

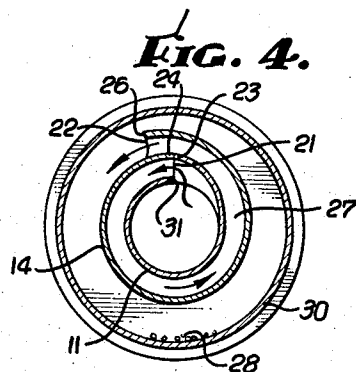
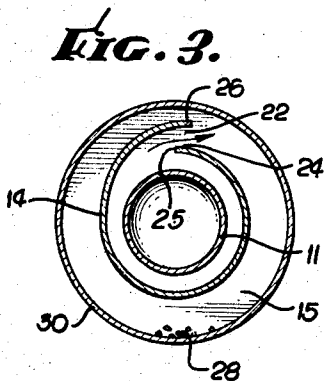
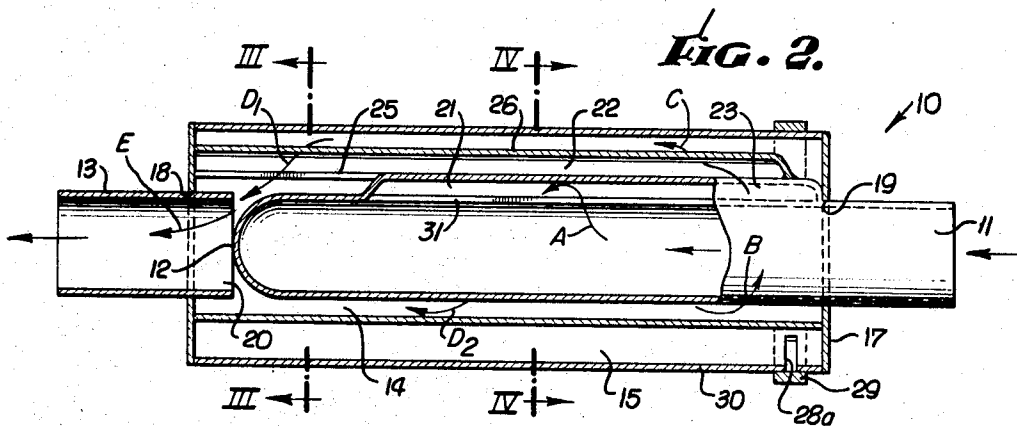
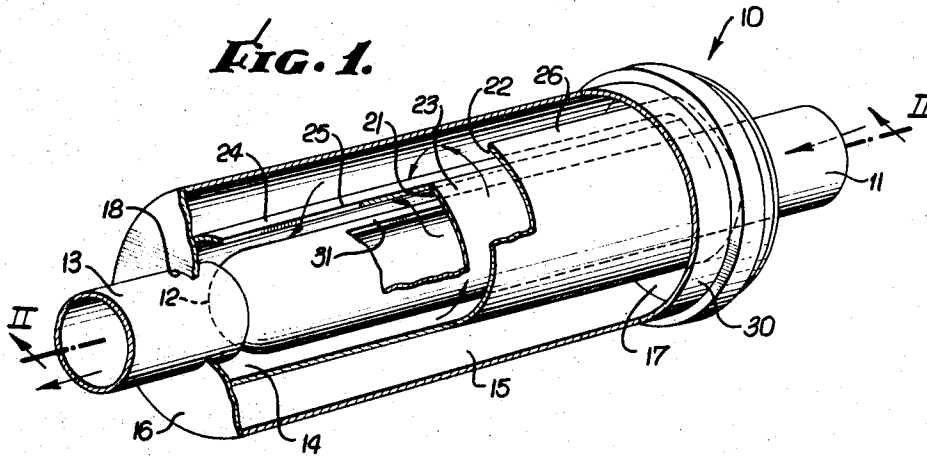
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SPARK ARRESTER

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SPARK ARRESTER

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ABSTRACT OF THE DISCLOSURE

A spark arrester for internal combustion engines, having axially aligned inlet and outlet tubes, the inlet tube having a closed end extending into a casing, and a spiral spark arrester around the inlet tube in the casing arranged to receive a portion of incoming gases, and means for passing another portion more desirably to the outlet tube to preclude buildup of excessive back pressure.

This invention relates to a spark arrester for internal combustion engines. More particularly, this invention relates to a spark arrester for small internal combustion piston engines, such as those in motorcycles and generators, particularly suitable for use in proximity to brush, timber and similar cellulosic materials.

Spark arresters for small displacement 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.

In prior art spark arresters for small displacement engines there results a substantial drop in arresting efficiency when the back pressure exceeds about one pound per square inch. The present invention eliminates this critical back pressure problem and provides a spark arrester having a high arresting efficiency at one pound per square inch back pressure, and in which there is no substantial drop in efficiency with an increase in back pressure beyond this limit.

The present invention further provides a spark arrester adapted to require less metal for construction, as well as fewer welding and brazing operations, than prior art devices, resulting in substantial improvements in the construction and assembly of such devices. The spark arrester of the present invention is adapted also to be combined with standard muffler systems in small displacement engines, for example up to about 15 cubic inches, and to operate in a vertical, horizontal or inverted position at very high arresting efficiencies without an increase in the velocity of the exhaust gases.

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The spark arrester of the present invention is comprised of an inlet tube having a closed end, and an outlet tube, the closed end of the inlet tube and an end of the outlet tube extending into a spiral arresting means contained within a larger tubular outer shell or casing which forms a carbon trap. The open end of the inlet tube is in communication with the engine exhaust and the outwardly extending end of the outlet tube is in communication with the atmosphere. The inlet tube is provided with a longitudinally extending outwardly directed opening for discharge of exhaust gas and carbon particles into the arresting means. The arresting member is provided with opening means for discharge of the carbon particles into the carbon trap formed by the walls of the arresting member and the shell. The inlet tube and outwardly directed opening thereof are positioned in such relationship to the arresting member and its opening that a passage is created between the outwardly directed opening in the inlet tube and the carbon trap whereby a travel path is provided from the inlet tube to the carbon trap for the carbon particles and from the inlet tube to the outlet tube for the exhaust gas. When the particles and gas impinge upon the closed end of the inlet tube, they are forced to be discharged from the tube into the arresting member in a spiral motion through the opening. The relatively heavy carbon particles are thrown outwardly and continue to travel along the inner wall of the arresting member in a spiral travel path and are discharged through the opening of the arresting member to the carbon trap from which they may be removed. The relatively light exhaust gas continues to travel with a spiral motion in the arresting member until it is discharged to the atmosphere through the outlet tube, or impinges upon an end wall of the arresting member whereby a circular motion is imparted to the gas, causing those carbon particles which remained in the gas stream to whirl with the gas in the arresting member and be discharged through the arresting members opening into the carbon trap. Spark arresters having the above structure have consistently surpassed the established performance and maintenance requirements and have been proven to possess extremely high arresting efficiencies and to substantially maintain the same beyond the previous one pound per square inch back pressure limit. For example, arresting efficiencies in excess of 96 percent were obtained at 24 c.f.m. and one pound back pressure and in excess of 94 percent at 42 c.f.m. and four pounds back pressure.

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

It is another object of this invention to disclose and provide a spark arrester for small displacement engines in motorcycles, other trail vehicles, and generators which are used in proximity to cellulosic materials.

It is another object of this invention to disclose and provide a spark arrester including passage means from an inlet tube to an outlet tube for exhaust gas from an engine, and from the inlet tube to a carbon trap for carbon particles contained in the exhaust gas.

It is another object of this invention to disclose and provide a spark arrester for internal combustion engines having a high arresting efficiency which is substantially maintained as the back pressure during operation increases above one pound per square inch.

It is another object of this invention to disclose and provide a spark arresting device for internal combustion engines, including a single continuous spiral chamber formed by the union of an inlet tube and arresting member.

It is another object of this invention to disclose and provide a spark arrester for internal combustion engines.

having a displacement up to about 15 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 adapted for compact construction and resulting in economies in materials, labor and maintenance.

Other objects and advantages will be apparent from a reading of the following description and drawings in which:

FIG. 1 is a perspective view, partly in section, showing the spark arrester of the present invention;

FIG. 2 is a longitudinal sectional view taken along lines II—II in FIG. 1, showing the inlet and outlet tubes extending into the tubular arresting member contained in the tubular carbon trap, and the longitudinal openings in the inlet tube and arresting member;

FIG. 3 is a transverse section along line III—III of FIG. 2 showing the opening in the arresting member permitting discharge to the carbon trap;

FIG. 4 is a transverse section along line IV—IV of FIG. 2 showing the continuous spiral chamber formed by the longitudinally abutting inlet tube and arresting member, and the openings permitting discharge of carbon particles and exhaust gas.

Referring to FIGS. 1 and 2, the spark arrester 10 of the present invention comprises an inlet conduit 11, which may be a tube, having a closed end 12 and an outlet conduit 13, which may be a tube; the outlet tube is shown mounted in wall 16. Inlet tube 11 is shown extending through wall 17 of the outer shell or casing 30, the closed end 12 of such inlet tube terminating in proximity to the outlet tube 13, with which it is in axial alignment. The inner wall of the shell and outer wall of the spirally formed arresting member 14 define a carbon trap 15 into which the carbon particles of the exhaust gas discharge. End plate 16 closes off one end of arresting member 14 and carbon trap 15, and end plate 17 closes off the opposite ends of the arresting member and carbon trap. End plate 16 may be provided with an opening 18 through which outlet tube 13 extends in sealed relationship with the end plate. End plate 17 may be provided with an opening 19 through which inlet tube 11 extends in sealed relationship with the end plate. The closed end 12 of inlet tube 11 may be disposed in longitudinally spaced relationship with the open, inward end 20 of outlet tube 13 which is, preferably axially aligned with inlet tube 11. The opposite end of outlet tube 13 communicates with the atmosphere.

The open end of inlet tube 11 extends outwardly and may communicate with an engine exhaust pipe. It may be secured thereto by bolts or other suitable securing means. The inlet tube may be adapted to be combined with standard muffler systems utilized in small displacement internal combustion engines.

A best seen in FIGS. 2 and 4, inlet tube 11 may be provided with a discharge opening which may be an opening extending longitudinally substantially along the inwardly extending portion of the tube, preferably in the form of a longitudinal slot 21. One method of forming the outwardly directed opening from the tube is to form a slit longitudinally in the wall of the tube. Longitudinal edge portion 23 of slot 21 of the inlet tube may preferably be flared outwardly way from longitudinal edge portion 31 as shown in FIG. 4, to increase the circumference of the tube at edge portion 23. As shown in the drawings the outwardly directed opening formed in inlet tube 11 preferably extends from the end wall 17 towards the closed end 12 of the tube but terminates at a point spaced from such closed end. This longitudinal edge portion 23 of the tube may be secured, by means of welding or by other satisfactory means, to longitudinal edge portion 24 of a spirally formed arresting member 14 whose exterior longitudinal and unsecured edge is indicated in FIGS. 1 and 2 at 25. Longitudinal edge portion 26 of member 14

which defines opening 22 may be similarly flared outwardly. Consequently a single spiral chamber 27 may be formed by the union of the inlet tube and the arresting member and a continuous spiral travel path provided for movement of the carbon particles from the inlet tube until they are eventually discharged into carbon trap 15. It will be noted that the longitudinal marginal edge portion 26 of the spirally formed arresting member 14 is virtually above the marginal edge 24 (see FIG. 3); these two edges 26 and 24 extend in a zone encompassed by a narrow radial angle; the spacing between these edges forms an opening 22 discharging into trap 15. Edge portion 26 of member 14 approaches but does not contact the inner surface of casing 30.

As best seen in FIGS. 1 and 2, and as shown by the arrows indicating direction of flow, the stream of exhaust gases and the incendiary carbon particles 28 contained therein, enter inlet tube 11 and travel in longitudinal flow along the tube until they impinge upon the wall of closed end 12 of the inlet tube, whereby they are forcibly laterally discharged through the opening 21 into arresting means 14 with a change in direction of flow (see arrow A) from longitudinal flow to spiral flow. Compared to the weight of the gaseous particles, the relatively heavy carbon particles, due to centrifugal force, tend to hug the inner wall of the arresting member, travelling along the continuous spiral travel path in spiral chamber 27 formed by the union of the chambers of inlet tube 11 and arresting member 14, (see arrow B) until they are discharged through opening 22 into carbon trap 15.

The stream of exhaust gas continues to travel in spiral flow in the arresting means (see arrow D2) until it is discharged through opening 20 in outlet tube 13 to the atmosphere. A portion of the gas stream remaining in the arresting member impinges upon the inner surfaces of end plates 16 and 17, thereby imparting a circular motion to the gas and causing the remaining carbon particles in the gas stream to whirl with the gas stream until discharged through opening 22 into carbon trap 15 (see arrows B and C) and then around edge portion 25 to opening 20 (see arrows D and E).

To facilitate the removal of carbon particles from the carbon trap, outer shell 30 may be provided with an opening means 28a, preferably in the form of an elongated slot, as shown in FIG. 2. During normal engine operation, the slot is covered by a closure means 29 which may be a band secured circumferentially around the shell, by a bolt or similar means to effect an air-tight seal. When it is desired to remove the carbon particles from the carbon trap, band 29 is removed from the shell and the engine is operated, whereby the exhaust pressure causes the particles to be discharged through opening 28a into the atmosphere. To operate in an inverted position, the carbon trap may be extended towards the outwardly extending end of the outlet tube and a clean-out opening provided in the shell adjacent that end.

The longitudinal openings or other discharge means in the inlet tube and arresting means may be adjusted to determine the velocity of the gas. The total flow area in the opening provided in the inlet tube may preferably be adjusted to be substantially equal to the total flow area of the inlet tube so as to effect no increase in velocity, although a change in direction of flow is effected in the arrester. The opening in the arresting member may be similarly adjusted.

To assemble the spark arrester of the present invention, the inlet tube and arresting member may first be sealed together, for example, by welding or otherwise joining a longitudinal edge of the longitudinal slot of the inlet tube to a longitudinal edge of the slot of the arresting member. The single chamber thus formed may be inserted in the shell along with the outlet tube, and the end plates affixed thereto to position the member and outlet tube as herein indicated.

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The present invention thus provides a compact spark arresting device which requires a minimum amount of metal, is assembled quickly and operates efficiently over a large range of back pressure conditions.

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 compact spark arrester for an internal combustion engine comprising:
 - a cylindrical casing having opposed end walls;
 - a discharge tube extending through an end wall of the casing;
 - an inlet tube extending axially through the opposing end wall into said casing, said inlet tube having a closed end in proximity to the discharge tube; said inlet tube being longitudinally slit for a portion of its length within the casing from adjacent said opposite end wall to a zone longitudinally spaced from the closed end of the inlet tube, one marginal edge portion of the tube at said slit being outwardly flared to form an outwardly directed opening;
 - an arresting member of spiral form positioned longitudinally in said casing and surrounding said inlet tube, a portion of the inner longitudinal marginal edge of such member being secured to the flared edge portion of said tube;
- whereby a portion of exhaust gases may pass from said inlet tube into said spiral arresting member and another portion may pass around the closed end of

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the inlet tube into the discharge tube thereby preventing generation of excessive back pressure in the device.

2. A compact spark arrester as indicated in claim 15 wherein the spiral arresting member extends from end wall to end wall in said casing and includes a free longitudinal edge in spaced relation to said cylindrical casing.

3. A spark arrester as stated in claim 15 wherein the arresting member includes an inner longitudinal marginal edge and an outer longitudinal marginal edge, a portion of the inner marginal edge being secured to the flared edge portion of said tube and the outer marginal edge is in spaced relation to said cylindrical casing and extends in a zone within a narrow radial angle with respect to said inner edge.

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