United States Patent

Steele

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[54] **ENGINE DECOMPRESSION DEVICE**

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[52] **U.S. Cl.** **123/182**

[51] **Int. Cl.** **F01l 13/08,** F02n 17/08

[58] **Field of Search** 123/182

[56] **References Cited**

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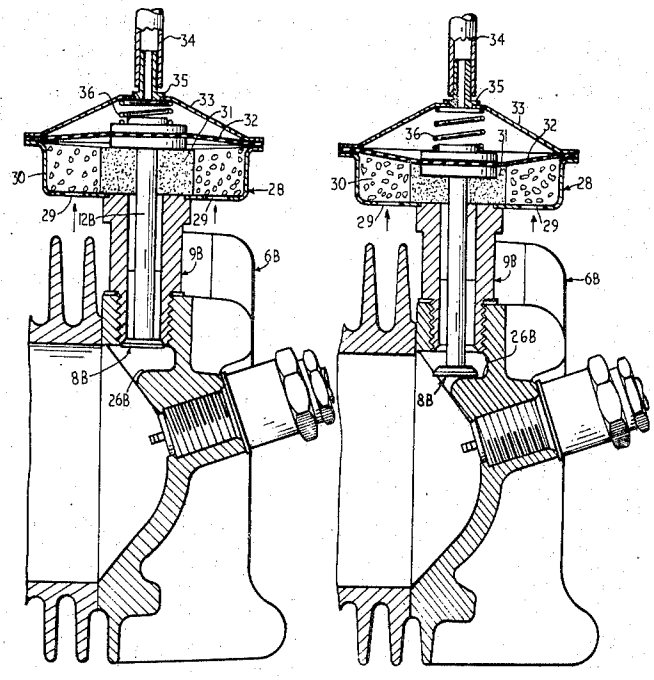
Primary Examiner—Al Lawrence Smith

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[57] **ABSTRACT**

A decompressing device for the firing chamber of an internal combustion engine during only low cranking speed, comprising a venting valve for the chamber, a housing therefor screwed to a port in the chamber, a valve element exposed to compressed gases in the chamber and forced temporarily thereby to a closed condition, and means for damping return opening action of the valve element whereby at and above a predetermined speed of the engine the valve element remains continuously closed.

8 Claims, 5 Drawing Figures



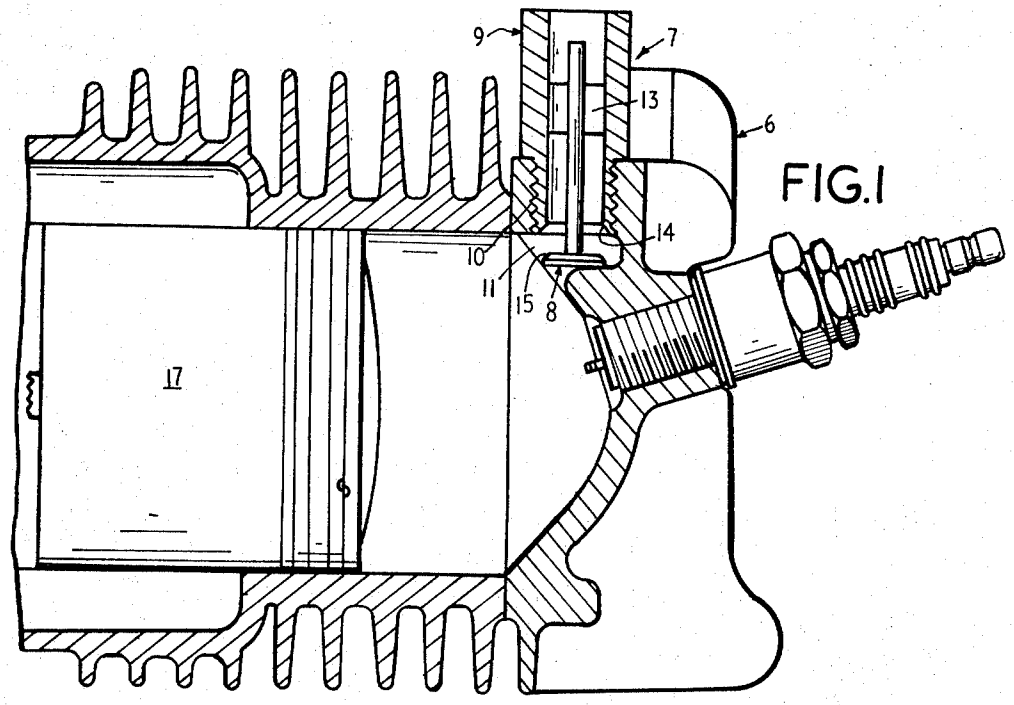

9
7
13
6
14
10
11
15
8
17

FIG.1

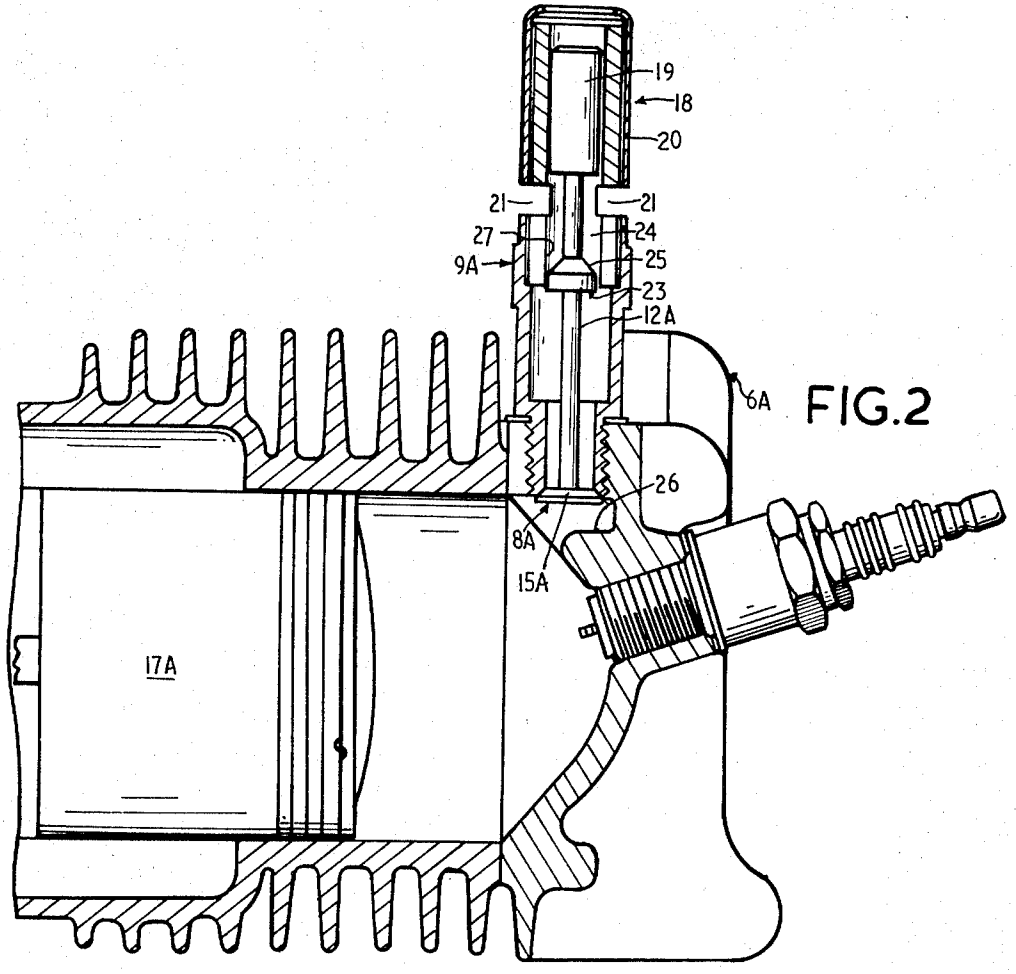

19
18
20
21
21
27
24
9A
25
23
12A
6A
26
8A
15A
17A

FIG.2

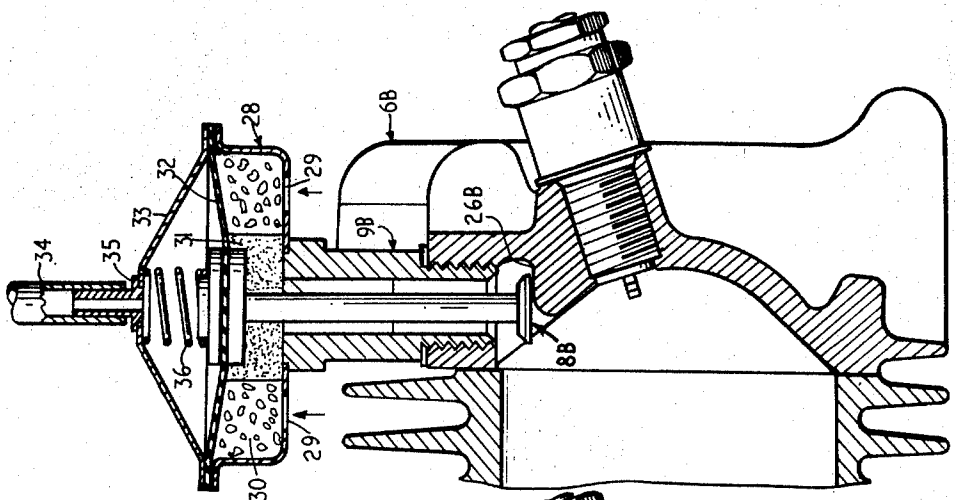


FIG.5

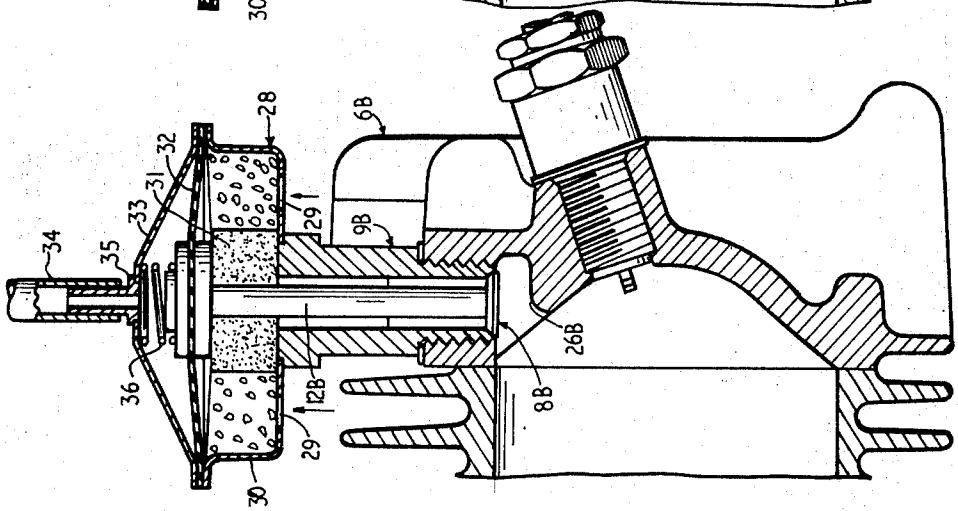


FIG.4

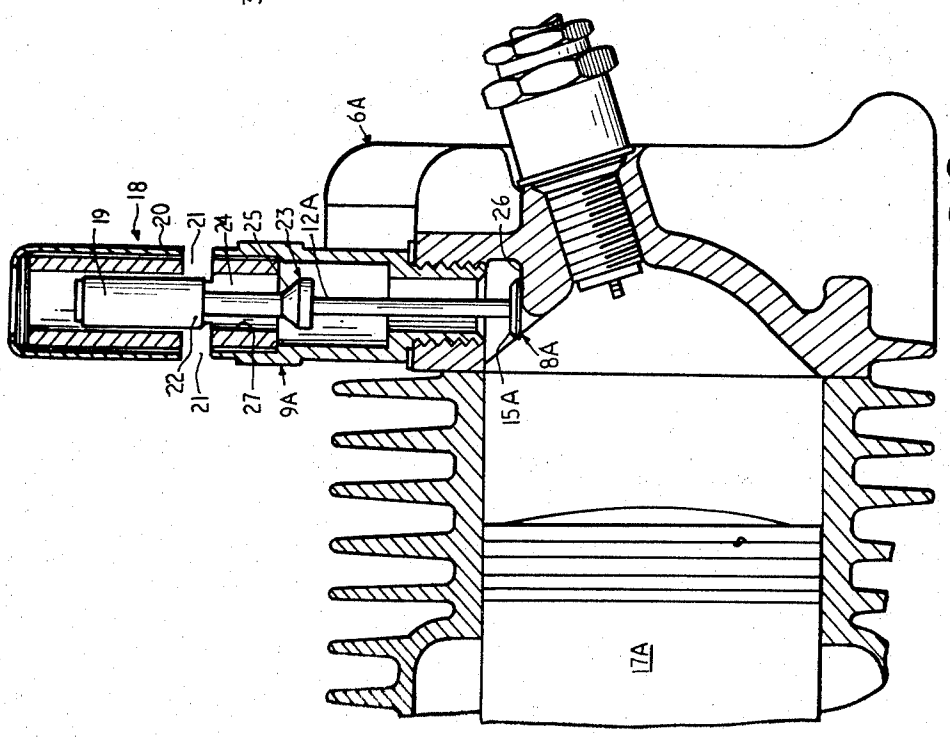


FIG.3

ENGINE DECOMPRESSION DEVICE

This invention relates to decompression devices for the firing chambers of engines and particularly those which restore compression within the engine automatically.

There are two principal types of decompression devices presently available which function in this way. They either respond to the speed of the engine or to the count of engine revolutions. Decompression devices are invariably a venting valve and employ a mechanical interlock for automatic closing to restore full compression conditions. These known devices usually entail complex and/or delicate mechanisms either to count the engine strokes or to sense the engine speed. Furthermore, such valves frequently require to be manually set before starting of the engine is attempted. A further disadvantage of existing devices is that the transition between venting and closed conditions of the valve is abrupt.

It is the main object of this invention to provide a decompression device for an engine which substantially avoids some or all of the above defects.

To this end the invention in its most general form is a device for decompressing an internal combustion engine during cranking and automatically progressively restoring compression thereto as the running speed of the engine increases, said device comprising a housing mountable to a port in the engine compression chamber, venting means for the housing for the escape of compressed gases in said chamber, a valve seat in the housing, and a valve element positioned and constructed so as to be forced to close upon the valve seat by the compressed gases in, and passing from, the chamber.

Preferred embodiments of the invention are illustrated in the accompanying drawings, in which:

FIG. 1 is a fragmentary side elevation of a typical engine cylinder shown in half section and incorporating a first form of compression release valve;

FIG. 2 is a similar view to FIG. 1 showing a second form of valve incorporating a dashpot, with the valve shown in its closed position;

FIG. 3 is a similar view of the embodiment of FIG. 2 showing the valve in an open position;

FIG. 4 is a similar view of an engine cylinder showing a third form comprising a vacuum controlled valve in its closed position; and,

FIG. 5 is a similar view to FIG. 4 showing the same valve in an open position.

A first preferred embodiment of the invention shown in FIG. 1 will now be described as applied to a two stroke engine 6, but it could also be adapted for four stroke engines. The decompression device 7 responds to the velocity of gases forced through it during compression strokes of the engine 6 on which it is incorporated. The device is proportioned so that certain minimum velocity of mixture passing through it is required to provide the pressure difference to raise it against its weight and thus close it. As described the device is assumed to be mounted substantially upright to utilize gravitational effect. Alternatively, the valve 8 of the device 7 may be closed against spring action.

To illustrate the principle behind the decompression device of this invention let it be assumed that the device consists of a tubular metal housing 9 having a

threaded reduced diameter portion 10 at one end to permit fixture of the device within a port 11 to the firing chamber 12 of the engine 6, and a rod 12 extending axially through the housing 9. A suitable form of vented bearing 13 is provided to support the rod 12 for axial sliding movement. A valve seat 14 is formed in the threaded end 10 of the housing 9 and a valve head 15 is provided on that end of the rod 12 extending out of the housing's threaded end 10. In the open position of the valve 8, shown in FIG. 1, gases compressed within the firing chamber are free to pass between the valve head 15 and its seat 14, upwardly through the housing 9 and out of its vented upper end 16. Under such conditions full compression cannot occur within the chamber but when the valve head 15 is forced on to its seat 14 by the velocity of gases passing through the housing 9 the firing chamber is no longer vented to atmosphere and full compression therein can occur.

The velocity of the gases, composing the fuel mixture escaping through the valve 8, is at its greatest when the piston 17 is travelling at its highest velocity during compression, i.e., when the piston 17 is slightly less than half-way through it s stroke. When the piston 17, at this point, is travelling at such a speed that the mixture velocity through the valve 8 is equal to or exceeds the minimum velocity required to close it, the valve 8 will close. It will remain closed until the pressure difference is reduced below the minimum required to hold the valve 8 closed against its own weight. If the engine 6 did not fire on this compression stroke, or on any subsequent stroke during the starting cycle, the valve 8 would re-open on the down stroke of the piston.

If, as is usual, the engine is being accelerated by the starting means, the piston 17 will be travelling faster, position for position, in each subsequent compression stroke in the starting cycle. This means that the valve 8 will close earlier, resulting in greater compression in each subsequent compression stroke until the engine 6 starts or the starting cycle is completed.

During operation, i.e., running, of the engine 6 the conditions that will cause the valve 8 to open may possibly occur when operating at low speed and low throttle opening. The valve 8, under these conditions, will open on the 'down' stroke of the piston 17 and allow air to be drawn into the cylinder. This will result in objectionable noise due to the pulsating flow and velocity of the induced air, and the possibility of explosions in the muffler due to the thinning out of the mixture.

However, it should be noted that this simple type of valve 8 may be satisfactory for an engine which is required to operate continuously at high r.p.m. and/or which is always under sufficient load (i.e. does not have to idle).

By increasing the back pressure in the muffler (not shown), or other part of the exhaust system, for the engine 6 during low speed or low running, the valve 8 may be held closed due to the high cylinder pressure produced during the period that the exhaust port (not shown) of the engine 6 is open. This provision will entail that only during cranking of the engine 6 will the valve 8 decompress the engine's firing chamber.

The defects noted above can also be overcome by excluding air from being sucked in through the hollow housing 9 on induction strokes of the engine, or at slow

running speeds. By a second embodiment of the invention this is achieved by arranging for the valve to remain closed through the initial portion of its downward travel and a damping device used to limit its movement within this closed portion of travel during engine operating conditions. The use of an air dashpot **18** as shown in FIGS. **2** and **3**, as the damping device is a very simple and most economical solution. To provide for this the upper end of the rod **12A** is provided with a piston **19** fitted within a closed chamber **20** in the outer end of the housing **9A** beyond venting slots **21** circumferentially provided in the wall of the housing **9A**. The lower end **22** of the dashpot piston **19** almost closes the vents **21** in its unoperated condition, as shown in FIG. **3**. When operated, however, the piston **19** advances into the chamber **20** to force the air therein back through the small clearance gap between the piston **19** and the internal wall of the dashpot **18**, so that return of the piston is resisted by the resulting reduced pressure which would exist. For improved operation of the device it is provided with an intermediate piston **23** operating within a reduced bore **24** of the housing **9A** beneath the venting means **21**. Preferably, this piston **23** has a tapered leading end **25** and in the closed condition of the valve **8A** as in FIG. **2** it extends a short distance into the reduced bore **24**. This will provide for some degree of opening of the dashpot **18** before the open valve **8A** is connected to the venting means **21**.

With the engine **6A** not turning, the valve head **15A** rests on a ledge **26** in the engine head. As soon as the engine piston **17A** begins to compress the mixture in the cylinder, the valve head **15A** rises so that mixture can escape past the underside of the dashpot piston **19**. With increase of velocity of the escaping mixture, the valve head **15A** rises until the pressure drops across the area of the intermediate **23**, and the valve section, to a minor extent, is such that the valve head **15A** progressively closes under the influence of the compression in the cylinder.

With the engine running the dashpot **19** acts to ensure that the valve **8A** although it may be partly open is not vented. The intermediate piston **23** has some clearance from its housing wall **27** but no appreciable amount of air can be inducted into the chamber **24** until the piston **23** opens and there is no accompanying objectionable noise.

A third form of the valve is shown in FIG. **4** and **5**. In this form a valve **8B** is mounted in a housing **9B** screwed into the engine cylinder **6B**. A housing dish **28** is secured to the top of the housing **9B**. Apertures **29** for the admission of air are provided in the underside of the dish **28**. An annular filter element **30** is secured within the dish **28** and air entering the apertures **29**, passes through the filter **30** and into its hollow center **31**. The air then passes down between the valve stem **12B** and the housing **9B** and into the engine cylinder **6B** when the valve **8B** is in its open position as shown in FIG. **5**.

A flexible diaphragm **32** is stretched across the top of the dish **28** and clamped thereon by a domed cover **33**. A flexible conduit **34** is secured to a spigot **35** mounted on top of the cover **33**. The conduit **34** is also connected to a tapping in the intake duct between the carburettor butterfly and the inlet port (not shown) of the engine **6B**.

When the engine **6B** is stationary a spring **36**, positioned between the cover **33** and diaphragm **32**, forces the valve downwardly into contact with a step **26B** in the compression chamber of the engine. As the engine is cranked air will pass in via the filter **30** and through the open valve **8B** as shown in FIG. **5**. The movement of the engine piston (not shown) will lower the air pressure in the main intake (not shown) below atmosphere and this pressure drop will be conveyed to the space above the diaphragm **32** and pressure below the diaphragm will force it up, against the action of the spring **36**, thus closing the valve **8B**, and the engine **6B** will produce normal compression within the combustion chamber. With the engine running the reduced pressure in the intake duct will hold the valve **8B** closed as in FIG. **4**.

It will be appreciated that the valve closing action of the diaphragm **32** is initiated, in the case of a single cylinder engine, upon the induction stroke of the engine piston which coincides with the opening of the valve **8B** at low running speeds of the engine. Therefore, by appropriate design a good balance between both actions can be obtained to ensure that even at a low running speed the engine is operating at maximum efficiency.

The principal function of the valve holding devices of the invention is to ensure that the valve remains closed during running of the engine when on occasions the pressure in the firing chamber drops too low during the downstroke of the piston thus allowing atmospheric pressure on the valve from the outside to open the valve. These conditions occur typically when the throttle in the carburetor has a low opening such as at idling or when it is closed to slow the engine from a high speed. In such cases the function of the diaphragm **32** is to use the low pressure in the inlet manifold to hold the valve **8B** closed. However, the pressure in the inlet manifold is of a fluctuating nature, especially in engines which have few cylinders. In order to dampen these pulsations a restricting orifice **34A** is inserted in the conduit **34** connecting the diaphragm **32** to the inlet manifold.

The low pressure on top of the diaphragm **32** causes atmospheric pressure on the other side to hold the valve **8B** closed against the action of the low pressure in the cylinder on the downstroke of the piston **17A**.

The advantage of using a diaphragm for the function of holding the valve under low pressure conditions in the cylinder is that such low pressure conditions typically occur at the same time as the lowest pressure conditions occur in the intake manifold, that is, under reduced throttle openings with the engine running. It should be clear that this explanation of the diaphragm action applies to conditions obtaining with the engine running, that is, after the engine has been started.

None of the valve holding devices of the invention are designed to have any effective function during the starting of the engine. During the starting of the engine each of the devices described is the same in principle as the valve illustrated in FIG. **1**. The only difference is that in some cases a spring may be used instead of, or together with, relying upon the effects of gravity.

As an alternative to either of the above arrangements it may be possible to provide one of the following:

1. A mechanical interlock (e.g. centrifugally operated) that will hold the valve closed once the engine has started.

2. An electrical interlock that uses a solenoid, powered by an extra coil in the magneto, to hold the valve closed once a given r.p.m. is reached. The output from the coil in the magneto could either be filtered to give a substantially steady current or the impulses could be arranged to coincide with the instant the valve begins to drop.

From an understanding of the above description it will be seen that the device of the invention has the advantage that, due to the progressive increase in compression, the initial strokes are provided with less than full compression but still with sufficient to start the engine. Due to the reduced compression less voltage is required to produce a spark at the plug. As the magneto needs less speed to produce this reduced voltage, the engine is thus able to start at a lower speed.

What I claim is:

1. A device for decompressing an internal combustion engine during cranking and automatically progressively restoring compression thereto as the running speed of the engine increases, said device comprising a housing mountable to a port in the engine compression chamber, venting means for the housing for the escape of compressed gases in said chamber, a valve seat in the housing, a valve element positioned and constructed so as to be forced to close upon the valve seat by the compressed gases in, and passing from, the chamber; a fluid chamber in the housing, means for at least partly evacuating fluid from said chamber; a displaceable member forming a wall of said chamber, and a valve stem interconnecting said displaceable member and said valve element to hold said valve element closed when said fluid chamber is at least partly evacuated.

2. A device according to claim 1, wherein said evacuating means comprises a fluid line for connecting the fluid chamber with the inlet manifold of the engine.

3. A device according to claim 2, wherein the displaceable member is a diaphragm.

4. A device according to claim 1, wherein the housing is tubular and threaded at one end for screwing to said port, and the valve seat and the valve element are located at the threaded end of the housing, and further comprising a dashpot located at the opposite end of the housing and containing said fluid chamber, said displaceable member being a piston for the dashpot, and said means for partly evacuating fluid from the dashpot chamber comprising clearance of the piston from the wall of the dashpot chamber.

5. A device according to claim 4, wherein an intermediate chamber is provided in the tubular housing, an intermediate piston is provided on the valve stem, and the venting means is located between the two chambers of the housing, said intermediate piston being so located on the valve stem that it is accommodated in the intermediate chamber when the valve element is at least partly open.

6. A device for decompressing an internal combustion engine during cranking and automatically progressively restoring compression thereto as the running speed of the engine increases, said device comprising a tubular housing threaded at one end for screwing to a port in the engine compression chamber, a valve seat located at the threaded end of the housing, a valve element having a stem which passes axially through the housing with said valve element protruding from the threaded end of the housing so as to close upon the valve seat with the passage of compressed gases from the engine compression chamber into said housing, venting means in the housing for the escape of compressed gases therein, a fluid chamber at the other end of the housing, a diaphragm on an end of the valve stem and defining one wall of the fluid chamber, and a fluid line having a restrictive orifice being connected to the fluid chamber and having means for connection to an inlet manifold of the internal combustion engine, whereby reduced pressure in the intake manifold serves to hold the valve element closed when the engine is running in excess of a predetermined speed.

7. A device according to claim 6, wherein the venting means is located between the diaphragm and the threaded end of the tubular housing, and comprises an air filter.

8. A device according to claim 6 including also a bias spring acting upon the valve stem to hold the valve element off the valve seat.

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