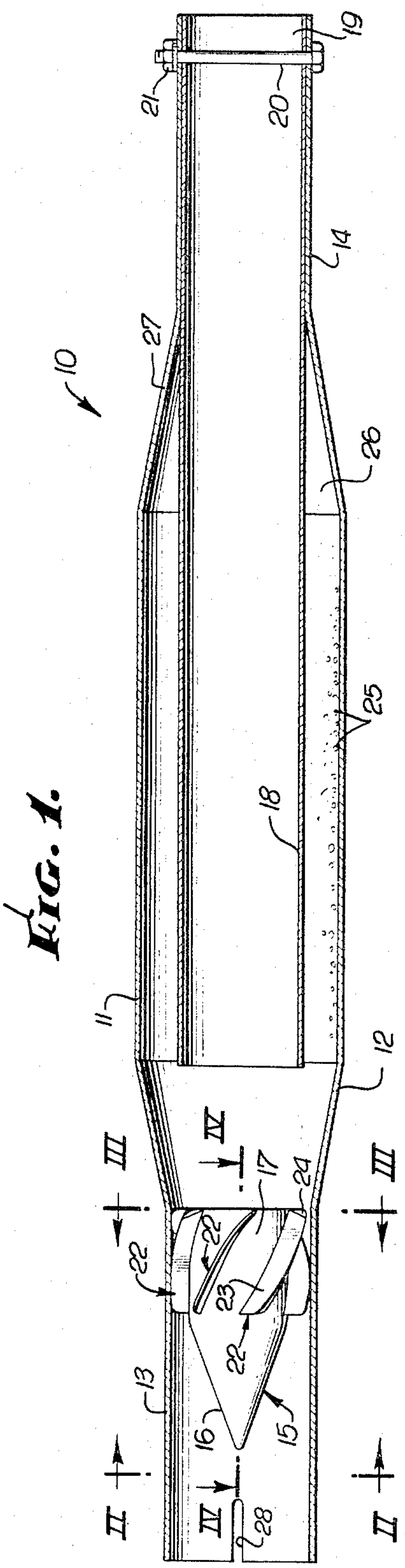
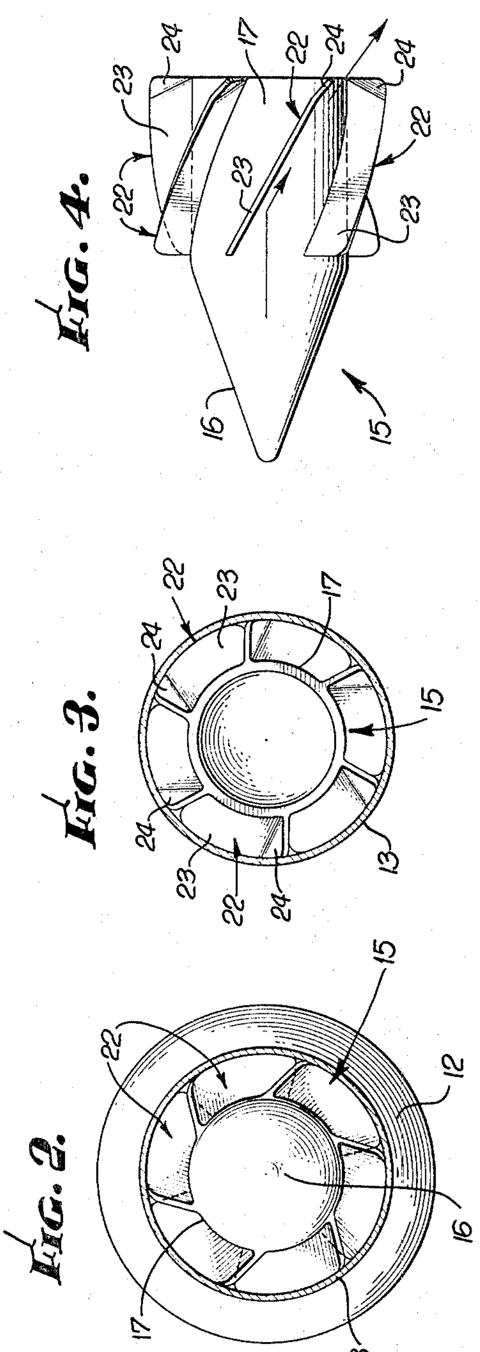
Oct. 29, 1968 J. KRIZMAN 3,407,575

THROUGH-FLOW SPARK ARRESTER

Original Filed Dec. 27, 1965





INVENTOR.
JOHN KRIZMAN

BY Miketta, Glenny, Poms & Smith

ATTORNEYS.

United States Patent Office

3,407,575

Patented Oct. 29, 1968

1

3,407,575
THROUGH-FLOW SPARK ARRESTER

John Krizman, 10549 Monogram Ave., Granada Hills, Calif. 91344

Continuation of application Ser. No. 516,627, Dec. 27, 1965. This application Dec. 8, 1967, Ser. No. 697,543
6 Claims. (Cl. 55—448)

ABSTRACT OF THE DISCLOSURE

A through-flow spark arrester having an outer shell with an enlarged center section which is axially between inlet and outlet sections connected to it by conical portions. The inlet section has means to accelerate and whirl entering gases, and a tubular outlet extends through the center and outlet sections, providing a trap chamber between it and the outer shell.

Cross reference to related application

This application is a continuation of my application Ser. No. 516,627, filed Dec. 27, 1965 now abandoned.

Background of the invention

Spark arresters for small internal combustion engines in vehicles, such as motorcycles or other trail vehicles, or in generators, used in proximity to forests, must conform to standards which establish minimum performance and maintenance requirements designed to minimize the risk from exhaust spark fires.

The performance of spark arresters is measured by "arresting efficiency" which is defined as the percent of carbon particles retained or destroyed by the spark arrester when tested under prescribed conditions in a standard apparatus. An arresting efficiency of at least 80 percent is required for all flow rates from 10 percent of the "rated minimum flow rate" to the "rated maximum flow rate." The "rated maximum flow rate" is defined as the maximum rate of flow at which the back pressure, i.e., the differential pressure from intake to discharge of the arrester, is one pound per square inch. The "rated minimum flow rate" is defined as ten times the lowest flow rate at which 80 percent arresting efficiency is obtained. The "rated flow range" of the arrester is the range of flow rates, in cubic feet per minute, between the rated maximum flow rate and the rated minimum flow rate. Upon determination of the rated flow range of a specific spark arrester, it may be applied in the system of an engine which has an exhaust flow rate within the rated flow range under operating conditions of maximum speed and power.

The drop in arresting efficiency with increase in back pressure is a characteristic of various proposed spark arresting devices which separate carbon particles contained in exhaust gases fed thereto, and in which the gaseous stream undergoes one or more drastic changes in direction of flow, for example, a change in direction of 90 degrees or more prior to discharge to the atmosphere. Such changes in direction of flow in themselves result in an increase in back pressure which adversely influences the arresting efficiency and counteracts the desired objective. In addition, the prior art devices utilizing such systems are limited in their application in that, unless considerations of size are disregarded, they are suitable for use only in very small displacement engines, generally up to about 15 cubic inches.

Further, other types and structures of spark arresters and other separator devices have been known, but these too have not been structures which perform at satisfactorily high arresting efficiencies, while having a minimal

2

increase in back pressure. Some of these devices, for example, provide a structure which causes a re-circulation of gases, usually through a type of trap chamber. Such devices also have the effect of decreasing the arresting efficiency while at the same time increasing back pressure.

In other instances, the prior art has provided highly complex and expensive devices which would be unsatisfactory for the present purposes.

Summary of the invention

The present invention provides a through-flow spark arrester having three main components. The first is an outer shell which has an enlarged center section, and in axial alignment therewith, inlet and outlet sections of relatively smaller diameter. The inlet and outlet sections are connected to the center section by truncated conical portions. Within the inlet section there is a second component, which is in the nature of a cone and cylinder structure positioned coaxially in the inlet section and terminating at the junction of that inlet section with the adjacent conical portion. This structure has fins which extend in the annular space between it and the inside wall of the inlet section, and are so positioned as to impart a whirling motion to the gases and particles passing through this inlet section. In addition, the arrester by virtue of the thus reduced cross sectional area of the inlet section causes the exhaust gases and carbon particles flowing through it to be accelerated to a velocity significantly higher than the entry velocity thereof. The third component is a tubular outlet positioned coaxially within the outer shell and having its entry end adjacent the plane which passes through the juncture of the expanding conical portion (which is near the inlet section) and the enlarged center section, the other conical portion and into the outlet section, being sealed relatively to the outlet section. This construction thereby provides a trap chamber between the tubular outlet and the outer shell which has an entrance only at the annular space surrounding the inlet of the tubular outlet; this trap chamber in normal operation has no outlet. Accordingly, the gases and carbon particles are initially accelerated by the device in the inlet section, and are also caused to have a whirling motion. Immediately after leaving the inlet section, the cross sectional area of the gas passage through the spark arrester substantially increases, so that there is a reduction in the velocity of the gases; however, the carbon particles have substantial momentum due to the velocity imparted to the mass thereof and continue at a relatively high velocity generally in a direction outwardly of the axis of the arrester. They thereby enter into the trap chamber between the tubular outlet and the outer shell. During the initial operation, there is some entry of gas into this trap chamber, to the extent that the gas therein is compressed somewhat. Thereafter, there is no significant entry of gas into the trap chamber, but the gas is diverted into the tubular outlet, and thereby is caused to flow through the tubular outlet without a significant change in direction and without an increase in back pressure.

It is an object of this invention, therefore, to disclose and provide a spark arrester for internal combustion engines having a high arresting efficiency.

It is another object of this invention to disclose and provide a spark arrester including diffuser means for directing the flow of carbon particles contained in an exhaust gas outwardly to a carbon trap and the flow of the exhaust gas to an outlet tube for discharge to the atmosphere.

It is another object of this invention to disclose and provide a spark arrester having an extremely high arresting efficiency, through which an exhaust gas fed from an internal combustion engine travels substantially without changing direction of flow while being separated from carbon particles contained therein.

It is another object of this invention to disclose and provide a spark arrester for internal combustion engines having a displacement up to about 80 cubic inches and adapted to operate in a vertical, horizontal or inverted position.

It is a further object of this invention to disclose and provide a spark arrester which may be economically constructed and assembled and which requires a minimum of maintenance.

Other objects and advantages will be apparent from a reading of the following description and drawing.

Brief description of the drawing

FIG. 1 is a longitudinal sectional view of the spark arrester of the present invention.

FIG. 2 is a transverse section taken along lines II—II of FIG. 1.

FIG. 3 is a transverse section taken along lines III—III of FIG. 1.

FIG. 4 is a top view of the diffusing means shown in FIG. 1 taken along lines IV—IV.

Description of the preferred embodiment

Referring to FIG. 1, the spark arrester **10** of the present invention comprises a tubular outer shell having a relatively long center section **11**. Center section **11** is positioned between the relatively short tubular inlet and outlet sections designated **13** and **14**, respectively. The inlet section **13** and the outlet section **14** are of smaller diameter than the center section **11**, and are in axial alignment with it. Joining and connecting the center section **11** and the inlet section **13** is an enlarging truncated conical portion **12**, and similarly joining and connecting center section **11** with the outlet section **14** is a diminishing truncated conical portion **27**. The terms "enlarging" and "diminishing" are with reference to the direction of flow through the spark arrester **10**.

Within the inlet section **13** there is an accelerating and whirling means **15** comprising a centrally disposed cone portion **16** directed toward the inlet end of inlet section **13**, the base of cone portion **16** being joined to a cylindrical portion **17**, which has a relatively large diameter compared to the internal diameter of inlet section **13** and which thereby provides an annular space between the cylindrical portion **17** and the inlet section **13** which has a reduced cross sectional area in comparison to the cross sectional area of inlet section **13** in advance of the means **15**. In the space between cylindrical portion **17** and inlet section **13** there are a plurality of circumferentially spaced path guiding fins **22**, there preferably being six such fins spaced 60 degrees apart. These fins have substantially straight leading portions **23** and trailing portions angularly disposed to the longitudinal axis of the leading portion, to thereby form deflecting tabs **24**. The fins **22** thereby cause gases and particles passing through the annular space to be whirled in a generally helical path. The fins **22** lie in planes which are angularly related to the longitudinal axis of the means **15**, the leading portion **23** of each fin, for example, preferably being slanted to the radial centerline at an angle of 45 degrees, while the remainder of the fins slant gradually inwardly thereto to the trailing portion including the deflecting tab **24**, which latter slants at an angle of about 15 degrees to the leading portion **23**, as shown in FIGS. 2 and 3. To construct the means **15**, the fin **22** may be joined to the cylindrical portion **17**, as by soldering, and then the entire assemblage positioned within the inlet section **13** and soldered to the interior surface thereof.

It will be observed that the means **15** terminates adjacent the juncture between the inlet section **13** and the adjacent conical portion **12**. At its other end, inlet section **13** has slots **28** to facilitate attachment to the exhaust pipe of an internal combustion engine.

A gas outlet from the spark arrester **10** is provided by a tubular outlet **18** which is positioned within the outer shell. Tubular outlet **18** has an inlet end positioned adjacent the juncture of the enlarging conical portion **12** and the center section **11**, and extends through the center section **11**, the diminishing conical portion **27** and the outlet section **14**. The tubular outlet **18** has a discharge end **19** which terminates at about the end of the outlet section **14**. A portion of the outer surface of tubular outlet **18** is in substantial engaging contact with the inner surface of the outlet section **14**, being held in assembled relation thereto, sealed against the escape of gases and carbon particles, by conventional means such as bolt **20** and nut **21**. The outer shell comprising center section **11** and diminishing conical portion **27** thereby defines with tubular outlet **18** an annular space which may be seen in FIG. 1 to be closed at the juncture of conical portion **27** and outlet section **14**. This annular space forms a carbon particle trap chamber **26** for the carbon particles **25**.

In operation, hot exhaust gases containing carbon particles will be introduced into the inlet end of inlet section **13**, at an average velocity determined primarily by the operating characteristics of the engine and the atmospheric pressure. The velocity of the gases and the carbon particles will remain substantially unchanged until they reach means **15**, where they will begin to be accelerated to a higher velocity. In addition to being accelerated to a higher velocity, the gases and carbon particles will have a whirling motion imparted to them by the fins **22**. As the gases and carbon particles leave the means **15**, the cross sectional area of the passage rapidly increases due to the termination of means **15** and the configuration of enlarging conical portion **12**. Due to the mass and velocity of the carbon particles, they will have a momentum which will not be significantly affected by the enlarging cross sectional area of the passage and the consequent deceleration of the gases; accordingly, the gas particles will continue at relatively high velocity in a whirling and somewhat outwardly directed path, and will thereby enter the carbon particle trap chamber **26**. The exhaust gases will initially tend to compress the gases already existing in the space between the tubular outlet **18** on the one hand and the center section **11** and diminishing conical portion **27** on the other hand. Therefore, these gases being somewhat compressed in an annular space which has only an entrance and a "dead end," will not permit the flowing gases significantly to enter the annular space, but these flowing gases will pass without a substantial change in direction from the enlarging conical portion **12** into the tubular outlet **18**, and thence through the discharge end **19** thereof.

The carbon particle **25** may be removed from carbon trap **26** by removing bolt **20** and then removing the tubular outlet. Alternatively, the arrester may be provided with a suitable opening (not shown) covered by a closure such as a band during normal engine operation. The band may be removed, and the engine operated at a safe location, thereby permitting the engine exhaust to flush the carbon particles **25** from the carbon particle trap chamber **26** and through the opening. To operate in a vertical position, the carbon trap may be extended longitudinally beyond the cylindrical portion of the diffusing means in the direction of the cone portion so that it surrounds the inlet tube beyond the area where the fins are positioned, and a clean-out opening provided in the shell body in the area adjacent to such extension for removal of the carbon particles.

The present invention provides a very compact spark arrester made of a few simple parts, and having a very high spark arresting efficiency without a significant increase in back pressure, or other factor which would interfere with the efficient operation of the engine to which it is attached.

It is to be understood that various modifications may be made by those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.

I claim:

1. A through-flow spark arrester for an internal combustion engine comprising:

a tubular outer shell comprising a center section positioned between inlet and outlet sections, said inlet and outlet sections being of smaller diameter than said center section, in axial alignment therewith, and joined thereto by truncated conical portions, which respectively enlarged and diminish in the direction of flow, said center section being relatively long and said inlet and outlet sections being relatively short;

means centrally disposed within said inlet section for reducing the cross sectional area thereof and causing the gases and particles flowing therethrough to achieve an increased velocity and a whirling motion, whereby said particles have imparted to them a force urging them away from the axis of said arrester, said means terminating adjacent the juncture of said inlet section and the adjacent conical portion, said means including a plurality of circumferentially spaced fins lying in planes angularly related to the radial center line of said means;

and a gas outlet from said arrester comprising a tubular outlet within said outer shell having an inlet end adjacent the juncture of said enlarging conical portion and said outer shell center section and extending within said outer shell, said diminishing conical portion and said outlet section, a portion of the outer surface of said tubular outlet engaging the inner surface of said outlet section, said outer shell and tubular outlet defining an annular space closed at the juncture of said diminishing conical portion and said outlet section, said tubular outlet constituting the sole outlet from said arrester during normal operation thereof;

whereby combustion gases containing solid particles entering said inlet section are accelerated and whirled, the gases then decelerating in the enlarging conical section, enabling the particles to be carried by their momentum through said conical portion and into said annular space, the gases entering the inlet end of the tubular outlet without substantial change of direction and thence passing from said arrester.

2. A spark arrester as defined in claim 1 wherein each of said fins includes a leading portion and a trailing portion, said trailing portion including a deflecting tab disposed in angular relatonship to the longitudinal axis of said leading portion.

3. A spark arrester as defined in claim 2 wherein the leading portion of the fin is slanted to the longitudinal axis of said means at an angle of about 45 degrees and the deflecting tab is slanted at an angle of about 15 degrees.

4. A spark arrester as defined in claim 2 wherein the deflecting tab is disposed at an angle of about 15 degrees to the longitudinal axis of the leading portion.

5. A spark arrester as defined in claim 1, wherein the said fins are spaced apart about 60 degrees.

6. A spark arrester as defined in claim 1, and including releasable means for holding said tubular outlet in said position in said outlet section, whereby said tubular outlet may be readily removed from said outer shell.

References Cited

UNITED STATES PATENTS

588,096	8/1897	Swartzbaugh.
1,215,935	2/1917	Hickman.
2,004,468	6/1935	Hawley.
2,569,909	10/1951	Omney.
2,646,854	7/1953	Walker.
2,659,450	11/1953	Baird.
2,662,610	12/1953	Heinrich.
2,866,518	12/1958	Lincoln.
3,009,539	11/1961	Papp.
3,064,411	11/1962	Breslove.
3,216,182	11/1965	Cochran et al.

FOREIGN PATENTS

1,106,384	7/1955	France.

HARRY B. THORNTON, *Primary Examiner.*

B. NOZICK, *Assistant Examiner.*