

A GUIDE PLATE FOR A POPPET VALVE

The present invention relates to a guide plate for actuating a poppet valve.

5 Guide plates can be used to vary the motion characteristics of poppet valves that are used in internal combustion engines or pumps. The guide plate, which typically incorporates a guide path, can be moved such that a valve actuating means achieves different motion characteristics depending on the position of the guide plate. This is useful, as the valve actuation means then
10 opens and closes the valve with different valve timing depending on variables such as the speed of the piston.

It is a requirement of spark ignition engines to be throttled by controlled restriction of the air flow to the cylinders. In a predominance of engines a single butterfly valve, located at a distance from the inlet valves, is employed
15 to reduce air flow by restricting air flow along the inlet tract, thus the lowering of the inlet tract pressure.

It is generally accepted that superior engine efficiency at part loads would result when full inlet tract pressure is maintained at all times. This situation is possible and optimal when throttling is achieved by a controlled
20 variation of inlet valve opening.

It has also been demonstrated that in the case of multi cylinder engines, the necessity for part load operation of individual cylinders can be minimised by the shutting down of a selected number of cylinders.

The present invention seeks to solve the problems associated with the
25 prior art by providing a guide plate having a guide path for a valve actuation means, wherein part of the guide path is adapted to restrict the valve actuation means from moving the valve from an open position to a closed position, or from a closed position to an open position.

This provides the advantage that the mechanism for varying the valve
30 timing and/or valve movement can also cause the valves to be held in a substantially open position, or a substantially shut position, for a full cycle of the piston. This allows the cylinder to be kept open or shut, thus preventing

the cylinder from working and can also be used to regulate the speed of the engine.

In one embodiment, the present invention includes a guide plate having a guide path such that when the valve actuation means moves along a first
5 portion of the guide path, the valve actuation means does not move the valve from an open position to a closed position, or from a closed position to an open position, and when valve actuation means moves long a second portion of the guide path, the valve actuation means moves the valve from an open position to a closed position, or from a closed position to an open position.

10 In another form the present invention relates to a guide plate having a guide path including a valve actuating portion and a non-valve actuating portion, a valve actuating member which moves along the guide path, wherein the valve actuating member may move solely along the non-valve actuating portion such that the valve is not actuated.

15 In a preferred embodiment, the guide plate is moved to change the portion of the guide path along which the valve actuation means travels. In this way, the valve actuation means can reciprocate in a constant manner with respect to the cylinder position, but the valve lift can be varied by the movement of the guide plate. The guide plate can be moved to such a
20 position that there is either no valve lift during a full cycle of movement of the piston within the cylinder, or to such a position that the valve lift is never zero, i.e. the valve does not close for a whole cycle of the piston movement within the cylinder.

The present invention also relates to a method of selectively activating
25 or deactivating a valve for a mechanism having a guide plate with a guide path, and a valve actuation member moving along the guide path, including the steps of:

having a guide plate with a non-valve actuating portion and a valve actuating portion;

30 selectively positioning the guide plate in a position such that the valve actuation member moves along the guide path only along the non-valve actuation portion of the guide path so that the valve is not activated; and

positioning the guide plate such that the valve actuation means moves along at least a portion of the valve actuating portion to activate the valve.

One or more of the preferred embodiments will now be described with reference to the accompanying drawings, wherein:

5 Figure 1 shows a schematic representation of a guide plate of the present invention in a first position showing a first range of movement of a valve actuation means;

 Figure 2 shows the schematic representation of the guide plate of figure 1 in a second position showing a second range of movement of the valve
10 actuation means as it follows the guide path;

 Figure 3 shows a schematic representation of a second embodiment of the guide plate and guide path;

 Figure 4 shows a schematic representation of a third embodiment of the guide plate and guide path.

15 Figure 5 shows a representation of a fourth embodiment of the guide plate of the present invention;

 Figure 6 shows the fourth embodiment with the valve actuation means relocated to achieve a maximum lift state of the valve;

 Figure 7 shows the fourth embodiment with a first upper guide plate in a
20 second position and with the valve actuation means located to achieve a dwell state of the valve;

 Figure 8 shows the fourth embodiment with the valve actuation means relocated but retaining the dwell state of the valve.

 In Figure 1 there is shown a guide plate 10 having a guide path 12, and
25 a valve actuation means 14 travelling within. Typically, the valve actuation means is a pin that moves in a reciprocating motion along the guide path of the guide plate. More detail of the valve actuation means and other guide path embodiments is provided in International Patent application PCT/AU98/00090, the contents of which are hereby incorporated by
30 reference. When the guide path is moved from a first position, as shown in Figure 1, to a second position as shown in Figure 2, the path taken by the valve actuation means varies. When the guide path is in the first position, the

valve actuation means travels along the non-valve actuation portion 15, being in this case, the straight portion of the guide path, as shown by the positions 14a and 14b, which represent typical end positions of the movement of the valve actuation means during a cycle of reciprocal movement. This results in the valve actuation member not actuating the valve (not shown), but leaving the valve closed.

As the guide path is moved from the first position to the second position, the valve actuation means travels further along the valve actuation portion 17 of the guide path, and thus the valve actuation means causes valve lift to increase. The duration of valve opening is also increased.

As can be seen from Figure 2, the guide path has moved so that the valve actuation means now has some of its travel occurring along the valve actuating portion 17 of the guide path. The extent of the movement of the valve is shown by positions 14c and 14d and also in the relative positions of guide pins 50 and 51 relative to the guide plate 10. This allows the valves to be opened and closed.

By having the valve closed, it is possible to prevent the cylinder from filling with or emptying the working fluid, and thus in a multi-cylinder pump or engine, more load will be placed on the other cylinders that are working. This provides the advantage that the other cylinders are kept working at a capacity that is closer to optimal.

It is also possible to keep the valves open during a whole cycle of the pump or engine, by positioning the guide plate in a third position, such that the valve actuation means moves along a portion of the guide path that causes the valve to be lifted off the seat. This is shown in the embodiment shown in figure 4 where it can be seen that there is a guide plate 28 having a second straight portion 32 of the guide path 30. This second straight portion allows the valves to be held open for a full cycle of valve actuation means movement, the extent of which is shown typically as being between positions 36a and 36b. This causes the valves to be held open, which may be of benefit in certain applications. Thus, by moving the guide plate 28 it is possible to vary the valve movement via the valve actuation means from keeping the valve

fully closed, opening and closing, and fully open, during the cycle of the engine, pump or compressor.

As can be seen from the figures, the guide path has an extended end region that allows the valve actuation means to always be in a position such that the valves are kept open. This allows a free flow of air in and out of the cylinder, which may be desired in certain circumstances.

In Figure 3, a schematic of a pivotally mounted guide plate 20 is shown. Position 20 a shows a position of the guide plate when rotated to vary the motion characteristics of the valve. When it is desired to keep the valve closed during an engine cycle, the guide plate 20 is in a position as shown in solid outline wherein the valve actuating means has its entire travel range within the non valve actuating portion 26a of the guide path 26. The valve actuating portion of the guide path 26b is curved, and by rotating the guide plate to the position shown by 20a, the valve actuating mechanism will travel at least partially into valve actuating portion 26b, thus actuating the valve.

In Figures 5, 6, 7 and 8 a pivotally mounted guide plate 20 is shown. As this embodiment is similar to the embodiment shown in Figure 3, like reference numerals have been employed. The guide plate 20 is mounted on a pivot point 22, thus allowing the guide plate 20 to alter its position so that the valve actuating means 24 can travel either on the non-valve actuating portion 26a of the guide path 26 when it is desired to keep the valve 40 shut for example between the end positions 24a and 24b, or along the valve actuating portion 26b of the guide path, when it is desired to keep the valve 40 open. In between these extremes, the movement of the guide plate causes the valve actuation means to vary its trajectory, thus changing the motion characteristics of the valve.

As shown in figures 5 to 8, the valve actuation means is driven by valve crankshaft 60. Valve crankshaft 60 preferably rotates at a fixed proportion of engine crankshaft speed. The range of motion of the valve actuation means is determined by the stroke of the crankshaft. In the present invention, it has been discovered that the non-valve actuating portion of the guide path should be at least as long as the stroke of the crankshaft, in order to ensure that the

travel of the valve actuation means will be able to be wholly contained within the non-valve actuation portion of the guide path for at least one position of the guide plate.

5 It can be seen that the guide plate 20 in Figures 5 and 6 has rotated to be in position 20a in Figures 7 and 8. The guide plate, when in a position as shown in Figures 5 and 6, causes the valve actuation mechanism to move both the valve actuating portion 26b and the non-valve actuating portion 26a. Thus when the guide path is in the position shown in Figures 5 and 6, the
10 valve can be opened and closed in accordance with desired timing relating to piston position. In Figures 7 and 8, however, the guide plate 20 has moved into a position such that the valve actuating mechanism only moves along non-valve actuating portion 26a, and therefore the valve is not actuated during an engine cycle (being a rotation of the engine crankshaft). The guide plate
15 can move to be in a position anywhere between the two positions shown in Figures 5 and 6, and 7 and 8.

 It should also be noted that an additional advantage of the present invention is that the guide plate having a guide path to vary valve motion characteristics, can act as a throttle mechanism. By varying the position of the
20 guide path, the valve lift can be varied, resulting in less working fluid entering the system. As the valves control the flow of air, there is no requirement for a separate or second throttling mechanism. The present invention may also be used in conjunction with a means for reducing or stopping the flow of fuel into individual cylinders. An example of such an arrangement in an internal
25 combustion engine is where the engine management system cuts off the supply of fuel to certain cylinders, as well as closing off or keeping open the valves. This system may be of particular use with direct fuel injection, as the flow of fuel and air could then be controlled without the need for a separate throttling mechanism in the inlet manifold.

30 The present invention may be particularly useful when used with engines, pumps and compressors that need to be throttled or operated at part

load, however many applications where poppet valves are used are envisaged.

The guide plate having a guide path can be moved by any known method, and may be moved either in a linear direction, for example in slots, or
5 rotatably around a fixed point.

It should be noted that the present invention could include a wide variety of guide path shapes and arrangements, for example, including but not limited to the guide plates and guide paths shown in PCT/AU98/00090.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Guide plate having a guide path including a valve actuating portion and a non-valve actuating portion, a valve actuating member which moves along the guide path, wherein the valve actuating member may move solely along the non-valve actuating portion such that the valve is not actuated.
2. The valve actuating portion of claim 1 wherein the non-valve actuating portion is of sufficient length such that movement of the valve actuating member may occur solely along the non valve actuating portion of the guide path.
3. The valve actuating portion of claim 1 or 2 wherein the valve actuating member may move selectively along the valve actuating portion and the non-valve actuating portion.
4. The valve actuating portion of claim 1 or 2 wherein the valve actuating member moves cyclically along a portion of the guide path, and the guide plate moves with respect to the guide actuating member to adjust the portion that the valve actuation member moves along the valve-actuating portions and non-valve actuating portions.
5. A method of selectively activating or deactivating a valve for a mechanism having a guide plate with a guide path, and a valve actuation member moving along the guide path, including the steps of:
 - having a guide plate with a non-valve actuating portion and a valve actuating portion;
 - selectively positioning the guide plate in a position such that the valve actuation member moves along the guide path only along the non-valve actuation portion of the guide path so that the valve is not activated; and
 - positioning the guide plate such that the valve actuation means moves along at least a portion of the valve actuating portion to activate the valve.

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AMENDED CLAIMS

[received by the International Bureau on 5 February 2001(05.02.01):
original claims 1-5 replaced by new claims 1-10 (2 pages)]

**THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:**

1. Guide plate having a guide path including a valve actuating portion and a non-valve actuating portion, a valve actuating member which moves along the guide path, wherein the valve actuating member may selectively move solely along the non-valve actuating portion such that the valve is not actuated.
2. The valve actuating portion of claim 1 wherein the non-valve actuating portion is of sufficient length such that movement of the valve actuating member over an entire cycle of the engine may occur solely along the non valve actuating portion of the guide path.
3. The valve actuating portion of claim 1 or 2 wherein the valve actuating member may move selectively only along the non-valve actuating portion, or also along part of the valve actuating portion.
4. The valve actuating portion of claim 1 or 2 wherein the valve actuating member moves cyclically along a portion of the guide path, and the guide plate moves with respect to the guide actuating member to adjust the portion that the valve actuation member moves along the valve actuating portions and non-valve actuating portions.
5. A method of selectively activating or deactivating a valve for a mechanism having a guide plate with a guide path, and a valve actuation member moving along the guide path, including the steps of:
 - having a guide plate with a non-valve actuating portion and a valve actuating portion;
 - selectively positioning the guide plate in a position such that the valve actuation member moves along the guide path only along the non-valve actuation portion of the guide path so that the valve is not activated; and

AMENDED SHEET (ARTICLE 19)**This Sheet Has Been Replaced**

positioning the guide plate such that the valve actuation means moves along at least a portion of the valve actuating portion to activate the valve.

6. A variable valve timing mechanism wherein the variable means is in a position such that the valve actuating mechanism only moves along non-valve actuating portion of a guide path, such that the valve is not actuated during an engine cycle.

7. The mechanism of claim 6 wherein the valve is either held in an open or closed position.

8. The mechanism of claim 6 or 7 wherein the non-valve actuating portion of the guide path is of sufficient length that such movement of the valve actuating member over an engine cycle may occur solely along the non-valve actuating portion of the guide path.

9. The mechanism of any one of claims 6 to 8 wherein the variable means moves to adjust the amount of movement of the guide actuating member along the valve actuating path.

10. A means for controlling the speed of an internal combustion engine having a combustion chamber and at least one valve, by controlling the motion characteristics of at least one valve.



AMENDED SHEET (ARTICLE 19)

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