Sept. 19, 1939. H. COANDA 2,173,550

EXHAUST OF GASES FROM ENGINES

Original Filed July 17, 1936 2 Sheets-Sheet 1

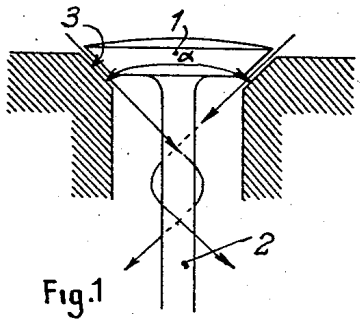

Fig.1

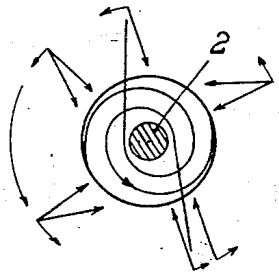

Fig.1a

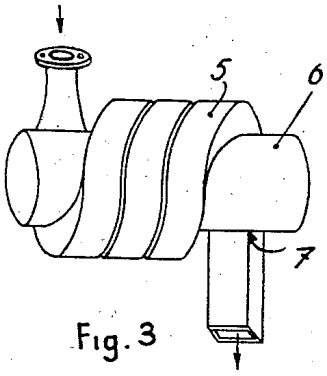

Fig.3

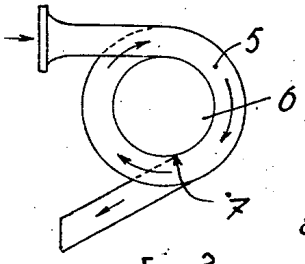

Fig.3a

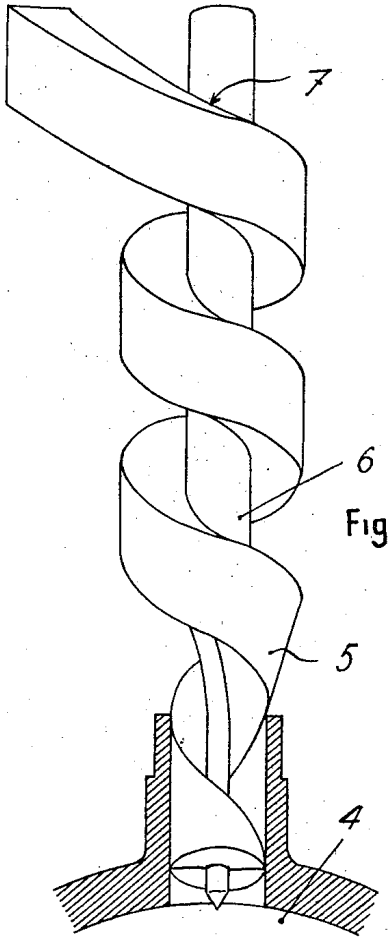

Fig.2

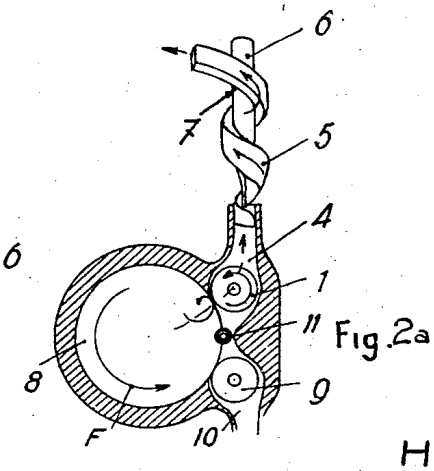

Fig.2a

INVENTOR:
HENRI COANDA
BY Haseltine Lake & Co.
ATTORNEYS

Sept. 19, 1939. H. COANDA 2,173,550

EXHAUST OF GASES FROM ENGINES

Original Filed July 17, 1936 2 Sheets-Sheet 2

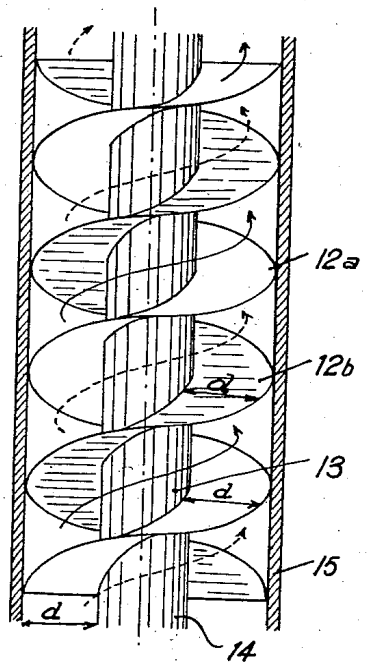

Fig.4

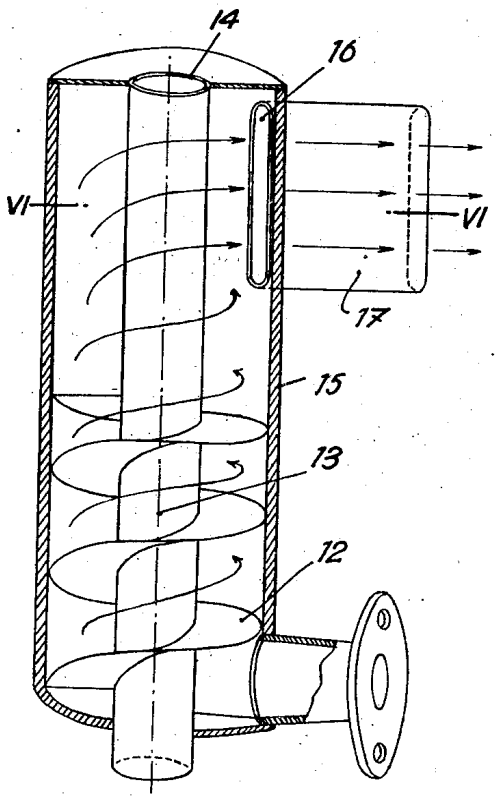

Fig.5

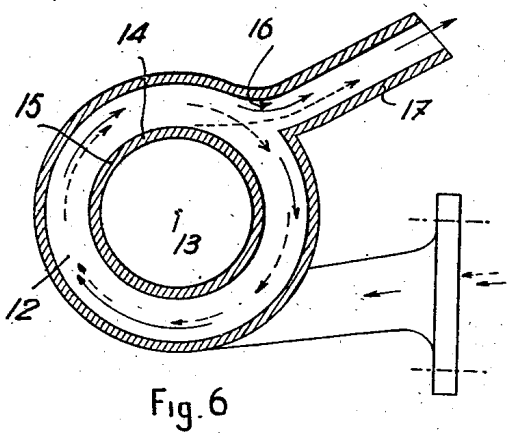

Fig.6

INVENTOR:
HENRI COANDA
BY Huseltine, Lake & Co.
ATTORNEYS

Patented Sept. 19, 1939

2,173,550

UNITED STATES PATENT OFFICE

2,173,550

EXHAUST OF GASES FROM ENGINES

Henri Coanda, Clichy, France

Original application July 17, 1936, Serial No. 91,062. Divided and this application July 14, 1937, Serial No. 153,499. In France July 17, 1935

6 Claims. (Cl. 60—32)

The present application, which is a division of my copending application Ser. No. 91,062, filed July 17, 1936, relates to exhaust systems for internal combustion engines.

In the above mentioned application, it was explained that the flow of the exhaust gases from an engine cylinder through the outlet valve or port of said cylinder imparts to said gases both a rotary movement and a flattening of the gaseous stream escaping with a high velocity past said valve or port. It is advantageous to maintain this rotary movement of the gaseous stream and its localized flattening for ensuring ejection of the gas in the form of thin sheets.

The object of the present invention is not only to maintain this flattened shape of the gaseous stream as far as the final outlet to the atmosphere or the point of use, in order to facilitate the outflow, but also to increase this rotary movement by a suitable guiding of the gases in such manner that, as a consequence of their accentuated gyratory movement, the gases develop a centrifugal force which opposes any return movement or even tendency of flow of the exhaust gases toward the cylinder, and eliminates any detrimental counter-pressure as might exist during the exhaust of the gases, such as it occurs often in the exhaust pipes employed at the present time.

For this purpose, according to an essential feature of the present invention, directly after the exhaust orifices of the engine, where the gaseous sheet flowing at high velocity has turned over itself and flattened, I provide a tube, or tubes, of flattened section having, over a certain distance, a spiral or helical shape. This tube, or system of tubes, which is wound either around a cylinder or around a cone, directs the gases according to their natural tendency and further accentuates it in any desired direction, which may be wholly different, after a certain path, from the general direction of said gases when issuing from the cylinder. This flow of the gases through at least one flat tube helically wound about an axis along the surface either of a cylinder or of a cone permits of producing the desired centrifugal force.

When the centrifugal force is sufficient it is unnecessary to keep giving a gyratory movement to the gases. The gases then escape into the atmosphere or into silencers or mufflers, preferably of the type including thin slots with one of the lips of said slots prolonged and curving away from the direction of the slot, as described in my prior Patent No. 2,046,017.

When the flat tubes consist of true tubes helically wound about an axis, it suffices to prolong them slightly in a direction practically at right angles to said axis.

When the so-called flat tubes are constituted by the space existing between the spires of two helical surfaces generated by a sheet wound in the annular space between two parallel cylinders, it suffices to provide a slot in the external cylinder and to fit it with a flat outlet tube element of corresponding section making a predetermined angle with the axis of the cylinder for causing the gases to flow out without shock into said outlet tube. Preferably, this outlet tube will be combined with a silencer advantageously acting in a manner analogous to a trompe, as above referred to, and devised in such manner as not to interfere in any way with the flow of the gases.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example and in which:

Fig. 1 is an axial vertical sectional view of an outlet valve showing, in a diagrammatic manner the path of travel of the exhaust gases, which, in this case, have a centripetal action;

Fig. 1*a* is a plan view corresponding to said Fig. 1;

Fig. 2 is an elevational view, partly in section, of a valve fitted with an exhaust tube according to the invention;

Fig. 2*a* is a corresponding view on a smaller scale;

Fig. 3 is a view similar to Fig. 2 and corresponding to a modification;

Fig. 3*a* is an end view of the device shown by Fig. 3;

Fig. 4 is a diagrammatic vertical sectional view of another form of flat tube according to the present invention;

Fig. 5 shows, in perspective view, with parts in section, an embodiment of the present invention;

Fig. 6 is a section on the line VI—VI of Fig. 5.

Referring to Fig. 1, which shows a valve 1 having a stem 2 and adapted to fit on a conical seat 3 the apex angle of which is α, experience teaches that, in view of the eddies created in the cylinder head, the gases escaping through the valve chamber are given a rotary movement (illustrated by the arrows) which causes them to turn always in the same direction about the axis of stem 2. Experience also teaches that the helical movement thus created is maintained, after passage of the gases between the valve and its seat, in the tube into which said valve opens.

In accordance with the principle of the above mentioned prior application, the exhaust gases pass from chamber 4 (valve chamber) into a tube 5 the inner end of which forms an element having a conventional (circular) cross section at its connection to the circular outlet of the valve chamber 4 but gradually altered in form so as to become flattened and to be turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes a ribbon or flattened shape, said point being a short distance from the outlet of chamber 4 (before the outer edge of the flange surrounding said outlet). From this point on, according to the essential feature of the present invention, the tubular conduit 5, which is now of substantially rectangular cross section is helically wound around an axis 6, and the outlet of said tubular conduit 5 extends away from said axis 6, at 7, in a direction substantially at right angles to said axis 6.

In the embodiment illustrated by Fig. 2*a*, 8 is the cylinder, 9 the inlet valve, 10 the valve chamber, 11 the spark plug. It will be readily understood that the gases flowing, as a consequence of eddies or for any other reason, with the helical movement indicated by arrow F, keep moving with a whirlwind movement when they escape through exhaust valve 1 and penetrate into tube 5, the portion of which that is wound helically accompanies this movement and intensifies it, until it is sufficient in order that, when escaping through the end of said tube 5, there may be created, behind each sheet of gas a suction sufficient for drawing out the successive gas sheets that escape, without any possibility of return to the engine cylinder.

Figs. 3 and 3*a* show a tube such as 5 but which is wound about an axis at right angles to the general direction of the gases issuing from the exhaust valve chamber.

Fig. 4 shows a modification in the construction of the helical tube for obtaining an equivalent of the flat tubes wound about an axis extending in the general direction of the gas outflow, as in the case of Fig. 1.

In this embodiment, the flat tubes are constituted by the space existing between two helical bands 12*a* and 12*b*, concentric, parallel, of the same pitch and of the same width *d*, disposed at right angles to the axis 13 about which they are wound, and limited, on the inside and the outside, by two coaxial cylinders 14 and 15, respectively, the distance *d* between which is equal to the width of said bands.

As a matter of fact, it is not necessary to prolong these inner threads as far as the end of the annular space between cylinders 14 and 15. As shown by Fig. 5, these threads cease at a distance from said end, and the gases keep turning with the helical movement.

According as the case may be, the inflow of the gases into the helical flat spaces thus formed may take place either at right angles or parallel to the axis 13 of cylinders 14 and 15, or even in any other way. Preferably, the outflow of the gases from the helical spaces takes place through an elongated slot 16 parallel to axis 13 and joined with a straight flat tube 17 into which the gases flow out.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion flowing at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, a tubular conduit of flat section directly prolonging said tube element and helically wound so as to accommodate and accentuate the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and outlet means for said tubular conduit extending tangentially thereto in a direction at right angles to the axis about which said conduit is helically wound.

2. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion rotating at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, a tubular conduit of flat section directly prolonging said tube element and helically wound along a cylindrical surface about the axis thereof, so as to accommodate and accentuate the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and outlet means for said tubular conduit extending tangentially thereto in a direction at right angles to said axis.

3. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion flowing at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, a tubular conduit of flat section directly prolonging said tube element and helically wound so as to accommodate and accentuate the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and an outlet element carried by said tubular conduit tangentially thereto and at right angles to said axis.

4. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust

means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion flowing at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, two coaxial cylinders, at least one strip extending helically in the annular space between said cylinders, so as to form a helical flat conduit therein, said helical flat conduit communicating at one end with said tube element so as to prolong it and to accommodate and accentuate the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and outlet means for said helical flat conduit provided at the opposite end thereof and extending tangentially thereto and at right angles to the axis of said cylinders.

5. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion flowing at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, two coaxial cylinders, at least one strip extending helically in the annular space between said cylinders, so as to form a helical flat conduit therein, the above mentioned tube element opening into said helical flat conduit tangentially at one end thereof, in a direction perpendicular to the axis of these two cylinders, so that said helical flat conduit accommodates and accentuates the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and an outlet element tangential to the outer cylinder at the other end of said helical flat conduit, communicating with the annular space between said two cylinders.

6. In an internal combustion engine, the combination of exhaust means, having an opening of conventional cross section, at least one tube element directly connected with said exhaust means, said tube having a similar conventional cross section at its connection to said exhaust means and being gradually altered in form so as to be flattened and turned over upon itself in the form of a twisted band at the point where the gaseous sheet rotating about itself assumes, in its portion flowing at high velocity and high pressure, a flattened or ribbon shape, said point being spaced a short distance exteriorly of said exhaust means, two coaxial cylinders, at least one strip extending helically in the annular space between said cylinders so as to form a helical flat conduit therein, the above mentioned tube element opening into said helical flat conduit tangentially at one end thereof, in a direction at right angles to the common axis of these two cylinders, so that said helical flat conduit accommodates and accentuates the gyratory motion of said gaseous sheet, whereby the latter undergoes a high centrifugal action, and an outlet tube of flat shape having its longer sides parallel to the generatrices of said two cylinders arranged tangentially to the outer cylinder at the other end of said helical flat conduit, communicating with the annular space between said two cylinders.

HENRI COANDA.