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L. M. WOOLSON

INTERNAL COMBUSTION ENGINE

Filed May 25, 1923

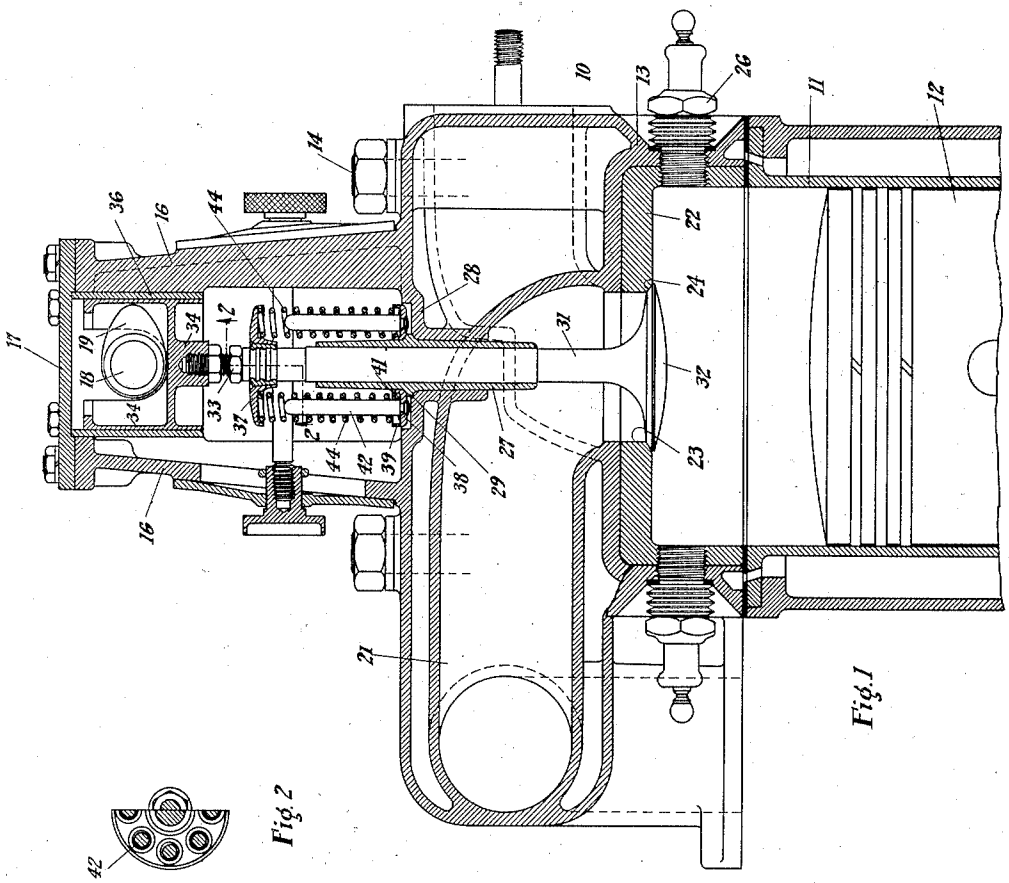


Fig. 1

Fig. 2

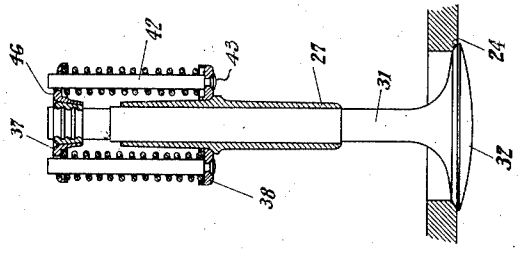


Fig. 4

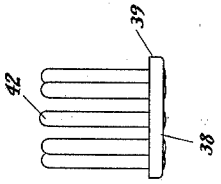


Fig. 3

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

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This invention relates to a valve mechanism for internal combustion engines, and more particularly to the spring mechanism whereby the puppet or mushroom valves of such engines are seated and against the action of which they are opened by the valve operating mechanism.

It has for an object to provide a mechanism of the character designated in which the natural period of vibration in the valve springs shall be materially increased, and the unit stress therein lowered. Another object is to provide a valve spring mechanism in which the total load is applied more evenly to the valve stem, and in which binding or "cocking" of the valve is minimized.

Another object is to provide a spring mechanism in which the factor of safety against spring breakage is greatly increased.

Other objects and structural details will be apparent from the subjoined description, in connection with the accompanying drawing in which:

Fig. 1 is a vertical section thru a portion of an internal combustion engine constructed in accordance with the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is an elevation of the guide pin assembly, and;

Fig. 4 is a vertical section thru a valve assembly showing a modification of the invention.

It has been discovered that valve spring failure under the high speeds used in modern practice is almost invariably caused by the synchronizing of the natural frequency of the valve springs with the fundamental period of the engine. To avoid this difficulty, this invention provides a means whereby the natural frequency of the springs is raised beyond the engine period at any possible speed. The periodicity of any given spring is a fixed characteristic of that spring, and changes in the number of coils, or in the size of wire forming the coils has but little effect thereon. Of the factors determining this characteristic, the radius of curvature of the spring coils is controlling. In the present invention these objects are accomplished by using a considerable number of relatively small springs, so located as to dispose their combined load about the valve stem. The total spring strength is thus divided between a number of springs, and the stress in each spring is correspondingly lowered, so that simple, untreated spring wire may be used instead of the heat treated alloy steel now required.

In this manner the liability to failure thru faulty workmanship is diminished. At the same time, as the load is divided among a plurality of springs, a number of these may break without affecting the operation of the engine.

Referring to the drawing, 10 represents an internal combustion engine having a cylinder 11 in which a piston 12 is adapted to operate, and a head portion 13 secured to the upper end of the cylinder in any appropriate way as by the bolts 14. The upper portion of the head 13 is provided with a pair of integrally formed walls 16, adapted to be closed by a detachable cover plate 17, providing a housing for the valve operating mechanism of the engine.

Suitably journaled in the housing is a camshaft 18, adapted to be driven from the engine crankshaft in timed relation thereto, in the well known manner, and provided with suitable cams 19 to actuate the engine valves. The head portion is also provided with suitable passages, such as 21, for the fuel mixture and for the exhaust. The head portion 13 supports a combustion head 22 above the cylinder 11, provided in its central portion with a port 23, the inner edge of which is chamfered to provide a valve seat 24, and which communicates with the passage 21. The combustion head 22 is also provided with suitable tapped openings for the reception of spark plugs 26.

Located above and in line with the port 23, is a valve guide 27, preferably mounted in the head 13 by pressing into a web 28 formed therein, and provided intermediate its ends with an internal shoulder 29. The valve guide 27 is adapted to receive and support the vertically disposed stem 31 of a puppet or mushroom valve 32, which cooperates with the valve seat 24 to control the port 23 in the usual manner. The upper end of the valve stem 31 is adapted for cooperation with an adjustable tappet member 33, secured to a crosshead 34, which reciprocates in guides 36 in the head portion 13.

Removably secured to the valve stem near its upper end is an annular collar 37, which provides an abutment for the valve springs. The cross head 34 is actuated by the cam 19 to depress the valve 32 against spring pressure and open the port 23, in a manner well understood in the art to which this invention relates.

Adapted to surround the valve guide 27 and resting against the shoulder 29, is an annular member 38, having upwardly directed circumferential flanges 39 and 41. Secured to the member 38 and preferably evenly spaced about the axis thereof are a number of upwardly disposed guide pins 42, arranged parallel to the valve stem 31. The guide pins 42 are preferably formed with necks at their lower ends, which project thru holes in the member 38, and are riveted over as indicated at 43, so that the member 38 and the pins 42 form a unit assembly, as clearly shown in Fig. 3.

The member 38 provides a fixed spring abutment between which and the annular collar 37 are disposed a plurality of coil springs 44, of relatively small radius; one of the springs 44 being placed around each of the guide pins 42. The combined pressure of the springs 44 acts upon the stem 31, thru the collar 37, to urge the valve 32 to its seat as will be readily understood. The pins 42 support the springs 44 and prevent lateral bending thereof, but terminate short of the lowermost position of the collar 37 when the valve 32 is wide open.

The operation of the invention is apparent. On the rotation of the camshaft 18, the cam 19, acting thru the crosshead 34 and the tappet member 33, depresses the valve stem 31 against the collective action of the springs 44, each of which is compressed and slides upon its guide pins 42. On continued rotation of the camshaft 18, the pressure of the cam 19 on the crosshead 34 is released, when the springs 44 return the valve 32 to its seat.

In Fig. 4 is shown a modification of the invention in which the guide pins 42 are of greater length to extend thru appropriate holes 46 in the collar 37. In this manner complete support to prevent lateral flexure of the springs 44 is provided, the collar 37 being also guided by the pins 42. In this case, however, the valve will not be freely rotatable on its own axis while it reciprocates in the valve guide 37.

It will be apparent that this invention provides a valve spring mechanism in which the total spring load is divided between a number of small springs, the radius of curvature of each of which is relatively small. The unit stress in each spring is therefore relatively low, permitting the use of less expensive and more uniform material for the springs. At the same time, because of the smaller radius of curvature, the natural period of each of the springs is greatly increased, thus preventing the possibility of synchronized vibration with the engine period. By properly spacing the axes of the guide pins 42 the total spring pressure is evenly disposed about the valve axis, while the engine will continue to operate even upon the breaking of several springs.

It will be understood that various forms of the invention other than those described above may be used without departing from the spirit or scope of the invention.

What is claimed is:

1. In an internal combustion engine, the combination of a valve, means for positively opening the valve, and means for yieldingly closing the valve comprising a considerable number of relatively small springs arranged about the valve stem.

2. In combination with an internal combustion engine, a valve having a single integral stem, and a plurality of compression springs disposed in spaced relation about the stem.

3. In combination with an internal combustion engine, a valve having a single integral stem, and a plurality of compression springs of relatively small radius disposed about the stem.

4. In combination with an internal combustion engine, a valve having a stem mounted in a fixed guide, an annular abutment secured to the guide, an annular abutment secured to the stem, and a plurality of springs disposed in spaced relation between the said abutments.

5. In combination with an internal combustion engine, a valve, an abutment secured thereto, a plurality of guide pins disposed about the valve axis and parallel thereto, a coil spring surrounding each of said pins and engaging the abutment, and a second abutment for said springs.

6. A puppet valve for internal combustion engines having a stem mounted in a fixed guide, a shoulder mounted on the guide, an annular abutment surroundig the guide and resting on the shoulder, a plurality of guide pins secured to the abutment in spaced relation, an abutment secured to the valve stem, and a coil spring surrounding each pin between said abutments.

7. In combination with a puppet valve for internal combustion engines, an apertured annular abutment secured to the stem thereof, a plurality of guide pins mounted to project thru the aperture in the abutment, a coil spring surrounding each pin and disposed to exert pressure on the abutment, and a second abutment for said springs.

8. In combination with an internal combustion engine, a valve mounted in a guide and a spring abutment removably secured to said guide, said spring abutment having a plurality of guide pins, a coil spring sur-

rounding each said guide pin, and a second abutment for the springs.

9. In an engine, in combination, valve guiding means, a puppet valve having a stem in said guiding means, an abutment on the valve stem, a stationary abutment, and a plurality of valve springs spaced around the valve stem between said abutments.

10. In an engine, in combination, a valve guide having a shoulder, an annular abutment surrounding the guide and resting on the shoulder, a valve having a stem extending through said guide, an annular abutment mounted on the valve stem in opposition to the first said abutment, and a plurality of coil springs arranged between said abutments and disposed in spaced relation about said valve stem.

11. The method of constructing the spring structure of the mushroom valve of an internal combustion engine, characterized by forming the springs so that the natural frequency of said springs is considerably in excess of the frequency of any vibration likely to be set up in the engine to which said valve is fitted.

12. The method as claimed in claim 11 in which the desired high frequency of vibration of the springs is obtained by forming said springs of relatively small diameter.

13. The method as claimed in claim 11 comprising the provision of a relatively large number of springs of small diameter arranged circumferentially about the valve stem.

14. A valve structure comprising a mushroom valve and a plurality of springs each having a period of vibration considerably higher than that of the engine in which it is incorporated, said springs being disposed symmetrically around the stem of said valve and acting against a common abutment on the valve stem.

15. In an internal combustion engine, the combination of valves, positive means for opening said valves, and spring means having a natural frequency of vibration higher than the frequency of vibration of the engine for closing said valves.

16. A valve structure comprising a mushroom valve and a plurality of springs each having a period of vibration considerably higher than that of the engine in which it is incorporated, a shoulder mounted on the valve guide, an annular abutment surrounding said guide and resting on the shoulder, a series of guide pins secured to the abutment in spaced relation, an abutment secured to the valve stem, and a coil spring surrounding each pin between said abutments.

17. A valve structure comprising a mushroom valve and a plurality of springs each having a period of vibration considerably higher than that of the engine in which it is incorporated, an apertured annular abutment secured to the valve stem, a plurality of guide pins mounted to project through the apertures in the abutment, and a coil spring surrounding each pin and disposed to exert pressure on the abutment.

18. A valve structure comprising a mushroom valve and a plurality of springs each having a period of vibration considerably higher than that of the engine in which it is incorporated, a shoulder mounted on the valve guide, an annular abutment surrounding and removably attached to said guide and resting on the shoulder, a series of guide pins secured to the abutment in spaced relation, an abutment secured to the valve stem, and a coil spring surrounding each pin between said abutments.

19. As an article of manufacture a valve spring device comprising upper and lower substantially ring-shaped members having alining apertures therethrough adapted to receive a valve stem, and a plurality of compression springs between the upper and lower members in spaced axial relation with respect to each other outwardly of the lining apertures of said members.

20. In a valve spring construction for engines a substantially ring-shaped member adapted for abutment against a stationary part of an engine and having a central opening therethrough, a plurality of rods carried by the member extending in spaced parallel relation transversely of the plane of the ring-shaped member and laterally of the opening through said member, a second ring-shaped member having a central screw threaded opening therethrough and laterally of said central opening having a plurality of other transverse openings adapted to slidably receive therethrough the free ends of said rods which are carried by the first mentioned member, and individual spiral compression springs on each of said rods under compression between said two ring-shaped members, and in abutment at their ends therewith.

21. In a valve spring construction for engines the combination with an engine including an engine casing, a valve including a reciprocable stem having a screw threaded portion thereon, and means to reciprocate said valve, a substantially ring-shaped member having a central opening therein slidably receiving the valve stem therethrough, a second member having an opening therein slidably receiving the valve therethrough, nut means on the screw threaded portion of the valve stem for adjusting the last mentioned member longitudinally of the valve stem, a plurality of spaced rods supported by the first mentioned member in right angled parallel relation entirely laterally of the opening of said member, the second mentioned member having a plurality of spaced open-

ings thereabout laterally of the opening in which the valve stem is slidably mounted, for slidably receiving the free ends of said rods, and relatively small diametered spiral compression springs engaging at similar ends the first mentioned member and at the opposite similar ends the second mentioned member whereby to force the first mentioned member against the engine casing to a stationary position, and to force the valve stem into a valve seating relation.

In testimony whereof I affix my signature.

LIONEL M. WOOLSON.