Sept. 29, 1964 C. P. HEBBARD 3,150,649

VACUUM RELIEF DEVICE FOR INTERNAL COMBUSTION MOTORS

Filed Oct. 5, 1962 2 Sheets-Sheet 1

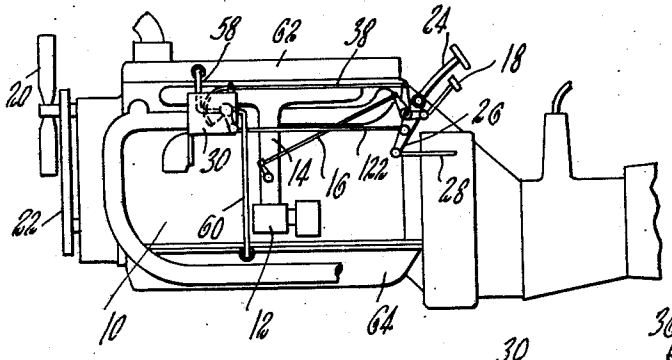


Fig. 1.

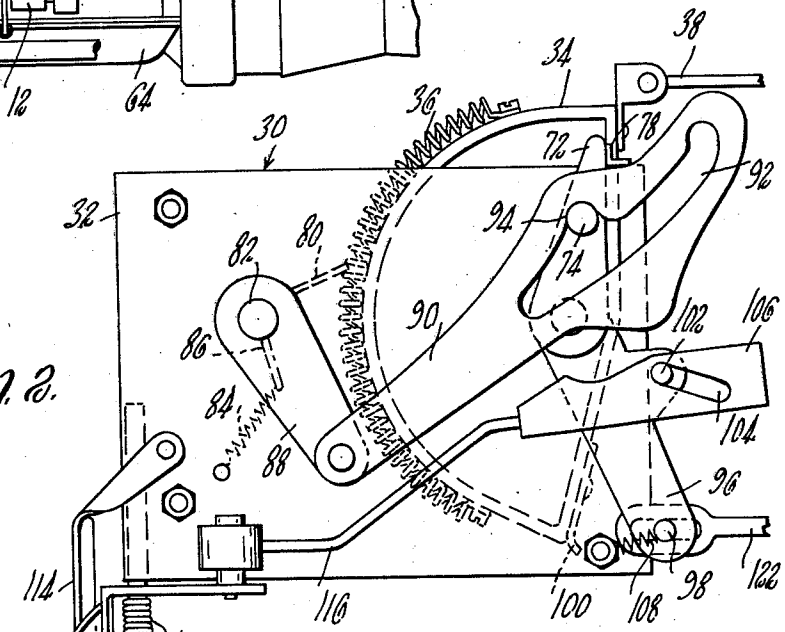


Fig. 2.

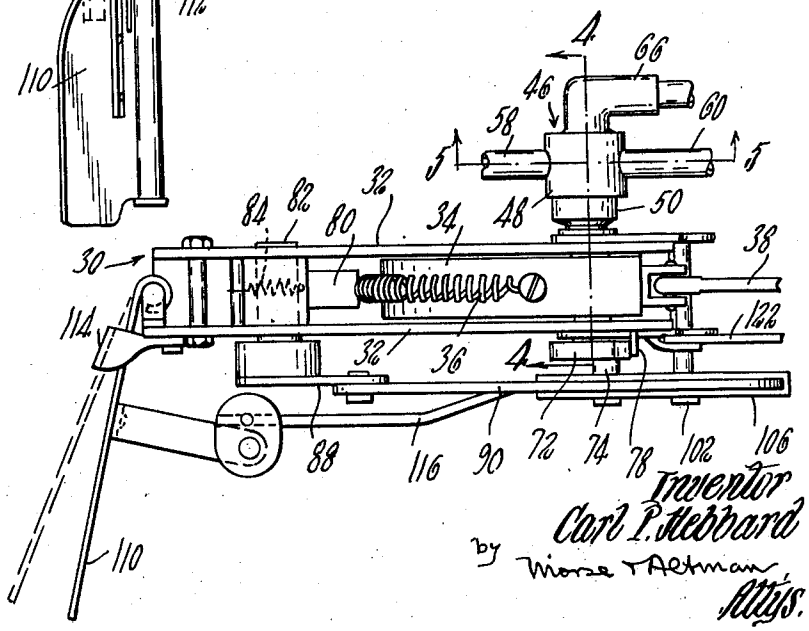


Fig. 3.

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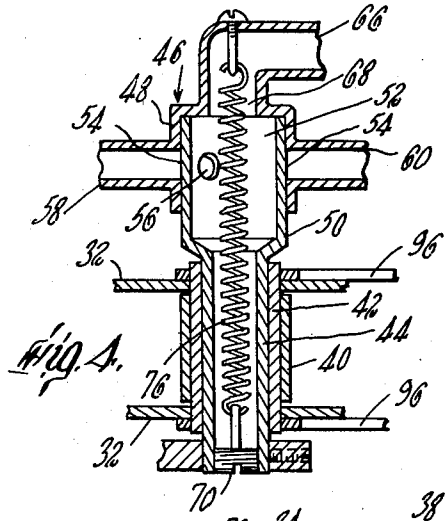


Fig. 4.

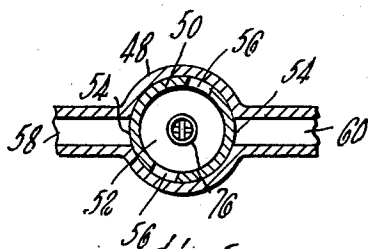


Fig. 5.

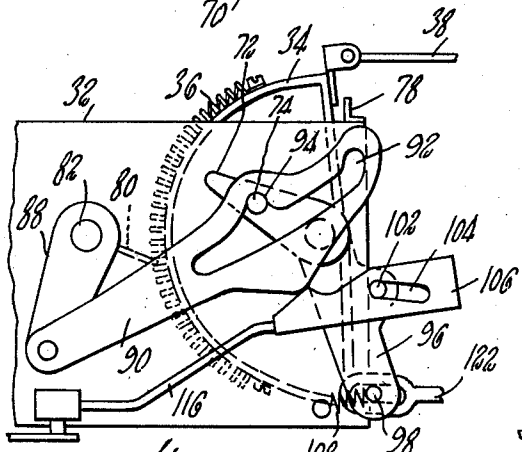


Fig. 6.

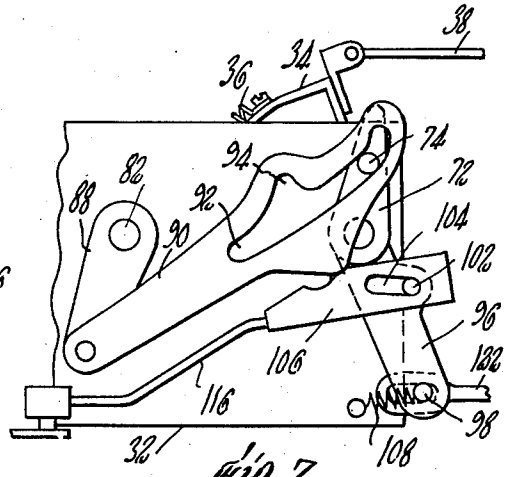


Fig. 7.

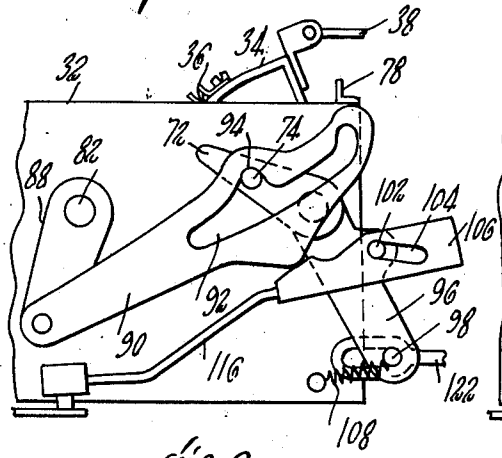


Fig. 8.

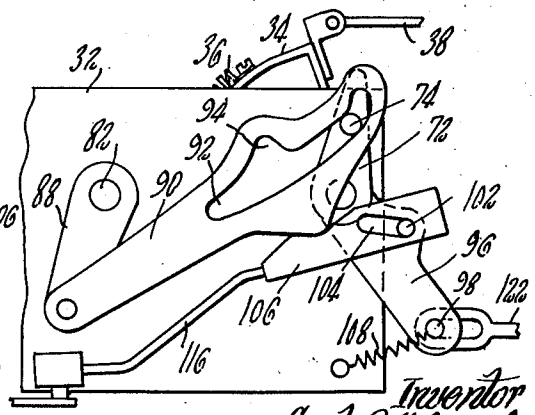


Fig. 9.

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VACUUM RELIEF DEVICE FOR INTERNAL COMBUSTION MOTORS

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Filed Oct. 5, 1962, Ser. No. 228,633
13 Claims. (Cl. 123—97)

This invention relates to a device for operating automatically to relieve excess vacuum in the intake manifold of an internal combustion motor under certain conditions of operation. For example, when an automobile is traveling along a road and the foot on the accelerator pedal is lifted to reduce the opening of the carburetor valve, the car drives the motor, causing the cylinders to act as pumps to draw air from the intake manifold faster that it can be supplied through the partly closed carburetor valve. This increases vacuum in the manifold and sucks undesired fuel from the carburetor, such fuel being wasted, some of it usually condensing on the walls of the intake manifold. Various devices have been made for the purpose of relieving excess vacuum thus caused, but for practical operation of an automobile, other conditions of operation must be taken into account. It is an object of the present invention to provide an air inlet for the intake manifold, the inlet containing a control valve responding automatically to the following conditions of operation, the valve being normally closed, especially when the motor is being accelerated.

(1) When the car is traveling with the accelerator pedal depressed to any position and the pedal is lifted any amount, the valve opens in accordance with the amount of lift.

(2) When the car is at rest or traveling less than about 15 m.p.h. and the throttle is closed to idling position, the valve is closed (to prevent stalling).

(3) When the car is traveling at a greater speed than about 20 m.p.h. with the throttle closed to idling position, as when decelerating or running downhill, the valve is open.

(4) If the car has vacuum-actuated brakes, application of the brakes closes the valve regardless of other conditions of operation if the valve is then open.

By supplying the inlet from the crank-case and the valve chamber at the top of the motor, vapors in these chambers can be drawn off to keep the chambers well ventilated and also to supply dust-free air to the intake manifold. This extra air not only reduces the vacuum in the intake manifold and the fuel sucked in, but also sweeps through the manifold to prevent condensation of fuel on the walls thereof.

These and other desirable objectives are attained by the combination and arrangement of parts hereinafter described in detail and illustrated on the drawings, of which

FIGURE 1 is a side elevation of an internal combustion motor on which is mounted a device embodying the invention;

FIGURE 2 is a side elevation, on a larger scale, of the device itself;

FIGURE 3 is a plan view of the same;

FIGURES 4 and 5 are sections on the lines 4—4 and 5—5 of FIGURE 3; and

FIGURES 6, 7, 8 and 9 are partial side elevations of the device, on a smaller scale, showing different positions of the moving parts.

A conventional illustration of the power plant of an automotive vehicle is given in FIGURE 1 of the drawings. This comprises a multi-cylinder, internal combustion motor **10** with the customary carburetor **12** communicating with an intake manifold **14**. A butterfly valve (not shown)

in the manifold is the throttle which is connected by a suitable linkage **16** to the accelerator pedal **18**. The motor **10** has a fan **20** which is driven through a belt **22** which connects it to the main shaft of the motor. A brake pedal **24** is connected by a lever **26** and rod **28** to a brake-applying mechanism (not shown) which may be vacuum-operated.

Mounted on the motor **10** at a suitable and convenient location is a mechanism **30** which embodies the present invention. As shown, the mechanism **30** has a frame **32** consisting chiefly of a pair of parallel plates between which an arcuate rack **34** is mounted to rock about its center as an axis. The teeth **36** of the rack may be conventional or, as shown, may consist of the coils of a helical spring secured to an arcuate strip. The rack **34** is connected by a rod **38** to the throttle-operating linkage **16** so that when the accelerator pedal **18** is pressed to open the throttle, the rack **34** rocks in the clockwise direction to the position shown in FIGURE 2. The moving parts of the device are usually in the position shown in FIGURE 2 when the motor is impelling the vehicle. When the operator's foot lets up on the accelerator pedal **18**, the rack **34** rocks in the counterclockwise direction (FIGURE 6). The rack **34** has a hub portion **40** which is fitted on a fixed bushing **42** extending between the plates of the frame **32** (FIGURE 4). Journalled in the bushing **42** is the tubular stem **44** of an air valve **46** which consists of an outer cylindrical cup-shaped member **48** and an inner cylindrical cup-shaped member **50** telescoped into the outer member to form a valve chamber **52**. The outer valve member **48** has one or more holes **54** through its side wall, two such holes being indicated in FIGURE 4. The inner valve member **50** has one or more holes **56** through its side wall which are movable into and out of registry with the holes **54** by relative rotative movements of the members **48**, **50** to open and close the valve. In the embodiment of the invention illustrated, the outer valve member **48** is stationary, the inner member **50** being rotatable. The stem portion **44** of the inner member **50** is journalled in the bushing **42** for that purpose. The holes **54** in the wall of the outer valve member **48** are preferably diametrically opposed and communicate with pipes **58**, **60** respectively. The pipes lead to any desired sources of air. By running one of them to the valve chamber **62** at the top of the motor, and the other to the crankcase **64** at the bottom of the motor, these parts of the motor can be ventilated and can provide dust-free air for the intake manifold. A third pipe **66** serves as an air duct to the intake manifold **14** and communicates with the valve chamber **52** at any convenient point such as a hole **68** through the bottom of the cup-shaped valve member **48**. Since the pressure in the intake manifold is always lower than atmospheric during the operation of the motor, more or less suction is maintained in the valve chamber **52** which is relieved by opening the valve to admit air through the pipes **58**, **60**.

The tubular valve stem **44** extends through and beyond the bushing **42**, the further end being closed by a screw-threaded plug **70**. Mounted on this projecting end of the valve stem **44** is an arm **72** which carries a pin **74**. The arm **72** is rockable to open the valve **46** when in the position shown in FIGURE 6, or to close the valve when in the position shown in FIGURE 7. The inner and outer members of the valve **46** are yieldingly maintained in assembled relation by a helical spring **76** one end of which is secured to the outer member **48**, the other end being secured to the plug **70** in the end of the stem **44**. When the valve parts are being assembled they are turned relatively so that the spring **76** will not only draw the valve parts toward each other but will also tend to turn the inner member **50** clockwise to the closed valve position, the outer member **48** being stationary. A suit-

able stop 78 is mounted on the frame 32 to be engaged by the arm 72 when the valve 46 is in its closed position.

For operation of the valve, a tongue or click 80 is mounted on a rock shaft 82 journalled in the frame plates 32. The click 80 is arranged to engage between successive teeth 36 of the rack 34 when it is in its mid position on the line of centers between the axes of its shaft 82 and of the rack 34. A spring 84 attached to one of the plates 32 and to a pin 86 projecting from the shaft 82 tends to maintain the click 80 yieldingly in its mid position from which it is rocked in one direction or the other by movements of the member 34 about its axis.

Mounted on the shaft 82 outside of the frame 32 is an arm 88 to the end of which an end of a latch member 90 is pivotally attached. The latch member has an elongated slot 92 therein with a notch 94 in the upper edge of the slot adapted to receive the pin 74 on the valve arm 72. When the arm 88 is rocked clockwise and the pin 74 is in the notch 94, the latch member 90 will move longitudinally toward the left and will rock the valve arm 72 to open the valve 46, as indicated in FIGURE 6. If the latch member 90 is then rocked upward enough to clear the pin 74 from the notch 94, the spring 76 will act at once to close the valve 46, as indicated in FIGURE 7. Longitudinal movements of the latch member 90 are produced by movements of the rack 34 from any position it may happen to be in. Thus, clockwise movements of the rack 34, which take place when the accelerator pedal is pushed down, rock the shaft 82 in the opposite direction and shift the latch member 90 toward the right so that if the pin 74 is in the notch 94, the valve is moved towards its closed position. Likewise, a small counterclockwise movement of the rack 34 accompanying an easing of the accelerator pedal will rock the shaft 82 in the opposite direction to open the air valve 46 if the pin 74 is in the notch 94. Thus the primary function of the mechanism is ordinarily to close the air valve when the accelerator is pushed down and to open the air valve when the accelerator is let up from any position. Whenever the accelerator pedal is let up, that usually results in the vehicle driving the motor to some extent instead of being driven by the motor.

However, when the motor is idling, the air valve should be closed even though the motor is not pulling the vehicle, as otherwise the motor will stall. To prevent this, means are provided for temporarily disabling the valve-opening linkage which includes the latch member 90. Such means include an arm 96 pivoted on the bushing 42 and extending downward outside of one of the frame plates 32. For convenience a similar arm is pivotally mounted outside the other frame plate 32, the lower ends of the arms 96 being connected by a short rod 98. The rack 34 is provided at its lower end with a tail 100 which is adapted to catch under the rod 98 and rock the arms 96 a little when the rack is moved to its limiting counterclockwise position as the accelerator is released to its idling position. One of the arms 96 carries a pin 102 which rides in a cam slot 104 in a bunter element 106 which when lifted sufficiently will engage the lower edge of the latch member 90 and raise it sufficiently to release the pin 74 from the notch 94 if it is then in the notch. When the accelerator pedal is thereafter depressed, the tail 100 of the rack 34 moves away from the rod 98 and permits a tension spring 108 to rock the arms 96 back to their normal position. This lowers the bunter 106 below the latch member 90 which then bears on the pin 74 so that when the latch member is moved to the right as the accelerator is depressed, the pin 74 will enter the notch 94 and be ready to open the air valve when the accelerator pedal rises.

On the other hand, when the vehicle is running downhill or rapidly decelerating with a closed throttle, it is desirable that the air valve be kept open in spite of the throttle being closed to idling position. For this purpose, means are provided to render the disabling means ineffective under such circumstances. A vane 110 is hingedly mounted at a convenient point on the frame 32 so as to be in the air stream from the fan 20. A spring 112 is provided to press the vane yieldingly against a stop 114 so that the vane presents a broad face to the air stream. If the stream is considerable in force as when the motor is turning at a speed equivalent to travel of the vehicle at, say, twenty miles per hour, the vane is swung rearward by the stream against the force of the spring 112. Pivotally connected to the vane by a rod 116 is the bunter 106 which is shifted rearward when the vane is swung by the air stream. The slot 104 in which the pin 102 rides is inclined so that rearward movement of the bunter lowers the bunter far enough, as indicated in FIGURE 8, to keep it from engaging the latch member 90 if the bunter is raised by the tail 100 rocking the arms 96.

If the vehicle is equipped with vacuum-operated brakes, the vacuum in the intake manifold must be maintained when the brakes are applied, regardless of the current operating condition of the motor. In such case the brake pedal 24 is connected by a rod 122 to the cross rod 98 of the arms 96 in such a way that when the brakes are applied, the rod 122 is retracted enough (FIGURE 9) to rock the arms 96 to raise the bunter 106 higher than it is raised by the action of the tail 100 so that even if the vane 110 has lowered the bunter 106, that lowering is more than offset by the elevating action of the brake rod 122.

The hereinbefore described mechanism for operating a valve is capable of other useful applications. For example, if the connecting rod 38 is attached to the accelerator pedal in such a way that it moves toward the left (FIGURE 2) when the accelerator pedal is depressed, and if the valve 46 is in a fuel line running to the carburetor, any depression of the accelerator pedal at any position will supply extra fuel to the carburetor.

I claim:

1. In combination, a valve and means for controlling said valve, said means comprising a rack with a series of teeth movable in a path along its length, a rockably mounted click comprising a straight tongue adapted to extend from its rocking axis into the space between the nearest two teeth of said rack when in its midposition, said click being rockable from its midposition by movement of said rack in either direction along its path, spring means tending to hold said click in its midposition, and connecting linkage responsive to rocking movements of said click to open and close said valve.

2. Mechanism as described in claim 1, said rack being arcuate and movable about the center of its arc.

3. Mechanism as described in claim 1, the teeth of said rack consisting of a helical spring secured at both ends.

4. Mechanism as described in claim 1, said connecting linkage comprising a shaft on which said click is mounted, a crank arm mounted on said shaft, a latch member attached to said crank arm, and means responsive to longitudinal movements of said latch member to open and close said valve.

5. Mechanism as described in claim 4, said latch member having an elongated slot therein with a notch in a side edge of the slot, said latch-responsive means comprising a valve stem rockable to open and close said valve, an arm fixed on said stem and a pin on said arm adapted to engage in said notch to rock said arm and stem when the latch member moves longitudinally.

6. Mechanism as described in claim 5, spring means tending to rock said stem to the closed valve position, and auxiliary means operable to rock said latch member about its pivot attachment to said crank arm to release said pin from said notch.

7. In an automotive vehicle having an internal combustion motor with an intake manifold and a throttle movable between an idling position and a full power po-

sition; an air duct opening into said intake manifold, a valve in said air duct, and means responsive to opening and closing movements of said throttle from any position thereof for closing and opening said control valve, said means including a rack with a series of teeth movable back and forth in step with opening and closing movements of said throttle, a rockably mounted click comprising a straight tongue adapted to extend from its rocking axis into the space between the nearest two teeth of said rack when in its midposition, said click being rockable from its midposition in either direction by movements of said rack, spring means tending to hold said click in its midposition, and linkage operatively connecting said click and said valve.

8. Mechanism as described in claim 7, said rack being arcuate and movable about the center of its arc.

9. Mechanism as described in claim 7, said linkage comprising a shaft on which said click is mounted, a crank arm mounted on said shaft, a latch member attached to said arm, and means responsive to longitudinal movements of said latch member to open and close said valve.

10. Mechanism as described in claim 9, said latch member having an elongated slot therein with a notch in the upper side edge of the slot, said latch-responsive means comprising a valve stem rockable to open and close said valve, an arm fixed on said stem, a pin on said arm extending into said slot and adapted to engage in said notch, whereby longitudinal movements of said latch member result in rocking movements of said valve stem when said pin is in said notch.

11. Mechanism as described in claim 10, and means operable to push said latch member upward to release said pin from said notch, and spring means tending to close said valve.

12. In an automotive vehicle having an internal combustion motor with an intake manifold, a motor-driven fan, a throttle movable between an idling position and a full power position, and throttle operating means; an air duct opening into said manifold, a valve in said air duct, a spring tending to maintain said valve closed, means responsive to closing movements of said throttle to open said air valve, said responsive means comprising a mechanical linkage between the throttle operating means and the air valve, means actuated by said throttle operating means when the throttle reaches its idling position to disable said linkage, and means responsive to a substantial air stream from said fan to render said disabling means ineffective while the air stream is substantial.

13. Mechanism as described in claim 12, said means responsive to the air stream from the fan including a vane rockably mounted near said fan, a spring tending to rock said vane toward said fan to an active position, said vane being movable by a substantial air stream away from said fan to an inactive position.

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