

Aug. 2, 1966

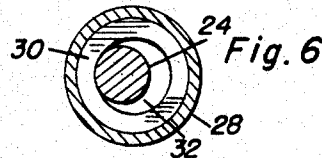
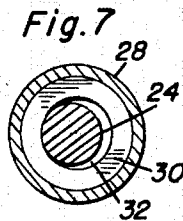
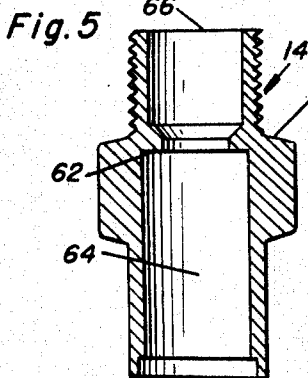
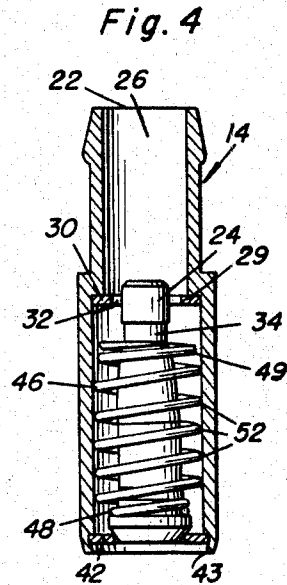
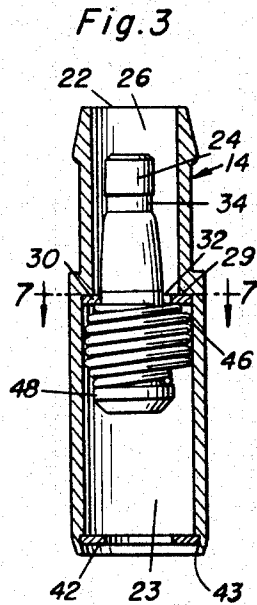
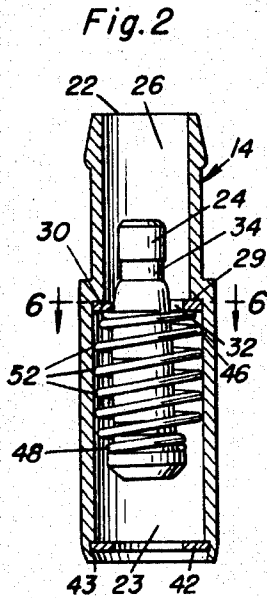
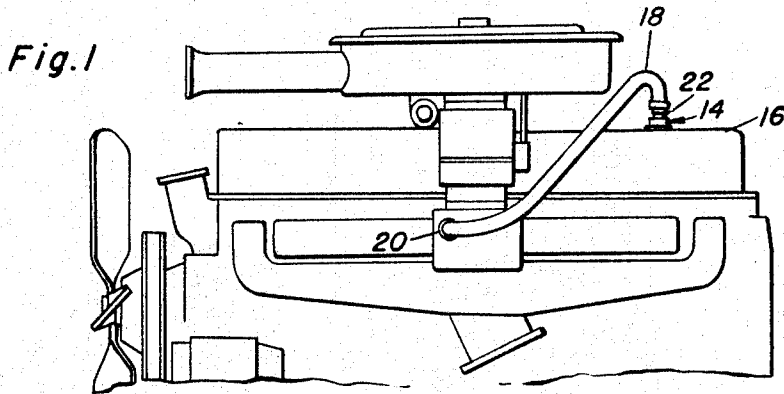
J. D. GIVLER ETAL

3,263,699

CRANKCASE VENTILATION CONTROL MEANS

Filed Nov. 26, 1963

2 Sheets-Sheet 1



INVENTORS

John D. Givler
William I. Barnes
Bernard E. Wasisco

BY
Stevens, Davis, Miller & Mosher
ATTORNEYS

Aug. 2, 1966

J. D. GIVLER ET AL

3,263,699

CRANKCASE VENTILATION CONTROL MEANS

Filed Nov. 26, 1963

2 Sheets-Sheet 2

Fig. 11

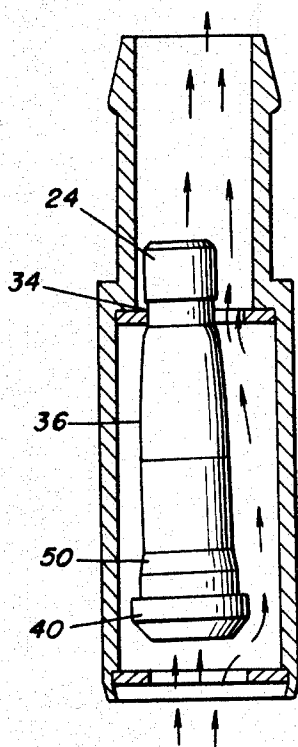


Fig. 12

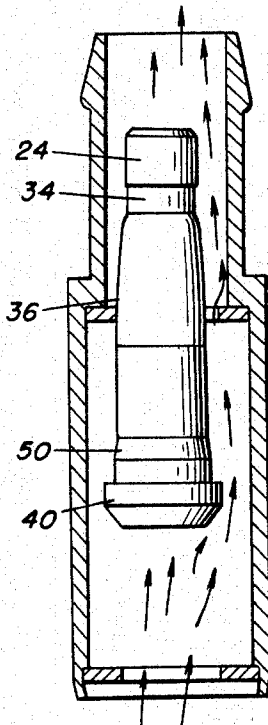


Fig. 13

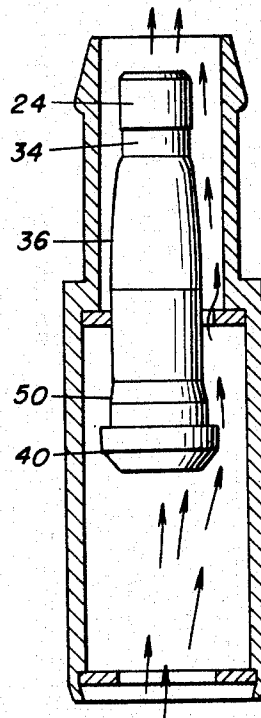


Fig. 9

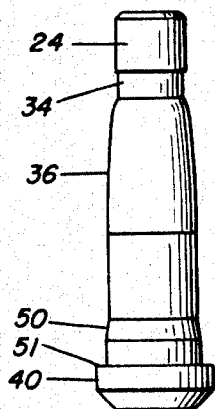


Fig. 10

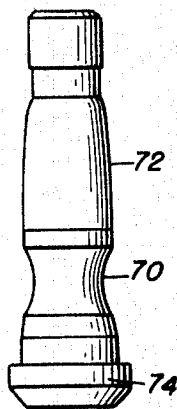
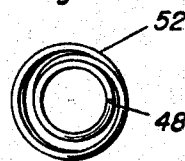


Fig. 8



INVENTORS

John D. Givler
William I. Barnes
Bernard E. Wasisco

BY
Stevens, Davis, Miller & Mosher
ATTORNEYS

1

3,263,699

CRANKCASE VENTILATION CONTROL MEANS
John D. Givler, Naperville, Ill., William I. Barnes, Royal
Oak, Mich., and Bernard E. Wasisco, Elmhurst, Ill.,
assignors to Standard Screw Company, Bellwood, Ill.,
a corporation of New Jersey

Filed Nov. 26, 1963, Ser. No. 326,279

9 Claims. (Cl. 137—480)

This invention relates to air flow control or metering means and more particularly to metering valves adapted for use in various systems to materially reduce discharge into the atmosphere of blow-by accumulating in the crankcase of an automotive engine and thereby inducing smog.

One system of reducing the discharge of blow-by from the crankcase involves the use of a conduit communicating the crankcase with the intake manifold of the engine so that the manifold vacuum will draw air and the blow-by through the conduit and deliver the blow-by laden current of air through to the cylinders. However, in such a system, the performance of the engine will not be satisfactory unless there is a continuous flow of the air current.

Accordingly, it is necessary to provide some means to control or meter the flow. One type of device which has been found generally suitable is a spring-loaded valve having an elongated floating pin or plunger the diameter of which is varied along its length so that the size of the metering orifice will automatically change depending upon the increase or decrease in the pressure differential across the valve. This action is necessary inasmuch as a valve having a fixed orifice size would, if such size were fixed for highway speeds wherein there is a low vacuum in the intake manifold, affect proper engine performance in that it would permit too great a flow through the conduit under a condition of high vacuum in the intake manifold when the engine is idling. On the other hand, if there were a fixed orifice properly sized for idling conditions, when the vacuum pressure decreases as the throttle is opened to accelerate to highway speeds, the lower vacuum in the intake manifold would draw little blow-by through the conduit at the very time when increasing the crankcase ventilation is necessary. However, in a spring-loaded valve with a floating plunger or pin to provide a variable orifice, when there is a low vacuum in the intake manifold, the spring holds the plunger in open position so there is virtually no restriction to flow through the valve, whereas when the manifold vacuum is high the plunger will move into the orifice reducing the effective orifice size and this in turn reduces the flow of blow-by laden air current through the valve.

A metering valve of the type described above must not only be capable of assuring a continuous flow without interfering with proper engine performance, but it must maintain this capability despite the fact that many different types of engines are to be served and it is required to operate under intense vibrations. Accordingly, it is the current practice of automobile manufacturers, to be certain there will be no interference with proper engine performance to require that such metering valves produce a smooth flow curve when tested to determine the continuity of flow under various pressure differentials across the valve, and that they do so within the limits of the flow curves furnished by the manufacturer for each of its engines.

On numerous occasions, it has been found that prior art valves of the floating pin or plunger type fail to produce smooth flow curves, and particularly fail to produce a curve conforming to the requirements of the engine manufacturer. In the case of metering valves having a free floating plunger which are designed to so center the

2

plunger as to prevent it from making contact with the bore of the valve housing and, in particular, from contacting the portions of the valve structure which define the orifice, the pressure fluctuations to which the valves are subjected cause the plunger to oscillate or jiggle. These oscillations affect the accurate metering and continuity of the flow as evidenced by irregular flow curves obtained in a high number of the tests of these valves.

Applicants have evolved and produced a flow metering device for crankcase ventilation systems which has been found to be capable of accurately metering the flow to the intake manifold and will assure the desired flow without any interference with proper engine performance.

Briefly summarized, the present invention involves the provision of a metering valve having an elongated plunger designed to vary the size of the orifice in response to changes in the pressure differential. The plunger is positioned and supported by a compression spring, the innermost coil of which embraces the plunger at one end in a press fit. This coil is arranged to hold the plunger in such a position that as it moves back and forth relative to the metering orifice, in response to changes in the pressure differential, one side of the pin will ride against the adjacent wall portions of the orifice. It has been found that this arrangement produces a dampening effect upon the oscillations or jiggling of the plunger within the valve orifice.

Further, while the spring is designed so that the innermost coil embraces one end of the plunger in a press fit, the remaining coils, and particularly those intermediate the end coils have an outer diameter slightly less than the inner diameter of the bore of the valve housing, and consequently when the spring is compressed these intermediate coils frictionally engage the inner walls of the valve. This arrangement also has a tendency to prevent jiggling of the plunger and to therefore assure a smooth continuous flow of the blow-by through the valve.

The invention is further characterized by an elongated metering plunger provided with a head portion and with a body portion of a lesser diameter than the metering orifice. The body portion has a reduced cylindrical portion extending along its length and merging into a progressively enlarged portion increasing in size in the direction of the head portion. The latter portion constitutes the variable metering portion of the plunger and may be provided with a curved periphery or a combination of curved and straight lines. It has been found that this feature contributes to the accuracy of metering of the flow and its continuity and thereby aids in obtaining satisfactory flow curves.

Further, the invention contemplates the provision of means to provide a relief at the outlet side of the metering orifice to maintain a continuous flow when the flow passage is of minimum size by reason of the movement of the plunger into the orifice in the engine idling position.

Reference is now made to the accompanying drawings for a better understanding of the nature and objects of the present invention, which drawing illustrate its principles and are not to be construed as restrictions or limitations on its scope.

FIGURE 1 is a skeleton elevation of a typical installation of a crankcase ventilation system;

FIGURE 2 is a vertical sectional view of a valve structure incorporating the present invention with the metering plunger and spring assembly disposed in a position when the automotive engine has been accelerated;

FIGURE 3 is a view like FIGURE 2 showing the plunger and spring assembly in a position when the engine is idling;

FIGURE 4 is also a vertical sectional view showing the plunger and spring assembly in the engine backfire position;

3

FIGURE 5 is a vertical sectional view of an alternative form of the valve structure wherein the valve housing and metering orifice are of a one piece construction;

FIGURE 6 is a cross section on line 6—6 of FIGURE 2;

FIGURE 7 is a cross section on line 7—7 of FIGURE 3;

FIGURE 8 is an end elevational view of the compression spring taken at the valve inlet end thereof;

FIGURE 9 is an elevational view of the metering plunger for the valve structure shown in FIGURES 2, 3 and 4;

FIGURE 10 is an elevational view of a modified form of metering plunger provided with an undercut adjacent the head portion of the plunger; and

FIGURES 11, 12 and 13 are diagrammatic views showing different stages of the metering at the orifice due to the changes of the plunger in response to pressure changes.

Referring now to the details of the invention, it will be noted that, as shown in FIGURE 1, the valve 14 may be suitably attached to the rocker arm cover 16 of the engine with the outlet end 22 up. A flexible tube or conduit 18 may be coupled at one end to the outlet end 22 of the valve and at the other end to the intake manifold 20. The means for interconnecting the parts of the ventilation system form no part of this invention inasmuch as these essentially plumbing details are well known to those skilled in the art.

The valve 14 has an outlet end 22 and an inlet end 23. An elongated solid metering plunger or pin 24 is disposed in the bore 26 of a generally cylindrical housing 28. A washer 30 having a central aperture 32 constituting a metering orifice is provided to cooperate with the plunger 24 to meter the flow of crankcase blow-by through the bore 26 of the valve housing 28. Washer 30 is of a size that it is frictionally held against displacement within the bore 26, and seats against a stop shoulder 29 formed in the housing 28.

Metering plunger 24 is held in place by a compression spring 46. The innermost coil 48 at the inlet end of the spring 46 is arranged to embrace the metering pin 24 in a press fit about the enlarged portion 50 on the head portion 40 of the plunger. The outmost coil 49 of the spring seats against the washer 30 in all of the engine load positions of the metering plunger and normally urges the plunger in the direction of the inlet end of the valve.

The body portion of metering plunger 24, it will be noted, is provided with a reduced cylindrical portion 34 adjacent the outlet end of the plunger which merges with an enlarged portion 36 that progressively increases in diameter in the direction towards the head portion 40. The periphery of the progressively increasing portion 36 may be curved or may consist of a combination straight and curved sides. Portion 36 which constitutes the variable metering portion of the plunger merges with an enlarged cylindrical portion which in turn merges into the head portion 40. Inasmuch as the head portion of the plunger is of a greater diameter than the body portion a shoulder is formed at the junction of these portions forming a stop shoulder 51 for the compression spring 46 and an abutment for coil 48. The body portion of the plunger has a diameter throughout its length less than the size of the orifice.

As best shown by FIGURES 2, 3, 6, 7 and 8, the coil 48 of the compression spring 46 is laterally offset relative to the other coils and the longitudinal axis of the bore 26. As a result of this construction and the press fit of coil 48 on the metering plunger 24, the plunger under all load conditions extends eccentrically in the bore 26 towards the outlet end of the valve housing 28. Accordingly, portions along the metering plunger ride against adjacent wall portions of the metering orifice 32. Such a construction produces a dampening effect and thereby reduces the oscillations or jiggling which occur in a free floating pin or plunger and cause an irregular or discontinuous metering of the flow through the ventilation system.

4

It will further be noted that the outermost coil 49 of spring 46 abuts the orifice forming washer 30 during the engine load positions of the plunger 24, and its outer diameter is substantially less than the bore 26 of the valve housing 28. The intermediate coils 52 have an outer diameter slightly less than the bore 26. Consequently, when the spring is compressed, the intermediate coils 52 frictionally engage adjacent wall portions of the bore 26. It has been found that this arrangement not only produces a self-cleaning action because the coils move towards and away from each other as the metering plunger 24 moves back and forth, but the engagement with the walls of the bore 26 also has a dampening effect upon oscillations or jiggling of the plunger.

As best illustrated by FIGURES 11—13 inclusive, as the metering plunger 24 moves back and forth in the metering orifice 32 in response to changes of the pressure differential, the rate of flow is metered by variations in the size of the orifice thereby maintaining a continuous flow. It has been found in numerous tests to ascertain the flow curve that a smooth curve results. It is believed that a contributing factor is the configuration of the metering plunger 24 thus providing along its length the combination of the reduced cylindrical portion 34 which merges into the curved progressively enlarged portion 36. The results of tests of such valves, in a remarkably high number of instances produce a smooth flow curve well within the limits of the requirements of the manufacturer for each type of engine.

In addition it has been found advantageous to provide floating plunger type flow metering valves with a controlled orifice. This is to say that not only is it important that the orifice be of a size to permit some flow during engine operation, but the depth or length of the orifice should be of a size to permit a relief at the outlet side of the orifice when the metering plunger 24 is in the engine idling position, as is best illustrated in FIGURE 13. In the valve structure illustrated by FIGURES 2, 3 and 4, the diameter of the bore 26 on the outlet side of the orifice is substantially greater than the orifice.

In the valve structure illustrated by FIGURE 5, the valve housing 60 is provided with a controlled metering orifice 62 in the bore 64 which is provided with a counter-bore 66 of a length to define an orifice depth which will provide a relief when the metering size of orifice is the least due the position of pin 24 when the engine is idling.

A further means of providing a relief when the metering plunger is in the engine idling position is illustrated by FIGURE 10 wherein the metering pin is undercut at 70 so that the outer diameter is of a reduced cross section between the curved portion 72 and head portion 74 and a relief area is thereby produced when the plunger reaches the extremity of the idling position.

It will be further noted that the metering plunger 24 is of a length whereby in all load positions thereof a portion extends into the orifice 32.

Metering valves embodying the principles of the invention disclosed herein have been subjected to numerous tests which showed they are capable of effecting a continuous flow of crankcase blow-by to the intake manifold for relatively long periods of engine use without interfering with the normal engine performance of numerous types of engines.

Of course, variations of the specific construction of metering valves herein disclosed can be made by those skilled in the art without departing from the invention as defined in the appended claims.

What is claimed is:

1. A flow metering valve adapted for use in an automotive crankcase ventilation system comprising a valve housing having an inlet end and an outlet end, said housing having a metering orifice disposed within its confines, and a spring-loaded metering plunger positioned within said orifice, said spring having a plurality of coils, one of said coils embracing said metering plunger in a press

5

fit, said last mentioned coil being laterally offset relative to the other coils, said plunger being capable of movement towards and away from said outlet end in response to changes in pressure in said ventilation system.

2. A flow metering valve adapted for use in an automotive crankcase ventilation system comprising a valve housing, said housing having an inlet end and an outlet end, said housing having a metering orifice within its confines, a metering plunger in said housing, said plunger being supported by a compression spring having a plurality of coils, one of said coils embracing said metering plunger in a press fit, said last named coil being laterally offset relative to the other coils, said plunger having a body portion and a head portion, the body portion of said metering plunger having a diameter less than the size of said metering orifice, said metering plunger being capable of movement towards and away from said outlet end in response to pressure changes in said ventilation system with portions of said plunger along its length riding against adjacent wall portions of said orifice in all operative positions of said plunger whereby oscillations of the plunger are dampened.

3. A flow metering valve as defined by claim 2, wherein a portion of said metering plunger under all flow conditions extends into said metering orifice.

4. A flow metering valve as defined by claim 2, wherein said one coil of said spring embraces said metering plunger adjacent said head portion.

5. The flow metering valve as defined by claim 2, including means disposed within said housing to provide a relief at the outlet side of said orifice.

6. A flow metering valve adapted for use in an automotive crankcase ventilation system comprising a valve housing having a bore, an inlet end and an outlet end, said housing having a metering orifice in said bore, a metering plunger in said housing having a body portion and a head portion, said plunger being supported by a compression spring having an innermost coil, an outermost coil and intermediate coils, said innermost coil being disposed adjacent the inlet end of said valve housing, said innermost coil being laterally offset relative to the other coils of said spring and embracing said plunger about said head portion and said intermediate coils being of a size that when said spring is compressed, said last mentioned coils fric-

6

tionally engage adjacent portions of said bore to thereby dampen oscillations of said plunger.

7. A flow metering valve adapted for use in an automotive crankcase ventilation system comprising a valve housing having an inlet end and an outlet end, a metering orifice of a uniform diameter disposed within the housing intermediate the ends thereof, a spring loaded metering plunger disposed in said housing, said plunger having a body portion of a lesser diameter than said metering orifice, being movable towards and away from said outlet end in response to changes in pressure in said ventilation system, and being supported by a compression spring having a plurality of coils, one of said coils engaging a portion of said plunger to urge said plunger against a wall portion of said orifice so that portions of said plunger along its length ride against said wall portion in all operative positions of said plunger to dampen oscillations of the plunger, the side of said plunger opposite from the side riding against said wall portion being spaced from all wall portions of the orifice to permit fluid flow through said space.

8. The flow metering valve defined by claim 7, said body portion of said plunger having a reduced cylindrical portion merging into a portion of progressively increasing diameter, at least a portion of the periphery of said last named portion being curved.

9. The flow metering valve defined by claim 7, including means disposed within said housing to provide a relief at the outlet side of said orifice.

References Cited by the Examiner

UNITED STATES PATENTS

2,452,956	11/1948	Robins	251—278	X
3,105,477	10/1963	Lowther	123—119	
3,111,138	11/1963	Humphreys	137—480	

FOREIGN PATENTS

779,175 7/1957 Great Britain.

WILLIAM F. O'DEA, *Primary Examiner.*

ISADOR WEIL, MARTIN P. SCHWADRON,
Examiners.

H. WEAKLEY, *Assistant Examiner.*