May 27, 1924. 1,495,690

W. HAYES

MUFFLER

Filed Aug. 30, 1920 2 Sheets-Sheet 1

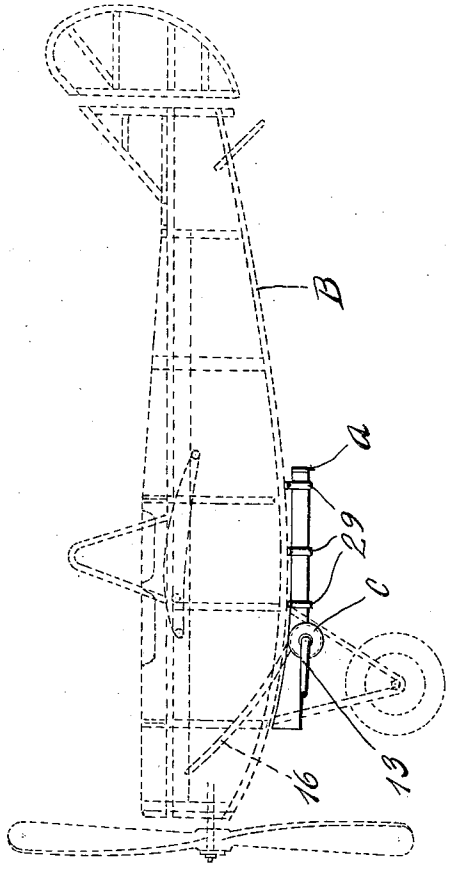



FIG. 1.

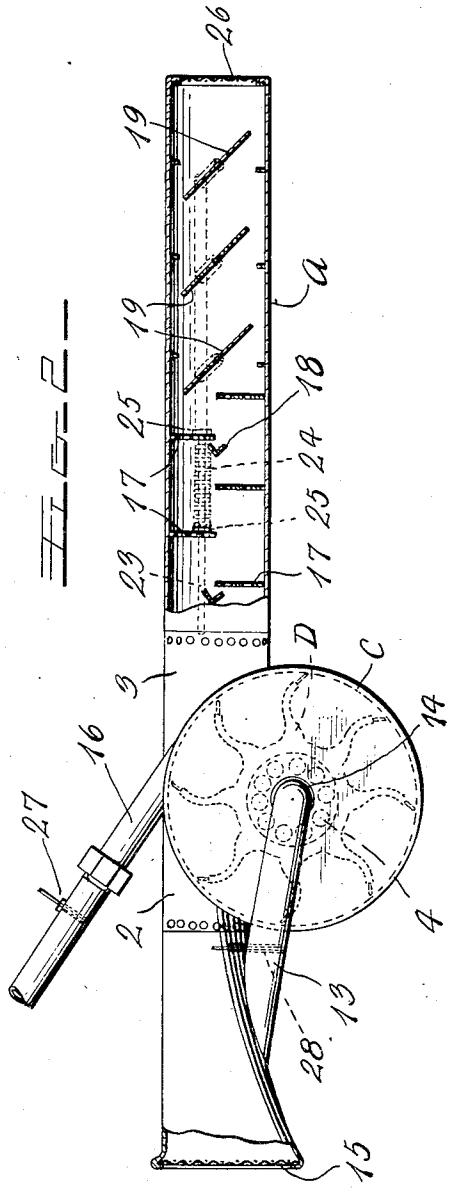



FIG. 2.

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Fig. 3.

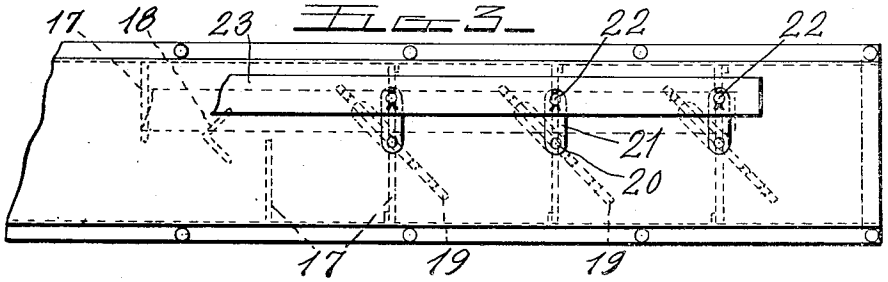



Fig. 4.

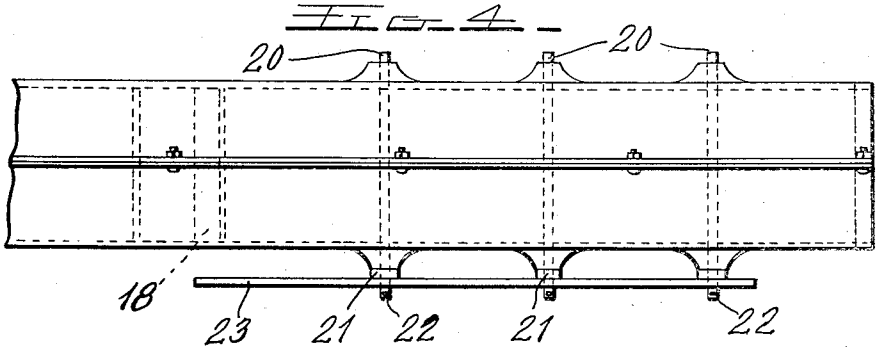



Fig. 5.

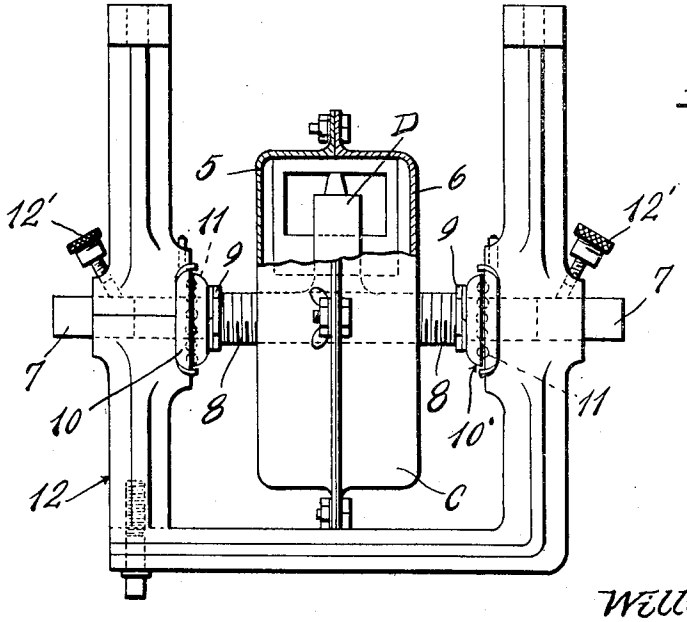
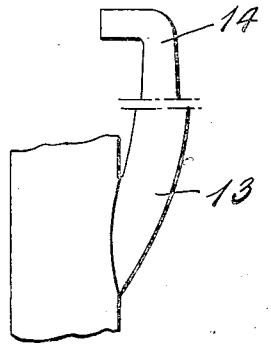



Fig. 6.




Inventor

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Patented May 27, 1924. 1,495,690

# UNITED STATES PATENT OFFICE.

WILLIAM HAYES, OF REPRESA, CALIFORNIA.

## MUFFLER.

Application filed August 30, 1920. Serial No. 406,829.

*To all whom it may concern:*

Be it known that I, WILLIAM HAYES, a citizen of the United States, residing at Represa, in the county of Sacramento and State of California, have invented certain new and useful Improvements in Mufflers, of which the following is a specification.

My invention relates to certain new and useful improvements in mufflers for propelling-engines of the internal-combustion type, such as are suitable for aeroplanes, automobiles, and other vehicles operated at high speed and where it is desired that the exhaust be baffled or muffled to reduce or eliminate as far as possible the noise in the engine-cylinders.

A leading object of the present invention is the construction of a simple apparatus for positively muffling the engine explosions, and to eliminate all back-pressure of the exhaust, and to drain all exhaust gases from both the exhaust pipe and the cylinders, and at the same time render the operation of a gasoline propelled vehicle substantially noiseless.

With the above and other objects in view my invention consists of the parts, and the constructions and arrangements of parts which I will hereinafter describe and point out in the appended claims.

In the accompanying drawings forming part of this specification and in which similar reference characters indicate like parts in the several views;

Fig. 1 is a side elevation of a muffler embodying my invention and showing the same attached to an aeroplane, the latter being shown by dotted lines.

Fig. 2 is a part side and part sectional view of the muffler detached and shown on an enlarged scale.

Figs. 3, 4, 5 and 6, are enlarged details of construction to be hereinafter referred to.

In carrying out my invention, it is my purpose to construct a muffler which may be readily applied to an aeroplane, automobile, motor-cycle, railroad passenger car and in fact any vehicle which is propelled by the explosion of an internal combustion engine where the vehicle is propelled at high speed, and where it is desired to eliminate the back-pressure of the exhaust while at the same time to reduce or to entirely eliminate the noise incident to the cylinder explosions. For the present purpose, I have shown the muffler, A, attached to a conventional form of aeroplane B, since said muffler is especially useful in connection with machines of this character. The muffler, in the instance noted, is suitably supported on the fuselage of the machine and said muffler is of tubular form and may have such longitudinal and transverse dimensions as will be considered desirable or necessary for the particular machine with which it is to be associated. The front portion of the muffler is made substantially funnel-shaped and its outer or intake end is of substantially a segmental or crescent form in cross-section, the said funnel portion of the muffler extending rearwardly and fitting the front or inlet end of a fan casing or housing, C, which housing is of cylindrical form and has the front and rear tubular extensions, 2, 3, respectively to the former of which the smaller or rear end of the conical front of the muffler is fitted and secured; to the rear extension, 3, of the fan casing the tail or rear portion of the muffler is fitted and supplied with baffles, dampers and other agencies, which I will hereinafter mention.

Within the fan casing rotates the fan, D, which may be of any approved construction. Preferably this fan is mounted upon ball or roller-bearings, 4, so as to make its operation more sensitive and to reduce friction to the minimum amount, the upper portion of said fan having its blades extending into the passage through which the air taken into the muffler through the conical intake will impinge and thus give rotation to said fan.

The fan casing is, preferably, made of similar parts or sections, 5, 6 (Fig. 5) with abutting flanges by which they may be secured together either by brazing or by the use of bolts or other fastenings. The shaft, 7, upon which the fan casing is mounted is hollow and has threaded portions, 8, for the engagement of lock-washers, 9, which serve to secure inside and outside ball races, 10 10′, in proper relation to each other so as to confine the intermediate series of balls, 11, the end portions of said shaft being turned down to form journals which extend through a U-shaped hanger-frame, 12, against which the ball-races are appropriately held by the lock-washers, said frame being recessed on the inner faces of its side members so as to receive the corresponding portions of the outside ball races. Provision is also made for the proper lubrication of the shaft and to this end I show grease-cups,

12', as fitted to the hanger-frame and adapted to deliver lubricant to the journal ends of the shaft.

Connecting with the conical front or air-intake portion of the muffler casing at a suitable point in rear of the inlet thereof, is a pipe or conductor, 13, which leads rearwardly to the fan casing and has its inner end provided with a right-angled portion or elbow, 14, (Fig. 6), which is designed to make proper connection with one end of the hollow shaft 7, upon which the fan is mounted. The purpose of this arrangement is to conduct a portion of the air taken into the inlet of the muffler casing directly to the hollow shaft where it acts to cool the bearings thereof, and assist lubrication, which in practice, will be supplied to the bearings by any of the well known and approved methods. Over the front end of the muffler casing is fitted a screen, 15, which may be secured thereto by bolts, nuts or by any other method.

Communicating with the fan casing and preferably with the upper end of the same is the exhaust pipe, 16, which leads from the engine cylinders and through which the spent gases are exhausted by suction induced by the rotating fan, D. said fan delivering these gases into the rear or tail portion of the muffler casing and which portion I prefer to make of two similar sections with flanges by which they can be secured together, each of said sections being provided with perforated baffle plates, 17, arranged in staggered relation so as to form substantially a broken or tortuous course through this portion of the muffler. To further retard the flow of the exhaust gases through the rear of the muffler I also provide in advance of certain of the baffle plates, suitable deflectors, 18, which may be in the form of angle plates appropriately fixed and extending transversely across the exhaust gas passage, as shown in Fig. 3. A simple and desirable way of securing these parts will be by brazing, welding or otherwise fastening the flanged sections of the muffler casing and brazing or otherwise securing the deflectors to the sections or otherwise in their proper position. The fan casing being made of similar sections with abutting flanges may also have the latter united by brazing, welding or by other well known means.

The rear or tail portion of the muffler casing is continued beyond the perforated baffle plates, 17, and in this rearward part I locate suitable swinging dampers, 19, which are adapted to open and close the passage through the tail portion of the muffler. These dampers are provided with journal pins, 20, or are otherwise pivotally mounted and from the axis of each of the dampers extends a rocker arm, 21, provided with a wrist pin, 22, adapted to an opening in a reciprocating bar or lever, 23, which extends longitudinally along the outside of the muffler casing and in practice is designed to be connected through appropriate hand or foot lever mechanism (not shown) within the control of the operator of the machine, so that upon actuating the said mechanism, the rod or lever, 23, is moved in the direction of its length thereby causing the rocker arms, 21, to turn about their pivotal centers and the dampers to open or close as conditions require, thereby controlling the flow of the exhaust gases and the discharge of the same through the outlet of the muffler casing. The longitudinally movable lever or rod is provided with a spring, 24, and it operates in suitable guides or bearings, 25, and which spring is confined between said bearings and is designed to return the parts, including the dampers, to their normal closed position when the connections with the rod are released by the operator. In Fig. 4, I show the journals or pins of the damper-plates as projecting from both sides of the muffler casing so that, if desired, the casing may be provided on either or both sides with one of the reciprocating damper-operating rods and coacting parts, heretofore described. The extreme end of the muffler casing is protected by a wire screen, 26, bolted or otherwise secured in place in much the same manner that the screen over the front or intake end of the casing is secured.

In addition to the foregoing I may use a cut-out valve, 27, in the exhaust pipe, 16, leading from the cylinders to the fan casing, and I may also use a cut-out valve, 28, in the air conductor, 13, which leads from the front portion of the muffler to the hollow shaft upon which the fan is mounted, the latter valve being, preferably, of the plunger or gate-type, but other forms of valves may be used if desired. Springs may be used in connection with these cut-out valves as well as on the damper actuating rod, said springs having sufficient strength to normally hold both dampers and cut-out valves in closed position; the dampers are designed to open when the machine is standing still, to eliminate back-pressure and the cut-out valves are intended to be closed when the machine is flying at high altitudes.

The muffler heretofore described is designed to be held to the fuselage by any appropriate means as iron bands, 29, or the like, so as to hold the parts in rigid relation to the machine. While I have shown the muffler and its rear extension as being substantially longitudinally in line, it will be apparent that these parts may be otherwise relatively arranged, accordingly their position may be modified without materially altering the character of my invention.

From the foregoing description it will be apparent that my improved muffler will eliminate the objectionable back-pressure on the exhaust, which is present in many other muffler constructions and therefore the engine explosions will be substantially noiseless. As a result of these conditions, mileage will be increased and the tendency to pre-ignition will be reduced.

The described muffler may be built of different sizes and shapes to more readily adapt it to the particular machine with which it is to be used, from the smallest size for motorcycles to the largest for railroad passenger cars.

In each instance, however, my muffler will embody means for conducting an air-current to the fan for driving the latter; means for conducting a portion of the air entering the intake of the muffler to the fan-shaft for cooling the bearings thereof; an independent hanger construction by which the muffler and fan casing may be secured to the fuselage of the aeroplane, or to the body of a vehicle; a series of perforated baffle plates; a series of movable dampers controlled by the operator; and the overhead exhaust pipe so situated relatively to the fan casing that the fan breaks up the gas formation for its passage to the tail portion of the muffler, and the engine exhaust is drained while the exhaust valves are open on which is known as the minus lap on the engine valves; this insures drainage of exhaust gases from the engine cylinders as well as from the exhaust pipe leading to the fan casing.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. A muffler for internal combustion engines of high speed vehicles comprising a casing open at the front and rear for the passage of an air current; a fan enclosed by said casing having a portion intercepting the air current whereby said fan is rotated; and an exhaust conductor having one end connecting with the casing adjacent the fan whereby an induced suction is created in the conductor and the drainage of spent gases is effected.

2. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; and an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases.

3. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; and an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear portion of the casing.

4. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear portion of the casing, and baffles in said rear portion of the muffler casing in the path of said gases.

5. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear of the casing; a series of connected dampers in the rear portion of the casing; and means for actuating the dampers.

6. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the

same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear portion of the casing, a series of dampers in the rear portion of the casing adapted to open and close the passage therethrough, and an actuating member connected with the dampers.

7. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear portion of the casing; a series of perforated baffles in rear of the fan; a series of swinging dampers in rear of the baffles, and a reciprocable rod connected with and actuating the dampers to open and close the air passage through the rear of the casing.

8. A muffler for internal combustion engines of high speed vehicles having a casing with a passage extending through it and open at the front for the free admission of the atmosphere; a fan enclosed by said casing having a part extending into said passage and subjected to the impingement of the air-current passing therethrough whereby said fan is rotated; an exhaust pipe having one end connecting with the casing in proximity to the fan whereby the latter induces a suction in the pipe to drain the same of exhaust gases, said fan being mounted in an intermediate portion of the casing and adapted to break up and deliver the exhaust gases into the rear portion of the casing; a series of perforated baffles in rear of the fan; a series of swinging dampers in rear of the baffles; a reciprocable rod connected with and actuating the dampers to open and close the air passage through the rear of the casing; and a spring connecting with the rod adapted to normally hold the dampers in closed position.

9. A muffler for internal combustion engines of high speed vehicles having a casing open at the front and rear for the passage of an air-current; a fan in said passage actuated by the impingement of the air-current thereagainst; and an exhaust conductor in which a suction is induced by the fan, the portion of the casing in front of the fan being of conical form and the inlet end of the casing being of flattened, substantially segmental shape in cross-section.

10. A muffler comprising a casing having a passage through it open at the front for the free admission of an air current; a fan enclosed by said casing; a hollow shaft for the fan; a mounting in which the shaft is journaled; and a pipe for conducting a portion of the air current from the casing to the interior of said shaft.

11. A muffler having a casing open at both ends to form an air passage; a fan and a housing therefor forming a part of said casing, said fan having a portion extending into the path of the air-current; a pipe connected with the casing back of the inlet end thereof and having an elbow at the inner end; and a hollow shaft for the fan with which said elbow connects.

In testimony whereof I affix my signature.

WILLIAM HAYES.