN.