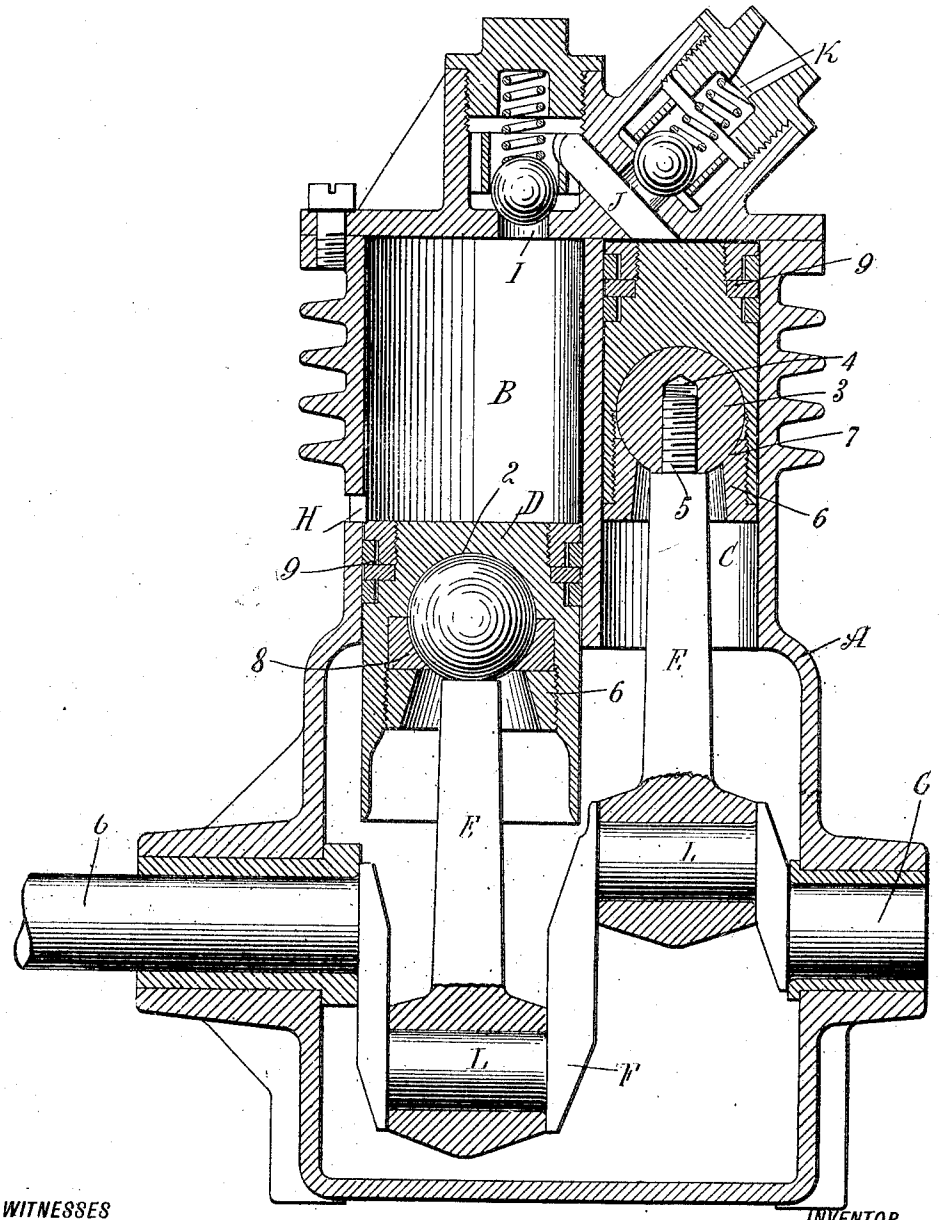
G. J. SPOHRER.

TWO-STAGE COMPRESSION PUMP.

APPLICATION FILED MAR. 9, 1912.

1,067,770. Patented July 15, 1913.



WITNESSES

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TWO-STAGE COMPRESSION-PUMP.

1,067,770. Specification of Letters Patent. Patented July 15, 1913.

Application filed March 9, 1912. Serial No. 682,583.

To all whom it may concern:

Be it known that I, GREGORY J. SPOHRER, a citizen of the United States, and a resident of Franklin, in the county of Venango and State of Pennsylvania, have invented a new and Improved Two-Stage Compression-Pump, of which the following is a full, clear, and exact description.

My invention relates in general to a piston pump and more particularly relates to the crank connections with the piston.

In automobile constructions at present, use is made of a pump for the purpose of supplying compressed fluid to actuate different mechanisms, as, for instance, the starting mechanism, tire-inflating mechanism, etc. The pumps now on the market are objectionable, because, among other reasons, they occupy a large amount of valuable space, and with pistons of small diameter, especially the high pressure piston of a small two-stage compression pump sufficient area of bearing cannot be obtained by the usual wrist pin or piston bearing to substantially stand the strain and wear. It is understood in pump constructions that a low pressure cylinder must be of relatively great diameter compared with the high pressure cylinder, in order to obtain an economical ratio of compression, and in those pumps, the strokes in both the high and the low pressure cylinders are equal, the only change being made in the diameter of the cylinders in which the compression takes place.

I construct a two-stage compression pump particularly adapted for automobile use, in which the low pressure cylinder is more nearly equal to the dimensions of the high pressure cylinder, and obtain the necessary ratio of cylinder volume by varying the extent of reciprocation of the pistons, by positioning the pins in the crank shafts different distances from the axis of rotation of the actuating shaft. To further economize the space occupied by such a pump, I make the crank link relatively short and it is a desideratum in a device of this character, to shorten the length of the piston, but as this piston must work against heavy pressure, it is necessary that it be of sufficient rigidity and size to withstand this pressure. The connections at present used in devices of this character are not adapted to form a strong connection between a relatively short piston and a relatively short link. It is advisable to have this connection positioned well within the body of the piston, and this form of connection always forms a feature of my invention, and in the present instance, I make use of a ball-and-socket connection which gives a firm connection in a relatively small piston, presenting more bearing surface and allowing the center of swing to be brought well up within the top of the piston. These two features are not allowable in present forms of piston bearings. I further increase the space for bearing in the high pressure piston by shortening the relative stroke of the high to the low, thereby increasing the diameter of the high pressure cylinder and still maintaining the proper cylinder volume essential to two stage compression, the whole device forming a small compact pump of high efficiency.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which the figure is a vertical transverse sectional view taken through a simple form of pump.

As is general in constructions of this nature, there is provided a shell A, the upper portion of which is formed into a low pressure cylinder B and a high pressure cylinder C, in each of which cylinders is disposed a piston D, said piston being connected by means of a connecting rod E to a crank F mounted in a driving shaft G. The fluid to be compressed is admitted through the inlet H and forced through the valve-covered outlet I and through the passage J into the high pressure cylinder C, the piston in which cylinder, on its return stroke forces the compressed gas through the valve-controlled outlet K. It will be noted that the high pressure cylinder C is almost the diameter of the low pressure cylinder B, and, if desired, both of these cylinders might be of the same volume.

The link connections with the pistons are relatively short, and the device is so con-

structed that the pistons approach as closely as possible to the shaft G at one limit of their stroke, so as to maintain the height of the pump as small as possible. The ratio of stroke between the high and the low pressure cylinders is obtained by varying the distance of the crank pins L from the axis of the shaft G, it being noted that the distance from the axis of the shaft to the axis of rotation of the crank pin actuating the high pressure piston, is materially less than the corresponding distance between the axis and the pin of the low pressure cylinder. In other words, I reduce the ratio between the cylinder diameters and change the ratio of the strokes of the pistons in the cylinders, by means of a pair of unequal double cranks. The pistons in this case are substantially hollow cylinders, the compression end of each of which is closed and the end facing the crank open. Within the open end and preferably a short distance from the compression end, is a semi-spherical recess 2, freely revoluble in which recess is a sphere 3, extending diametrically within the lower side of which is a screw-threaded bore 4, which is engaged by a reduced threaded end 5 of the connecting rod E.

In the case of the high pressure piston, the sphere 3 is retained in position by means of an exteriorly threaded sleeve 6, the upper end of which has a spherical recess 7 adapted to engage the under side of the sphere, said sleeve being in screw-threaded engagement with the open end of the piston. In the case of the low pressure piston, a hollow bearing block 8 may be interposed between the sleeve 6 and the sphere 3. This latter construction is preferable and is possible in the case of the low pressure piston, due to the larger size of this piston, thereby affording space in which to introduce this bearing block. It is to be understood that the bearing block has its recess ground to conform to the configuration of the lower portion of the sphere.

The connecting rod E projects through the sleeve 6, the opening through this sleeve being in the form of the frustum of a cone, in order to permit the swinging of the connecting rod. Suitable packing 9 is carried by the compression end of the piston, preventing the leakage of the fluid about the piston.

From the construction illustrated it will appear that the compression ends of the cylinders B and C lie in substantially the same plane whereby communication from one to the other is most conveniently arranged, a fact in harmony also with the general compactness of the entire constuction. It will be noted also that notwithstanding the difference in throw of the cranks, the connecting rods E are or may be duplicates of each other, and hence interchangeable, an element of vast importance commercially. It follows, therefore, because of the foregoing facts, that the lengths of the pistons from their compression ends to the centers of the respective balls 3 are very different, the length of the high pressure piston being greater than the other. This provides ample space for the application of the packing 9 thereto without interference with the ball and socket construction. Since the strokes of the two pistons are different in extent, but being operated by the same crank shaft, the low pressure piston must operate at a considerably higher speed than that of the high pressure cylinder, and hence, while the low pressure piston is making its compression stroke there will be a continuous compression of the gas as it flows into the compression chamber of the high pressure cylinder, by reason of the fact that the high pressure piston is receding therefrom at a comparatively low rate of speed. The maximum pressure therefore is had at the moment the low pressure piston reaches its maximum compression stroke. In other words, at no time from the beginning of the compression stroke of the low pressure piston is there any possibility of expansion of the gas and a resulting loss of force thereof.

While the novel elements have been described with reference to a pump, it is, of course, to be understood that these new features may be utilized with obvious mechanical variations, to adapt the device to engines, meters, or, in fact, any place where a reciprocating member is driven from a crank shaft.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In a two-stage compression pump, the combination of a pair of cylinders having a valved communication from one to the other, pistons in the respective cylinders, a crank shaft, connecting rods connected to the pistons, and a pair of cranks of unequal lengths operatively connecting said connecting rods with the crank shaft whereby the pistons are driven at different rates of speed and given unequal strokes.

2. The herein described two-stage compression pump comprising a pair of cylinders extending at their compression ends to the same plane and of different diameters, pistons of different diameters fitted in said cylinders and adapted to reach said plane in their successive compression strokes, connecting rods for the pistons, the connecting rod for the larger piston being connected thereto adjacent the compression end of the piston, and the connecting rod for the other

piston being connected thereto at a point remote from the compression end, a crank shaft, and means connecting the connecting rods to the shaft whereby the pistons are operated simultaneously from said crank shaft in opposite directions at different rates of speed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GREGORY JOHN SPOHRER.

Witnesses:

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HOLLY E. HOOVER.