June 8, 1937. E. C. HORTON 2,083,515

MUFFLER

Filed April 12, 1935 2 Sheets-Sheet 1

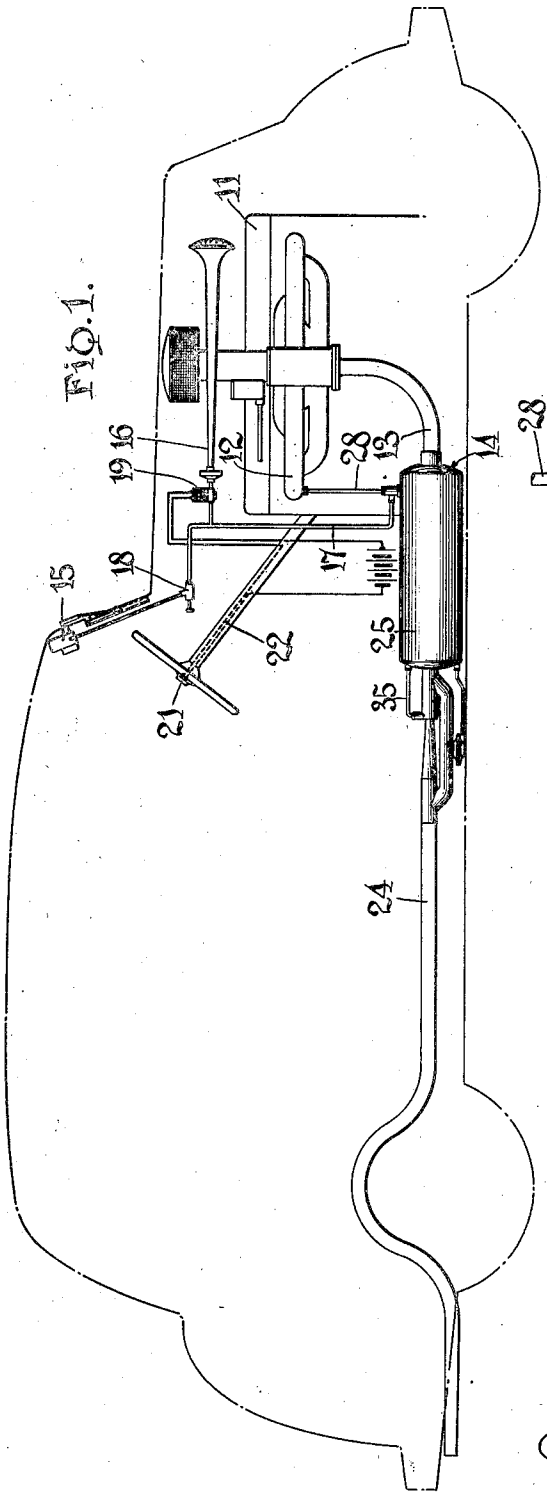


Fig. 1.

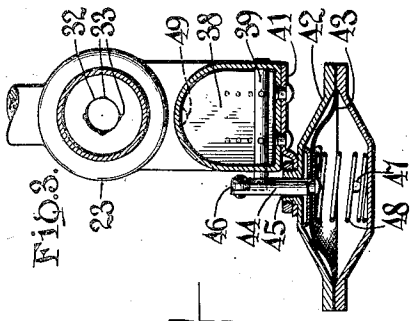


Fig. 3.

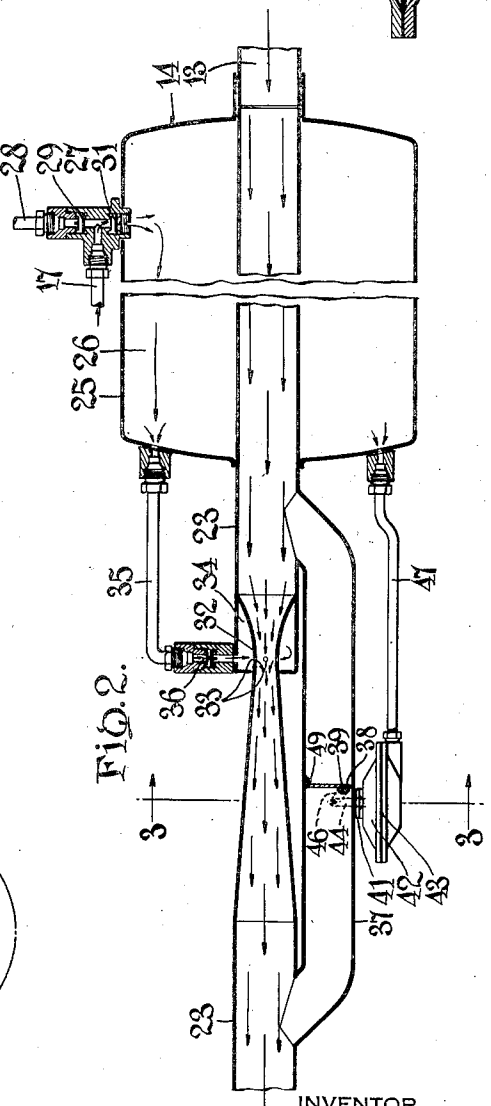


Fig. 2.

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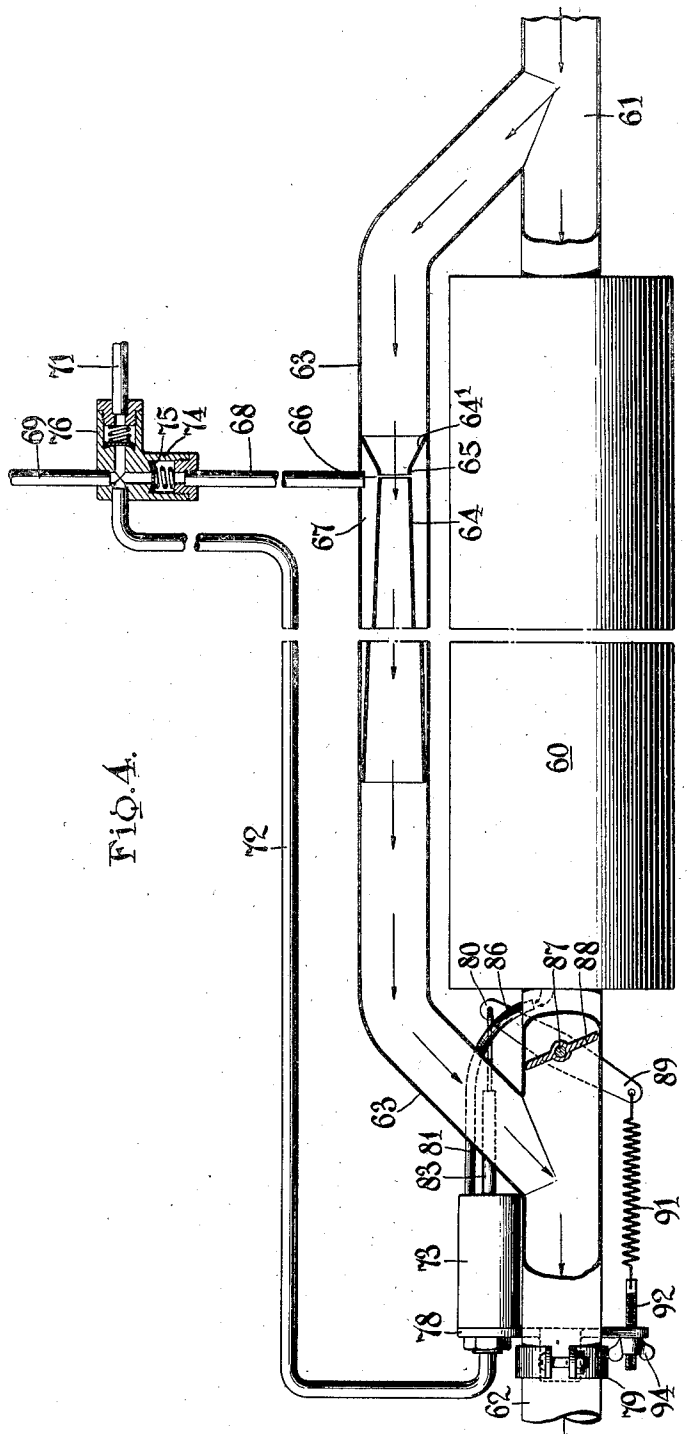


Fig. 4.

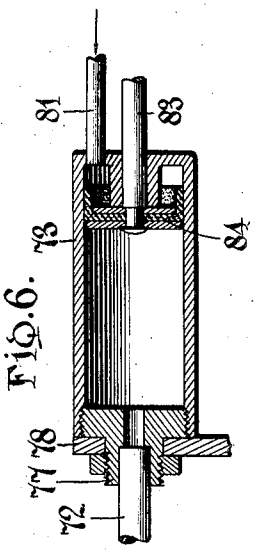


Fig. 6.

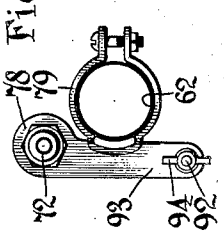


Fig. 5.

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2,083,515

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6 Claims. (Cl. 181—65)

This invention relates to a suction producing device adapted for incorporation in the exhaust line or muffler of an engine, such as a motor vehicle engine.

According to the invention, the flow of exhaust fluid from the engine is utilized to produce suction for various purposes such as operating any one or more of various devices such as horn, windshield cleaner, pump, and the like. The invention comprehends the provision of branch passages in the exhaust line, a suction producing device in one branch of the exhaust line, and valve means in the line, or in one branch passage thereof, controlled by automatic means. The automatic means comprises a control for the valve which is operable in accordance with the degree of suction in the suction line, or in a part such as a reserve tank of the suction line. Upon this suction control may be imposed a further control in accordance with pressure in the exhaust line, so that excessive pressure in the latter may be relieved by opening of the by-passage. By the suction control of the valve in the by-passage, the passage of fluid through the suction producing device, and hence the evacuation of the suction line, may be regulated to prevent excessive evacuation by such device either where such device is the sole source of suction or where an additional or alternative source, such as the intake manifold of the engine, is provided.

These and other objects and advantages will become apparent from the following description of typical embodiments of the invention illustrated in the accompanying drawings, wherein:

Fig. 1 is a diagrammatic side elevation of a motor vehicle provided with a suction accessory system in accordance with the present invention;

Fig. 2 is a longitudinal vertical section through the muffler and suction producing exhaust apparatus illustrated in Fig. 1;

Fig. 3 is a transverse vertical section taken along line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 2 but illustrating another construction;

Fig. 5 is a cross-sectional view taken along line 5—5 of Fig. 4; and

Fig. 6 is a longitudinal section through a portion of the apparatus shown in Fig. 4.

As shown in Fig. 1, the motor vehicle having engine 11 with intake manifold 12 and exhaust pipe 13, has an exhaust muffler 14 and suction operated accessories such as windshield cleaner 15 and horn or trumpet 16. The cleaner and horn are connected to branches of a suction conduit 17, which branches are controlled respectively by valves 18 and 19, the latter valve being electro-magnetic and being controlled by an electric circuit including the usual horn button 21 on the vehicle steering column 22.

The muffler 14 includes a conduit 23 of desired configuration, through which exhaust gases pass from exhaust pipe 13 into an exhaust outlet pipe 24. Surrounding a portion of conduit 23 is a tubular member 25 providing a suction chamber 26 connected by a fitting 27 to the accessory suction line 17 and to a manifold suction conduit 28 extending to the intake manifold 12. In fitting 27 are fluid operable check valves 29 and 31 which close away from conduit 28 and chamber 26 respectively, when the suction in either is lower than in the other. That is if suction is higher in conduit 28 and line 17 than in chamber 26, valve 31 will close while valve 29 may remain open, or, if suction in line 17 and chamber 26 exceeds that in conduit 28, valve 29 will close while valve 31 may be maintained in open position.

Intermediate of the inlet and outlet ends of conduit 23 is a constricted portion constituting a Venturi discharge tube, with throat 32 having apertures 33 therethrough. Extending about the Venturi throat and communicating therewith through apertures 33 is an annular chamber 34. The latter is connected to chamber 26 through a conduit 35 having therein a check valve 36 closing toward chamber 26 when the fluid tends to pass in that direction and opening when the fluid movement is toward annular chamber 34.

Connecting into conduit 23 on opposite sides of the venturi is a by-passage 37, of area substantially greater than Venturi throat 32. A butterfly valve 38 is disposed in by-passage 37, being carried by a pin 39 extending through and journalled in the walls of the by-passage. Adjacent to by-passage 37 and supported by suitable means such as bracket 41 is a chambered casing 42. Across the chamber of the casing is a diaphragm piston 43 which carries a piston rod 44 that extends through an opening 45 in one wall of the casing. A crank arm 46 on valve pin 39 is connected to the piston rod so that upon movement of the piston 43 (downwardly as the device is depicted in Figs. 2 and 3) the valve pin 39 will be rotated to open the valve 38.

The opening 45 loosely passes piston rod 44 so that air under atmospheric pressure is imposed upon one face of the diaphragm piston.

The other face of the piston is subjected to the pressure of fluid within chamber 26 by means of a conduit 47 extending between chamber 26 and casing 42. A spring 48, preferably disposed with-

in casing 42, normally urges the piston (upwardly as viewed in Figs. 2 and 3) to a position wherein valve 38 is closed, the closing movement of the valve being limited by a stop 49 on a wall of the by-passage 37.

As shown in Figs. 2 and 3 the pin 39 is offset from the center of valve 38 so that the pressure of fluid moving through by-passage 37 will tend to open the valve, and this tendency may of course be increased or decreased by increasing or decreasing respectively the degree to which the pin is offset. Such changing of proportions or location of the parts will modify the operation of the device which will now be described.

When the vehicle engine is operating under slight throttle opening so that a relatively small amount of exhaust fluid passes exhaust pipe 13, most, if not all, of such fluid will normally pass through throat 32 of the venturi, since then the capacity of the throat is sufficient to prevent the building up of enough pressure in the exhaust line to open valve 38 as held closed by spring 48. Such passage of exhaust fluid will reduce below atmospheric the pressure in chamber 34 due to the Venturi action, so that fluid will be withdrawn from chamber 26 via conduit 35 and past check valve 36. When the fluid pressure in chamber 26 is reduced below atmospheric to a sufficient, predetermined degree, the diaphragm piston 43 will be moved against the resistance of spring 48 to open valve 38. Thereupon a large portion of the exhaust fluid will move through passage 37, by-passing the venturi and thereby reducing or eliminating further evacuation of chamber 26 by the Venturi means.

When the engine is operating under a more full throttle opening, the mode of operation will be similar except that valve 38 may be opened to some extent, even when suction in chamber 26 is deficient, by the pressure exerted upon it by the exhaust fluid. However, due to the tendency of spring 48 to close valve 38 when suction in chamber 26 is deficient, the valve will open only to reduce excessive pressure of exhaust fluid and will thereby compel passage of a considerable portion of the fluid through the venturi to thereby further evacuate chamber 26.

It will be understood that the valve 38, by its automatic control, will enforce passage of fluid through the suction producing venturi, and that the automatic control depends upon two factors, first the direct action of the exhaust fluid, which when excessive in pressure will open the valve, and secondly, the action of the suction. When suction in chamber 26 is ample or excessive, the valve will be opened.

As indicated hereinbefore, increase or decrease of the degree to which the valve pin 39 is offset from the center of the valve, will vary the operation. If the pin is changed to a more central position, the tendency of the valve to open under pressure of exhaust fluid will decrease, so that if the pin is substantially centrally located, opening and closing of the valve will be dependent entirely upon movement of the piston 43 in accordance with the degree of suction maintaining in chamber 26. If the pin is offset to a greater degree, the valve will open under a lesser pressure of the exhaust fluid.

It will be understood that in addition to the function of producing suction for operating accessories, the device described will function to silence the engine exhaust by reason of formation of a partial vacuous zone about the exhaust passage, and of a compensating fluttering action of valve 38 in accordance with the exhaust pulsations. However, if desired, the chamber 26 may be formed apart from the exhaust pipe, or may be eliminated without impairing the suction producing function of the device.

In the construction illustrated in Figs. 4, 5, and 6, a muffler 60 of any suitable form, conventional or otherwise, is connected in the exhaust line between the end 61 thereof which connects the exhaust manifold of the engine and the end 62 thereof which opens to the atmosphere. Extending about the muffler 60 and joining the portions 61 and 62 of the exhaust line or conduit is a by-passage 63. Tapered tubular members 64 and 64' are secured in the by-passage to provide therein a Venturi tube, the reduced ends of the members constituting the constricted portion or throat 65 of the Venturi tube and being slightly spaced to provide an annular opening 66. This opening provides communication between the Venturi throat and the surrounding chamber 67 between members 64, 64' and the walls of by-passage 63. Connected to the latter and opening into chamber 67 is a suction conduit 68 in communication with conduits 69, 71, and 72. Conduit 69 may be extended to a fuel pump, horn, windshield cleaner, or other suction operated device; conduit 71 may connect to the intake manifold of the engine, or other source of suction; and conduit 72 extends to a cylinder 73.

A valve casing 74 at the juncture of conduits 68, 69, 71, and 72 contains a check valve 75 which opens toward conduit 68 by passage of fluid in that direction, and closes when the pressure in conduit 68 is greater than that existing in conduits 69 and 72. Casing 74 also contains another check valve 76, which opens toward conduit 71 by and upon passage of fluid from conduit 69 or 72 into conduit 71, and closes when the pressure in the latter is higher than that in conduits 69 and 72.

Cylinder 73 is disposed in parallel adjacency with portion 62 of the exhaust passage, and has a hollow threaded boss 77 through which the conduit 72 communicates with the cylinder chamber. The boss extends through and is secured to flange 78 of a clamp 79 which embraces the exhaust pipe 62. At the opposite end of the cylinder 73 is a bearing 82 for a piston rod 83 carrying a piston 84 in the cylinder. At the other end of rod 83 is a flexible link 85 pivoted to one end, 89, of a double arm 86. The arm is carried by the pivot pin 87 of a butterfly valve 88 in exhaust pipe 62 between the muffler 60 and the juncture of by-passage 63. The opposite end, 89, of the double arm is connected to a spring 91. A threaded shank 92 extends, slidably, through an opening in flange portion 93 of clamp 79, and is joined to spring 91 in such manner that the tension of the spring may be varied by adjusting a wing nut 94 on the shank against flange portion 93.

The end of the cylinder 73 opposite the suction conduit 72 has an opening connected by conduit 81 to a part of the exhaust pipe on the engine side of valve 88. Accordingly the piston 84 will be subjected to the differential pressures of the engine exhaust and the fluid in the suction line.

In the apparatus illustrated in Figs. 4, 5, and 6, the spring 91 will act on arm 86 to tend to close valve 88 so that exhaust fluid will pass through the by-passage 63 rather than through the muffler 60. The exhaust fluid, in passing the Venturi throat 65, will effect a decrease of fluid pressure at this point, so that fluid will be drawn from chamber 67 through opening 66 and thus the

chamber connected conduits 68, 69, and 72 and chamber of cylinder 73 will be partially evacuated. Evacuation of fluid from the cylinder 73, through conduit 72, will cause the piston 84 to move rod 83 and arm 86 in opposition to the pull of spring 91. Accordingly as the degree of suction in conduit 72 and cylinder 73 increases, the valve 88 will be opened increasingly, allowing more and more engine exhaust to pass through the muffler 60, thereby decreasing the flow through the venturi or by-passage 63 and likewise decreasing the suction producing Venturi action. This result would obtain, unmodified, if conduit 81 opened to the atmosphere. But since the piston 84 is subjected to exhaust pressure, the latter when it becomes excessive will also tend to move the piston to open valve 88. In this manner, a temporary deficiency in the degree of suction is prevented from unduly interfering with operation of the engine by too great an increase in the exhaust back pressure.

The tension of the spring 91 may be varied by adjustment of wing nut 94 in order to vary the degree of suction at which the valve 88 will be fully opened. Preferably the parts will be so adjusted that the valve 88 will be fully opened when the suction is sufficient to satisfactorily operate such accessories as windshield cleaners and horns, but is not excessive. The apparatus illustrated in Figs. 4, 5, and 6 will function in the manner just described whether the suction is produced by Venturi means or by withdrawal of fluid to the engine manifold via conduit 71. That is, if the volume of engine exhaust fluid is insufficient to cause the Venturi to create a satisfactory degree of suction for operating the accessories, but the manifold suction is sufficiently high, the valve 88 will also be opened. Thus, the back pressure of engine exhaust fluid is not increased by the suction producing means except when the suction in the suction system is insufficient.

It will be understood, however, that if desired, the manifold conduit 71 and valve 76 may be omitted and that the Venturi means may constitute the sole source of suction for the system. In either case the muffler 60 will operate in the usual manner to silence the noise of the exhaust gases when valve 88 is fully or partially open. When it is closed or partially open, so that some exhaust gases pass through by-passage 63, the fluid stream through throat 65 will be broken up to some extent by fluid entering through openings 66, and by expansion of gases in the portion of the Venturi tube beyond the openings 66, so that a muffling action will also take place in the by-passage 63.

It will be further understood that the terms "passage" and "by-passage" and the like as used herein and in the apended claims are not restrictive, since in both illustrated embodiments the passage containing the Venturi means or the passage parallel thereto may be considered to be either a "by-passage" or the primary exhaust passage.

It will be still understood further that the devices described are merely illustrative of the inventive principles involved, which may be applied in other physical embodiments within the purview and scope of the invention.

What is claimed is:

1. In a suction producing device, a passage for exhaust gases, a portion of said passage being constructed to provide a Venturi throat, said throat having a port therein and a suction conduit connected to said port, a by-passage for exhaust gases connected to said first mentioned passage on opposite sides of the constricted portion for by-passing gases thereby, a valve in said by-passage, and means operable by fluid pressure differential and connected to the suction conduit for controlling said valve.

2. In a suction producing device, a passage for exhaust gases, a portion of said passage being constricted to provide a Venturi throat, said throat having a port therein and a suction conduit connected to said port, a by-passage for exhaust gases connected to said first mentioned passage on opposite sides of the constricted portion for by-passing gases thereby, a valve in said by-passage operable in the direction of fluid flow through the by-passage, resilient means for urging the valve to a closed position, and means operable by differential pressure and connected to said suction conduit for urging the valve to open position, whereby in the presence of a predetermined degree of suction said means will open the valve.

3. In a suction producing device for conection to a suction line, a passage for exhaust gases, a Venturi discharge tube in said passage and having a suction inlet, a by-passage about said tube, a fluid connection between the suction inlet and said suction line, means operable by the pressure of said exhaust gases for regulating the relative flow of gases through said Venturi tube and by-passage, and means operable in accordance with the degree of suction in the suction line for controlling the first mentioned means.

4. In a suction producing device, a passage for exhaust gases divided to provide a pair of branch passages arranged so that the gases may pass through either one or both branch passages, one of said branch passages being constricted to provide a Venturi throat having a port therein and a conduit connected to the port, a valve in one of the branch passages, resilient means for urging the valve to a closed position, and means operable by suction and connected to said conduit for urging the valve to open position.

5. In a suction producing device for withdrawing fluid from a line, a passage for exhaust gases having branch passages arranged in parallel, a Venturi discharge tube in one branch passage and having a suction inlet connected to said line, means for regulating the relative flow of gases through the branch passages, said means comprising a valve in the other branch passage, resilient means for urging the valve to closed position, and means operable in accordance with the degree of suction in said line for opening the valve against the urge of said resilient means.

6. In a suction producing device, a passage for exhaust gases from an engine, said passage being divided to provide branch passages for said exhaust gases, one of said branch passages being constricted to form a Venturi throat and a suction conduit opening into said throat, means operable by pressure of the exhaust gases for controlling the proportion of said gases that passes through said throat, and means operable in accordance with the degree of suction in said suction conduit for controlling the first mentioned means.

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