Oct. 7, 1930. R. W. CRANE 1,777,396

PISTON MOUNTING FOR INTERNAL COMBUSTION ENGINES AND THE LIKE

Filed Feb. 29, 1928

Fig. 1.

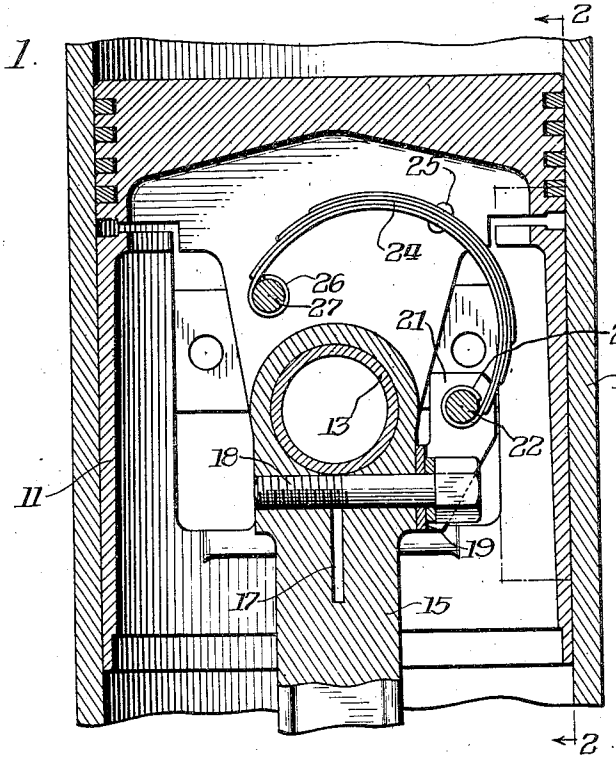


Fig. 3.

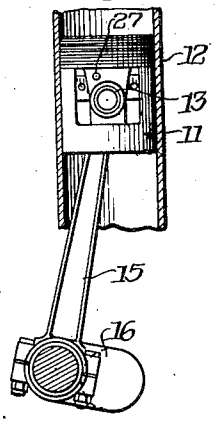
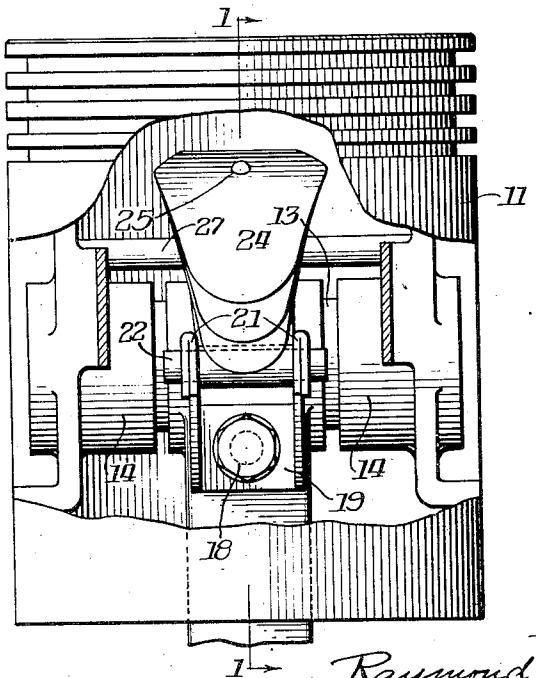


Fig. 2.



Inventor:
Raymond W. Crane
By Walter M. Fuller Atty

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UNITED STATES PATENT OFFICE

RAYMOND W. CRANE, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SKINNER AUTOMOTIVE DEVICE CO., INC., OF DETROIT, MICHIGAN, A CORPORATION OF CALIFORNIA

PISTON MOUNTING FOR INTERNAL-COMBUSTION ENGINES AND THE LIKE

Application filed February 29, 1928. Serial No. 257,964.

It has, heretofore, been proposed to prevent the sidewise slapping of pistons in the cylinders of internal-combustion engines by providing such pistons with springs of sufficient capacity and power to hold the pistons always firmly and rigidly in contact with one side only of their cylinders, thus precluding the rocking of the pistons on their piston-pins into contact with the opposite walls of the cylinders, the objectionable slapping noises being due to the pistons, oscillating on their pins between and into sudden striking contact with the opposite cylinder walls.

Such constructions are objectionable for the reasons that (*a*) unduly rapid wear on both cylinder and piston, or either alone, occurs on one side by reason of the greatly increased pressure between the cylinder and piston due to the action of the spring referred to, and (*b*) springs of adequate capacity to perform the specified function would add detrimental weight to the reciprocating parts and such springs would be so highly stressed in fibre as to result in probable physical failure when subjected to rapid frequency of vibration as required by engines having present-day speeds of operation.

One object of the present invention is to overcome the annoying and objectionable noisy piston slaps in an efficient manner without preventing the stated oscillations of the pistons on their pins and at the same time avoiding the troubles incident to the earlier structures specified above.

A further aim of the invention is to reduce piston-to-cylinder wall friction materially at the higher speeds of engine operation and preferably by the same means as is employed to cushion the oscillations of the pistons to eliminate the slapping noises.

An additional advantage accruing from the use of the new invention is the elimination or avoidance of piston-pin audible taps or noises by holding the piston-pin toward one side of its bearing with sufficient force to assure a practically uninterrupted sliding or rolling contact motion between these two elements, thus cushioning or softening any otherwise striking or hammering action between the pin and bearing, when looseness or freedom of action at this point exists, when the piston reverses its direction of sliding travel in the cylinder.

Also, in structures incorporating the present invention, the upper or piston ends of the connecting-rods are steadied and cushioned against their tendency to vibrate due to harmonics and strains in the crank-shaft and connecting-rods.

The foregoing advantages are secured, under the principles of this invention, by employing springs, or their equivalents, for the pistons of such capacity, shape, points of application, etc., as to allow the otherwise annoying rocking movements of the pistons to occur but so cushioned or restrained by the springs as to avoid or eliminate all objectionable slapping or tapping noises.

To enable those skilled in this art to have a full and complete understanding of the invention, both from structural and functional standpoints, in the accompanying drawing, forming a part of this specification, and to which reference should be had in connection with the following detailed description, a present preferred embodiment of the invention has been illustrated, like reference characters being employed to designate the same parts throughout the views.

In this drawing,—

Fig. 1 is a central longitudinal section through the improved piston and its associated cylinder on line 1—1 of Fig. 2;

Fig. 2 is a broken elevation of the piston as viewed from line 2—2 of Fig. 1; and

Fig. 3 shows on a small scale the new piston associated with the engine crank-shaft.

By reference to this drawing, it will be noted that the hollow piston 11, which may be of any ordinary or convenient form, reciprocates in the usual way in its engine cylinder 12, and has a hollow piston-pin or wrist-pin 13 oscillatory in bearings 14, 14 of the piston, the pin being located either at or to one side of the axis of the piston as may be preferred.

A connecting-rod 15, at its lower end, is rockingly mounted on the engine crank-shaft 16 in the customary manner, its upper

end being split at 17 and firmly clamped on the piston-pin by means of a cap-screw 18, which also holds in place a clip or bracket 19 having spaced, upstanding, end lugs or ears, 21, 21, in apertures of which a hinge-pin 22 is fixed, such pin being provided for reception in the end eye or loop 23 of a multiple, bowed leaf-spring 24, the leaves of which may, if desired, be wider at their middle portions than at their end sections, such overlying spring elements being secured together by a rivet 25.

It will be observed that the hinge-pin 22 is located directly opposite the axis of the piston-pin, when the connecting-rod is parallel to the axis of the piston, but, whereas this is a preferred arrangement, it is not absolutely essential.

The loop or eye 26 at the other end of the spring fits over a second hinge-pin 27 fixed in aligned holes in the side walls of the piston and on the side of the axis of the latter opposite that at which the other hinge-pin is located.

The two ends of the spring normally tend to approach one another on a substantially straight line, and, hence, the spring tends to rock the piston in a clockwise direction around the piston-pin owing to the location of the hinge-pin 27 above the axis of the piston-pin.

During the reciprocation of the piston and the revolution of the crank-shaft, the connecting-rod necessarily oscillates around the axis of the piston-pin causing a slight movement of that end of the spring attached or anchored to the connecting-rod.

Obviously, it is desirable to make the travel of such end of the spring as small as feasible to reduce the strains placed on, or the working range of, the spring.

Accordingly, such end of the spring is mounted on the connecting-rod as close to the axis of the piston-pin as is convenient, the construction shown being simple in structure and easily incorporated in a piston.

The location of the hinge-pin 27 is determined by several influencing factors, one of which is the particular type of piston employed, and the means which it affords for supporting the pin.

The spring normally swings the upper portion of the piston to the right against the corresponding cylinder wall, but when the operating conditions of the engine tend to rock the top portion of the piston to the left suddenly and to cause it to knock or hammer against the other side of the cylinder wall, such action is resisted, retarded and cushioned by the counteracting force or tendency of the associated spring.

As a result, the piston, instead of audibly slapping against the cylinder wall, upon the occurrence of the specified reversed thrust thereon, as when the gaseous mixture above it is exploded, is caused to rock over more slowing or in a restrained or cushioned manner, whereby the noise of contact, which would otherwise be objectionable, is wholly obviated.

The spring is so designed and arranged that it does not prevent the rocking or oscillatory movements of the piston between the opposite side walls of the cylinder, that is to say, it does not maintain the piston sufficiently rigidly with relation to its connecting-rod to hold the piston always in contact with one side only of the cylinder, but, on the contrary, as the forces acting on the piston tending to thrust it into slapping or hammering contact with either side of the cylinder occur, the spring will absorb or cushion such movements of the piston sufficiently to preclude the occurrence of annoying audible slaps, taps, or knocks.

This desirable result is probably due to the retardation of the speed with which the piston shifts its position when the spring is used in the relation shown and described.

Such avoidance of quick forceful transverse piston rocking movements in its cylinder, thus eliminating the slapping or hammering action referred to, results in reduced piston and cylinder wear.

The power or capacity of the spring used depends upon a number of conditions or factors among which may be mentioned:—(*a*) the gas pressures on the top of the piston, (*b*) the shape of the combustion-chamber of the cylinder, (*c*) the location of the spark-plug, (*d*) the diameter of the piston, (*e*) the weight of the reciprocating parts, (*f*) the location of the piston-pin in the piston, (*g*) the ignition timing, etc.

Such spring, to meet the conditions hereinabove detailed, is of only a small fraction of the strength of a spring which would be required to keep the piston always in contact with one side only of the cylinder, and, accordingly, sufficient space is available inside of the piston to accommodate a spring of the first type and performing its peculiar and limited functions to accomplish the results outlined in the manner stated.

The spring, in addition to eliminating or eradicating piston slaps perceptible by the ear, also prevents piston-pin knocks or noises due to the clearance, necessary or excessive, between the piston-pin and its bearing, whether such bearing is in the piston or in the connecting-rod, or in both. This highly desirable effect is produced because the end of the spring hinge-wise anchored to the connecting rod holds the pin and bearing in sidewise contact sufficiently to cause a sliding or rolling travel of the pin and bearing relative to one another in the curved path of one side of the bearing, hence removing substantial play of the pin and bearing lengthwise the

piston and thus avoiding the occurrence of such audible piston-pin noises.

Furthermore, in some cases, there is a tendency for the piston-pin to oscillate more or less sidewise relative to its bearing, at certain speeds or periods of the engine, due to whipping of the connecting-rod, or, in other instances, especially at high engine speeds, due to the centrifugal action of the reciprocating masses which are under the influences of associated revolving members, all of which actions may produce objectionable noises, either by the piston-pin or piston.

All of such distasteful or unpleasant noisy effects are adequately reduced by the employment of the spring, which under these circumstances either maintains the sidewise contact of the piston-pin and bearing or sufficiently cushions the movements of the piston and bearing relatively to one another, or cushions the motions of the piston in the cylinder.

Those skilled in this art will readily understand that this invention is not limited and restricted to the precise and exact details of structure illustrated and described and that more or less radical changes may be incorporated in the structure without departure from the heart and essence of the invention, as defined by the appended claims, and without the loss or sacrifice of any of its substantial or material benefits or advantages.

For example, although this application presents only one spring embodiment of the invention, it is to be understood that its equivalent in the form of hydraulic, pneumatic, frictional or mechanical means, other than springs, may be employed to afford the required resistance or cushioning force to effect the needed result.

I claim:

1. The combination of a cylinder, a piston having a piston-pin reciprocatory in said cylinder, a revoluble crank-shaft, a connecting-rod rockingly joined to said crank-shaft and rockingly joined to said piston through said piston-pin, and a leaf-spring anchored to said connecting-rod on a line substantially level with the axis of said piston-pin when the connecting-rod is parallel to the piston and associated with said piston at a point above said axis, to permit the transverse thrust movements of said piston in said cylinder and to cushion the same sufficiently to substantially prevent piston slaps audible to the unaided hearing of the average human being.

2. The combination of a cylinder, a piston having a piston-pin reciprocatory in said cylinder, a revoluble crank-shaft, a connecting-rod rockingly joined to said crank-shaft and having a split end accommodating said piston-pin, a screw clamping the split portion of said connecting-rod on said piston-pin, a leaf-spring anchored to said connecting-rod by said screw and secured to said piston at such a point and the spring being of such capacity as to permit the transverse thrust movements of the piston in the cylinder and to cushion the same sufficiently to substantially prevent piston slaps audible to the unaided hearing of the average human being.

3. The combination of a cylinder, a piston having a piston-pin reciprocatory in said cylinder, a revoluble crank-shaft, a connecting-rod operatively associated with said piston-pin and crank-shaft, a bearing in one of said members in which said piston-pin may turn, and spring means connected to said piston and to said connecting-rod at such points as to prevent noisy play between said piston-pin and its bearing audible to the unaided hearing of the average human being.

In witness whereof I have hereunto set my hand.

RAYMOND W. CRANE.