H. C. GIBSON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED DEC. 30, 1908.

965,135. **Patented July 19, 1910.**

Fig. I.

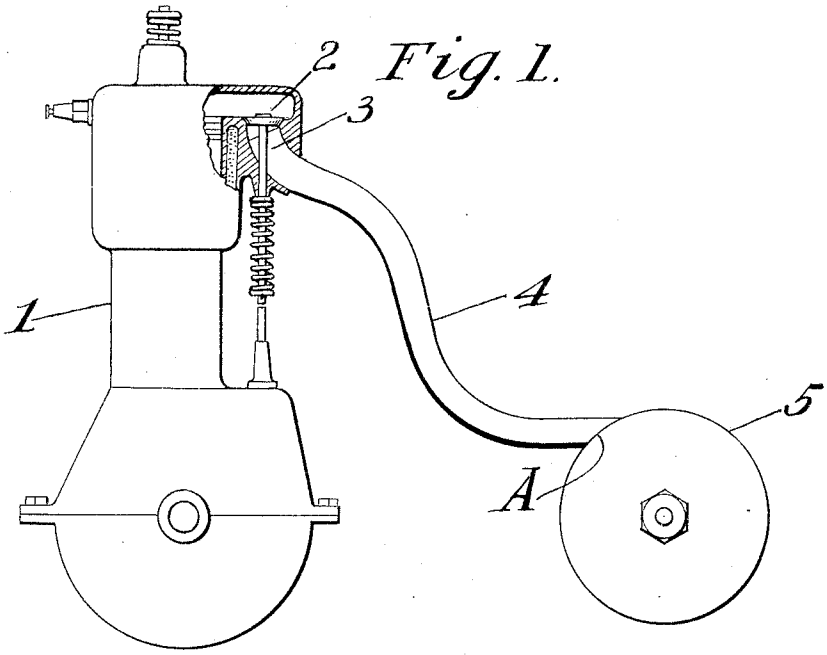


Fig. II.

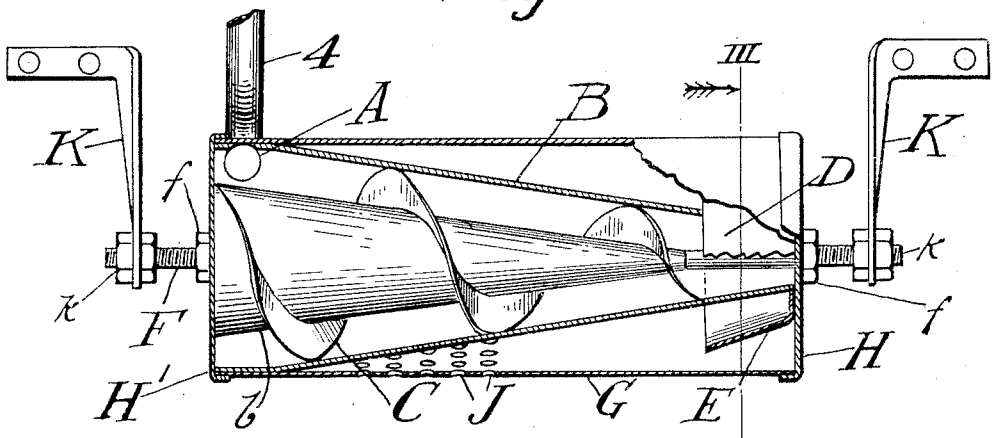
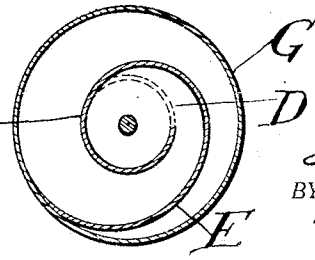


Fig. III



WITNESSES:

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INTERNAL-COMBUSTION ENGINE.

965,135. Specification of Letters Patent. **Patented July 19, 1910.**

Application filed December 30, 1908. Serial No. 470,014.

To all whom it may concern:

Be it known that I, HUGO C. GIBSON, a British subject, residing in the borough of Manhattan, city and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a description, reference being had to the accompanying drawings, forming a part hereof.

My invention pertains to devices and constructions which would usually be used in connection with internal combustion engines, but likewise of broader application; while in particular their use in conjunction with engines is most advantageous when embodied on an automobile.

In the form of my invention herein shown and described is illustrated the use of my invention in what is generally known as a muffler or exhaust silencer for an internal combustion engine. In this connection it is well-known that for various practical reasons it is not, in the general use of engines, particularly on automobiles, feasible to exhaust the products of combustion directly into the air from the cylinder. The noise is one serious objection, while the location of the engine is usually such as to bring a direct exhaust where the gases will be obnoxious or dangerous. The usual practice is to lead the exhaust gases from one or more cylinders, through a common exhaust pipe to the rear of the vehicle, or in other engines to any desired exit. The result of so confining the gases usually causes a back pressure in the cylinder resisting the expulsion of the products of combustion. In order, however, to deaden or muffle the noise of the final exhaust, numerous forms of devices, called silencers or mufflers, have been used which can generally be described as involving baffle-plates against which the gas is impinged and which divide a box into alternating compartments, or otherwise necessitating a circuitous, irregular path with twisting and turning before the final outlet. Such devices cause some and often considerable back pressure in the cylinder, resisting the expulsion of the products of combustion, and which consequently amounts to lost work on the part of the engine. I have overcome all of the objections usual in devices of this character, and by my invention secure a substantially complete muffling of the exhaust of gases from an intermittent source of expulsion, and in addition, when used with an internal combustion engine, my invention causes an average effective vacuum which tends to draw products of combustion out of the cylinder at the time of the exhaust, which avoidance of back pressure at that time means a direct gain in power for the engine. In the actual practice of my invention in such applications, I find that measurements show a very substantial vacuum under the conditions above stated and a corresponding improvement in the operation of the engine, in connection with which the device has been used.

To more specifically describe one form of my invention, I have shown in the accompanying drawings in—

Figure I. a side view of a gasolene engine in part section, with the connections from the exhaust to the muffler; Fig. II. a longitudinal section through the muffler shown in Fig. I.; Fig. III. an end view of section taken at III—III in Fig. II.

In the particular form of embodiment of my invention, which I have chosen to illustrate herewith, 1 is a gas engine, 2 the exhaust valve thereof, 3 the exhaust port, 4 the exhaust pipe connection to the muffler 5. The muffler comprises the intake A, the conical casing B, spirally arranged deflectors or walls C, the outlet D of the conical casing, the spiral deflector E, the rod F and outer casing G, ends H, H′, the openings J from the outer casing, muffler clamping nuts *f*, brackets K and bracket clamping nuts *k*.

Referring to the drawings of one particular form of embodiment of my invention, the engine 1 may be any internal combustion engine such as a multi-cylinder engine used in an automobile, which upon the raising of the exhaust valve 2 allows the passage of the products of combustion through the exhaust port 3, which are carried by the exhaust pipe 4 to the muffler. The exhaust pipe enters the cylindrical casing of the muffler in a tangential direction, so that the gases leaving the exhaust pipe are gradually turned in their movement in the muffler by the curved surface of the conical casing B. They enter the conical casing at the larger end, and the spiral walls or partitions C guide the gases in a helical direction toward the smaller end of the case B. In this manner the axial direction of the moving column

of gases is gradually deflected to a smaller and smaller radius of twisting until they substantially constitute a vortex at the smaller end of the casing B. At this end, however, a peripherically large portion of the side of the casing B is cut out leaving an aperture relatively larger than the area of the inlet A. Fashioned to this outlet D is a spiral deflector E, as shown in Fig. III., which guides the gases, now subject entirely to centrifugal force, outwardly into the space formed by the larger surrounding casing G through which they pass to the exit from the outer casing consisting of numerous holes or perforations J. Convenience of manufacture is offered by constructing the conical casing B with its internal construction and slipping the same into the cylindrical casing G and affixing the caps H and H′ to either end, and passing a rod F from end to end through the caps H and H′, while nuts *f* screwed onto either end of rod F clamp the entire muffler construction firmly together as a unit. For convenience of attaching the muffler, I have in this particular embodiment extended the rod F at either end so that it may engage brackets K K conveniently attached at any suitable place to the automobile or other object, and by means of the nuts *k* the muffler as a unit can be firmly attached or readily detached from or into position. In this construction exhaust gases enter the larger end of the conical casing B, and as in the form shown I have inserted an internal smaller conical casing *b*, a passage is formed between the inner cone *b* and the outer cone B, and the partition walls C, so that the gases are gradually turned in their direction of movement, but the section of the passageway is increasing as the smaller end of the casing B is approached, so that the gases may expand, tending gradually to reduce to atmospheric pressure. The dimensions of the device are such that they have substantially expanded near or to atmospheric pressure by the time they reach the vortex of the end of the cone, but in so doing they have not been obstructed by any baffle-plate and therefore their momentum has not been decreased. At the same time the arrangement has brought the convolutions of the passageway compactly together, so that in the small space permissible for a device of this character a long passageway and ample distance for expansion and time for expansion has been achieved. A most important point, however, is involved in the fact that the discharge from the exhaust pipe 4 into the muffler casing is at the larger end of the conical casing, so that any noise, owing to the inrushing gases, is not magnified as would be the case in originating a noise at the smaller end of a flaring compartment. As the volume and speed of inrushing gases varies with the operation of an engine of this character, and may vary in any source of intermittent discharge in connection with which my apparatus may be used, it is not always possible to determine fixed proportions of the passageways or the pitch of the helix, which will give the absolutely accurate time and size for expansion of the gases to atmospheric pressure, under all of the varying conditions. For such varying conditions I therefore prefer to add the additional outer casing G, which receives the gases from the conical casing and from which they then find their way into the outer air, as through the perforations or any other suitable means in the outer shell. To more gradually deflect these gases from the small end of the conical casing B, I adapt the spiral or evolute compartment, and to still further aid in the gradual deflection of the direction of movement, I flare the compartment outwardly toward the exit end of the larger casing.

While I have shown and fully described a particular form of embodiment of my invention in a structure which has given most remarkable results in actual practice, I do not wish to confine myself to the particular construction shown and described. In many cases it is unnecessary to insert the inner cone *b*, but the movement of the gases leaves an inert core while the gases thus swirl out in contact with the outer casing. As the initial deflection to a circular motion is at the large diameter of the cone B, the skin friction at the entrance of the muffler is minimized and the small retardation due to contact with the surfaces is very gradually increasing.

An important feature involved is a fact that with no obstructions, the gases pass through my muffler expanding as desired, and gradually exhausting silently and under little pressure, but, maintaining their momentum, a practically continuous column or moving mass proceeds through the structure substantially unaffected by the intermittent or pulsating discharge from the exhaust port of the engine. As a result the mass of gases passing uninterrupted when the exhaust valve 2 is closed, tends to create a vacuum in the exhaust pipe 4.

I have found that a very substantial suction is produced in the exhaust pipe in the use of my invention, whereas in engines heretofore an obstacle to high efficiency has been a back pressure in the exhaust pipe. With my muffler it is posible to get such a suction that upon the opening of the exhaust valve the exit of products of combustion will be more rapid than has heretofore been possible, which reduces the pressure at that stroke of the engine, and sucking out the gases as it does, has the effect of more thoroughly scavenging the cylinder than is possible in the use of other forms of mufflers.

This is particularly advantageous in 2-cycle internal combustion engines preventing many of the troubles which have heretofore existed.

In actual practice the substitution of my muffler for the usual form of mufflers, has made possible increased power and greater flexibility in the engine, readily and very substantially enabling an increase in speed of operation and other advantages.

While various other forms of construction could be made to embody my invention, it will be seen that having the stream of gases deflected, as described, brings the portions of the passage side by side resulting in the maximum possible length of passageway for a given over-all size of apparatus. Under some conditions of operation I have found that substantially all noise is eliminated, and the beneficial results of my invention obtained without any additional outer casing beyond the conical casing. In its thus simple form my device consists of a piece of bent sheet metal secured at its edges, into which may be loosely or otherwise placed a band of sheet metal which forms the spiral. In all, this comprises a device extremely cheap in construction and simple in manufacture, and with all the very great advantage inherent to the particular design. The structure at the same time is light and can readily be attached to a vehicle or any suitable place in proximity to the engine in coöperation with which it is used.

It will be noted that the gases are free to escape at the small end of the expanding passage, and as their momentum has been maintained, no sudden change in their direction having been caused, they issue due to centrifugal force and practically suck the column of gases behind them. In other forms suitable deflectors made cause the sucking outlet in view of the momentum.

As it will be seen that my invention may be embodied in various forms and constructed with various changes in design and material, and used in various connections other than such as have been herein specifically described or shown, what I claim and desire to secure by Letters Patent is:

1. In combination with an internal combustion engine, a device interposed between the exhaust therefrom and the exit of gases to the air, including a passage for diverting the direction of movement of the gases and permitting their expansion substantially to atmospheric pressure at their exit, a port at their exit adapted to permit unbaffled passage in the direction of their velocity.

2. In combination with an internal combustion engine, a device interposed between the exhaust from said engine and the exit of gases to the air, including a passage for gradually diverting the movement of the gases from linear to vortex motion and permitting unbaffled exit of said gases in the direction of their velocity to free air.

3. In combination with a gas engine, a muffler having a passage the contiguous portions uniformly increasing in section and gradually varying in direction to a free exit.

4. In combination with a gas engine, a muffler having a passage the contiguous portions of which are side by side and present a gradually varying axial direction and unbaffled exit.

5. In combination with a source of intermittent discharge of gases under pressure, a device interposed between said source and the final exit of the gases to the air, including a spiral passage or duct, and a final port permitting unbaffled exit in the direction of their velocity.

6. In combination with a source of intermittent expulsion of gases, a device adapted to receive and discharge the gases including a compartment, curved walls in said compartment, an inlet to said compartment at its larger end, a relatively greater outlet from said compartment at its relatively smaller end.

7. In combination with a source of intermittent expulsion of gases, means to receive said gases and discharge same including a conical compartment, an inlet at the larger end of said conical compartment and an outlet for the discharge of the gases at the smaller end thereof.

8. A gas engine muffler comprising a conical chamber, ribs in said chamber adapted to guide gases in a spiral direction therethrough and from the smaller end into the free air.

9. A muffler comprising a conical compartment, an inlet thereto at its larger end having a relatively smaller area than an outlet at the smaller end of said compartment.

10. In a gas engine muffler, an exhaust passage of gradually increasing sectional area surrounded by a wall forming a compartment of constantly decreasing sectional area from the inlet end to the gas outlet end thereof.

11. A muffler including a conical compartment, an inlet from the engine exhaust to the large end of said compartment, walls adapted to guide the gases helically through said compartment, a deflecting case or cap for the gases over the smaller end of said compartment.

12. In a muffler a conical compartment, an inlet thereto at its larger end, a deflecting wall disposed at the gas exit at its smaller end.

13. In a muffler a truncated conical compartment, an inlet thereto adapted to deliver gases tangentially at its larger part, walls dividing said compartment into a passage

gradually varying in direction and increasing in section, a casing surrounding said compartment, a spiral deflecting wall near the smaller end of said compartment and means of exit from the outer casing near the larger end of and outside said conical compartment.

Signed at New York this 29th day of December, 1908.

HUGO C. GIBSON.

Witnesses:
DANIEL J. GUINAN,
H. MUCHMORE.