Aug. 14, 1962 F. SCHLEY 3,049,109

FREE PISTON ENGINES

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FIG. 1

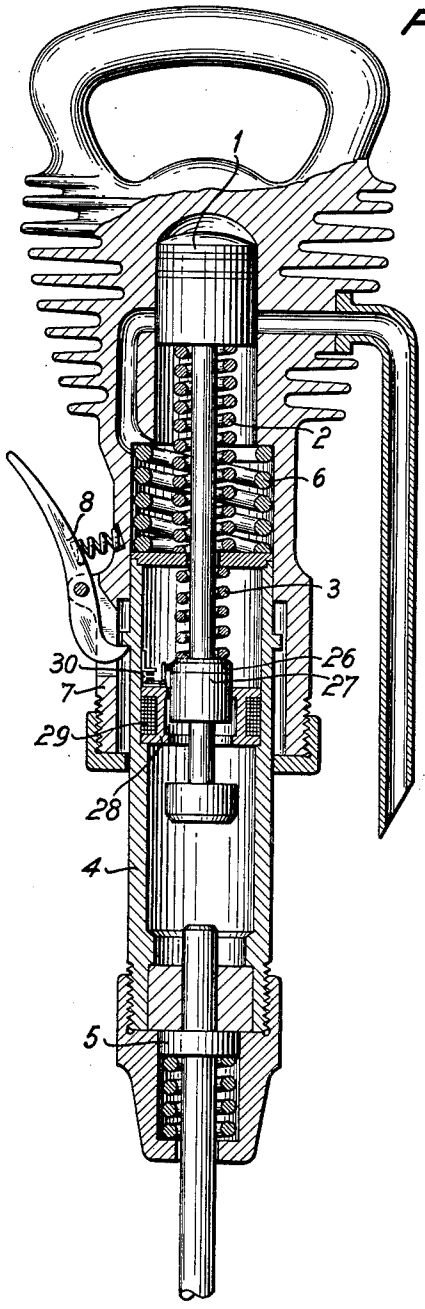

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FIG. 2

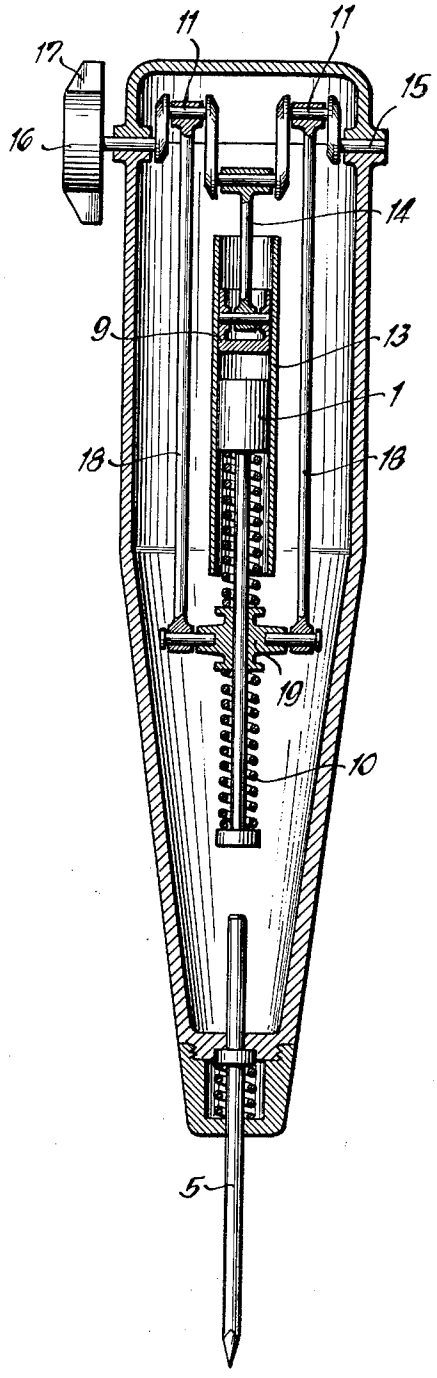

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FIG. 3

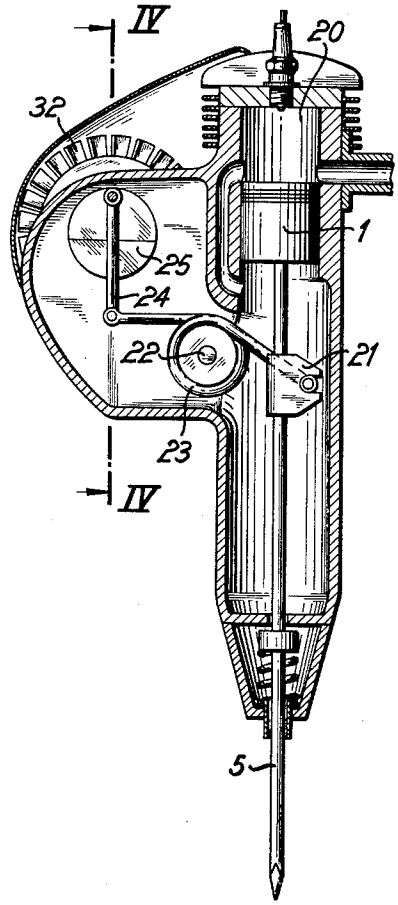
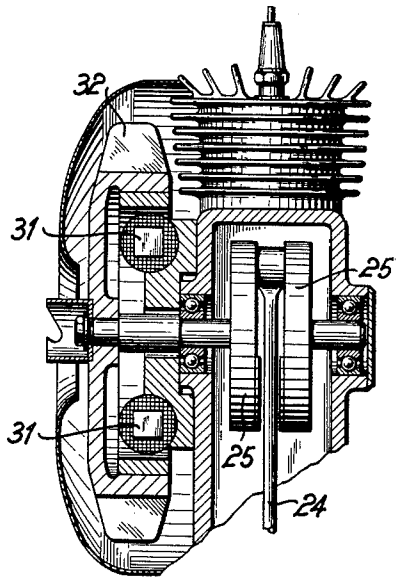


FIG. 4



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FREE PISTON ENGINES

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This invention relates to free piston engines.

According to the present invention there is provided a free piston engine comprising a piston arranged to be freely reciprocated against the action of spring means, the piston being acted on by said spring means in such a manner as to be urged away from both end positions of its working stroke and in such a manner as to be held, when inoperative, in a position in which it is between said end positions.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made to the accompanying drawings, in which:

FIGURE 1 is a longitudinal sectional view of an internal combustion hammer,

FIGURE 2 is a diagrammatic illustration of a further internal combustion hammer,

FIGURE 3 is a diagrammatic illustration of a third internal combustion hammer, and

FIG. 4 is a section along the line IV—IV of FIG. 3.

Referring now to FIGURE 1 a striker piston 1 driven by the ignition of combustion gas so cooperates with springs 2 and 3 as to carry out a forced damped oscillation about a centre position. This oscillation is determined by the setting of the two springs 2 and 3 and by the position of an adjusting abutment sleeve 4. The adjusting abutment sleeve 4 receives a push-in tool 5 at its lower end and is axially displaceable in a housing 7 against the force of a spring 6. A locking device 8 mounted on the housing 7 maintains the adjusting sleeve 4 in a position which permits idle running of the tool, that is to say, in a position in which the striker piston 1 does not exert any striking action on the tool 5. It is thus possible for the springs 3 and 6 to shorten the stroke of the striker piston 1 against the force of the spring 2. The spring 2 stores the no-load energy when the sleeve 4 is in this position.

For developing the full striking power, the tool 5 is pressed in known manner against the material to be worked. The adjusting sleeve 4 slides against the spring 6 in the housing 7 as far as an upper stop. The distance between the striker piston 1 and the push-in tool 5 is reduced and the degree of compression of the fresh gas mixture in the cylinder is thus also reduced, so that the full striking power is applied to the push-in tool 5 in the full-throttle position.

An advantageous feature resides in that the striking power is continuously variable. The striking power depends upon the adjustment of the carburetor supplying the gas mixture to the cylinder and upon the pressing force exerted on the tool by the operator, the spring 6 bringing the adjusting sleeve 4 into a particular position between the no-load position and the upper stop in the housing 7, depending upon the pressing force which is momentarily being applied. In the event of misfiring or other brief disturbances, the striker piston 1 carries out a few free, damped oscillations, so that the tool does not stop immediately.

For starting, the locking device 8 is released. The spring 6 then pushes the adjusting sleeve 4 against a lower stop in the housing 7, while the spring 3 pushes the striker piston 1 into its lower dead centre position. During this action, fresh gas is admitted and, when the striker piston strikes the push-in tool 5 the described actions are repeated in the opposite direction, the fresh gas being compressed in the cylinder and ignited. The ignition device is not shown. It may be formed in known manner of a battery-operated ignition system.

It is advantageous to secure a permanent magnet 27 to the striker piston 1 in addition to an interrupter cam 26, and to secure to the adjusting sleeve 4 pole pieces 28, a field winding 29 and also the interrupter 30 of a magneto formed therefrom. The ignition instant is thereby simultaneously shifted with the deflection of the adjusting sleeve.

In the hammer shown in FIGURE 2, the striker piston 1 moves together with a working piston 9 in a common cylinder 13 of a two-stroke internal combustion engine. During the expansion of the ignited combustion gases enclosed between the two pistons 1 and 9, the pistons move apart. Movement of the working piston 9 rotates by way of a connecting rod 14, a three-throw crank shaft 15, a magneto 16 and fan blades 17. Pivotally connected to cranks 11 of the crank shaft 15 are connecting rods 18. The cranks 11 are offset by 180° with respect to the crank to which the rod 14 is connected. The rods 18 act on the striker piston 1 by way of a sliding block 19 and a spring 10. The striker piston 1 is simultaneously driven in the same direction by the combustion gases. The spring 12 is so dimensioned and set in relation to the spring 10 and the mass of the striker piston 1 is such that, in operation of the tool at the natural frequency of the oscillation system, the work necessary for the compression is performed and, during no-load running, the striker piston 1 does not strike against the push-in tool 5.

According to FIGURE 3, the striker piston 1 which reciprocates in a cylinder 20 is provided with a piston rod to which is secured a forked member 21. The forked member 21 is pivotally connected to a torsion spring 23 rotatably mounted at 22. The torsion spring 23 establishes through a connecting rod 24 a resilient coupling between the striker piston 1 and a crank shaft 25. The crank shaft 25 with built-on magneto 31 and cooling blower 32 supplies the rotary movement necessary for the production of ignition current and cooling air and, together with the torsion spring 23, the work necessary for the compression of the fresh gas in the cylinder.

The transmission ratio between the crank shaft 25 and the striker piston 1, as also the spring characteristic of the torsion spring 23 are made such that no striking work can be performed during no-load running. In the resonance range of the oscillation system formed of the mass of the striker piston 1, the torsion spring 23 and the moment of inertia of the crank shaft 25, the full striking power is transmitted from the striker piston 1 to the push-in tool 5 at full throttle.

It is to be understood that the invention is applicable to free piston engines operated by compressed air or other medium.

I claim:

1. A free piston expansible chamber motor having a piston, first and second spring means, said piston being reciprocable freely in one direction against the action of said first spring means and in the opposite direction against the action of said second spring means, characterized in that said first and second spring means act in the to-and-fro directions respectively to limit the upper and lower movements of the piston, and to vibrate the piston in inoperative position between its upper and lower positions upon lack of the expanding medium.

2. A free piston engine comprising a housing, a cylinder in the housing, an axially displaceable sleeve co-axial with the cylinder and mounted in the housing, a transverse base to said sleeve, stops limiting axial displacement of the sleeve, a first spring controlling axial displacement of the sleeve, a piston in said cylinder, a piston rod con-

nected to said piston and passed through said base, an enlarged head on the end of the rod remote from the piston, a second spring one end of which bears on the piston and the other end of which bears on said base, and a third spring one end of which bears on said base and the other end of which bears on said head.

3. An engine as claimed in claim 2 and further comprising locking means for holding the sleeve in a position in which the engine runs under no-load.

4. An engine as claimed in claim 2, and further comprising a tool carried by said sleeve and positioned to be struck by said head when the engine is working under load.

5. A free piston engine comprising a housing, a cylinder in the housing, first and second pistons in said cylinder, a crank shaft mounted in the housing adjacent one end of the cylinder and having first, second and third cranks, a first connecting rod connecting the first piston to the first crank, a piston rod passed through the other end of the cylinder and having one end connected to the second piston, a head on the other end of the piston rod, a block slidably mounted on the piston rod, a first spring one end of which bears on the piston and the other end of which bears on the block, a second spring one end of which bears on the head and the other end of which bears on the block and second and third connecting rods connecting the block to the second and third cranks.

6. In a free piston engine, a cylinder means, spring mechanism, a free piston disposed in said cylinder means to reciprocate to-and-fro in opposite directions against the action of said spring mechanism, abutment means within the engine, said free piston having its inoperative position intermediate its dead center positions, said spring mechanism including first and second tension and compression spring means on opposite sides of said abutment means respectively coacting with said free piston and said abutment means to limit both upper and lower movements of the piston.

7. A free piston engine comprising a cylinder, a free piston in said cylinder and reciprocable between end positions at opposite ends of its working stroke, abutment means within the engine, first spring means effective above said abutment means urging the piston away from one of its end positions, and second spring means effective below said abutment means urging the piston away from the other of its end positions, said first and second spring means cooperating with said abutment means and with one another to maintain the piston between said end positions when the engine is in its inoperative position.

8. A free piston engine comprising a housing having a cylinder therein, at least one piston working in the cylinder between end positions at opposite ends of its working stroke, abutment means within the engine, first spring means effective above said abutment means urging the piston away from one of its end positions, and second spring means effective below said abutment means urging the piston away from the other of its end positions, said first and second spring means cooperating with said abutment means and with one another to maintain the piston between said end positions when the engine is in its inoperative position.

9. A free piston engine as claimed in claim 8 wherein a second piston works in said cylinder, a crank shaft is mounted in said housing adjacent one end of the cylinder and having first, second and third cranks, a first connecting rod connects the first piston to the first crank, a piston rod passes through the other end of the cylinder and has one end connected to the second piston, a head is on the other end of the piston rod, a block is slidably mounted on the piston rod, said first spring means comprises a spring one end of which bears on the piston and the other end of which bears on the block, said second spring means comprises a spring one end of which bears on the head and the other end of which bears on the block, and second and third connecting rods connect the block to the second and third cranks.

References Cited in the file of this patent

UNITED STATES PATENTS

1,740,818	Killingsworth	Dec. 24, 1929
1,755,361	Pfluger et al.	Apr. 22, 1930
2,734,488	Wampach	Feb. 14, 1956
2,838,032	Schulin et al.	June 10, 1958

FOREIGN PATENTS

764,976	Great Britain	June 2, 1957