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INTERNAL COMBUSTION ENGINE EXHAUST SYSTEM

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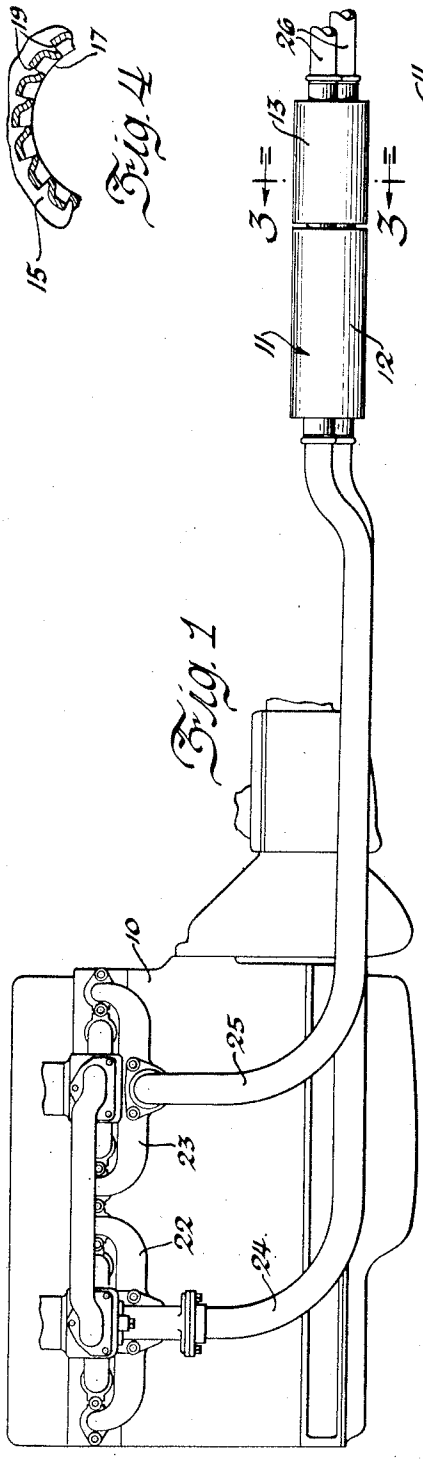

Fig. 1

Fig. 4

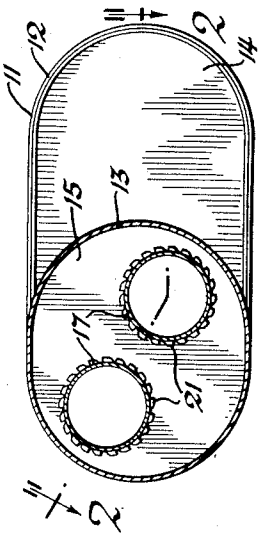

Fig. 3

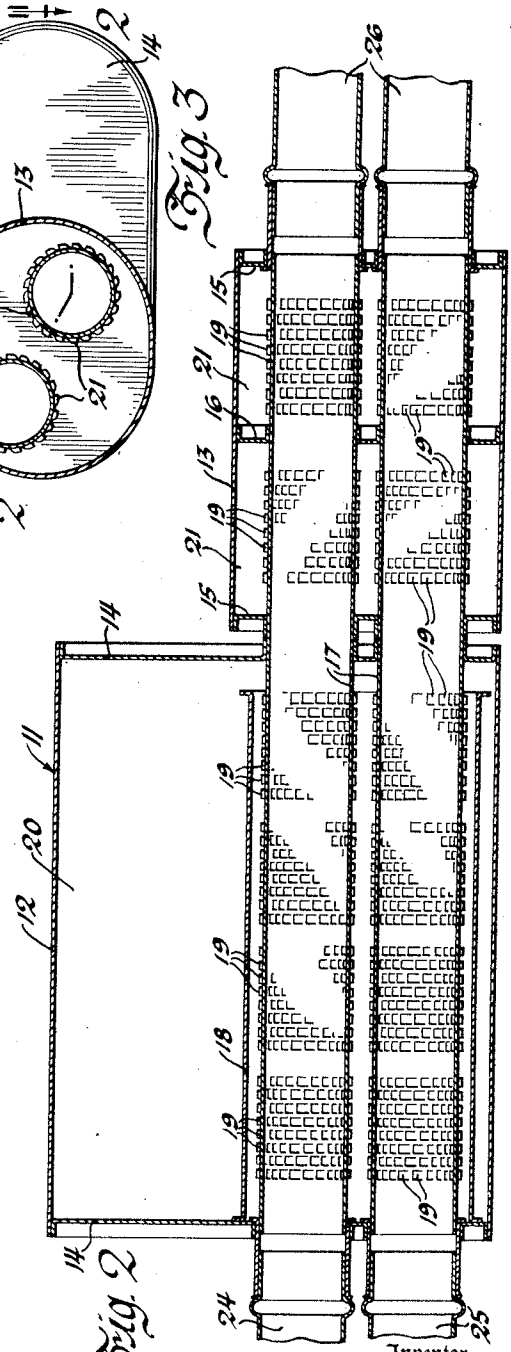

Fig. 2

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INTERNAL-COMBUSTION ENGINE EXHAUST SYSTEM

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9 Claims. (Cl. 181—48)

It is the general practice to provide multicylinder internal combustion engines with exhaust systems which include a manifold into which the exhaust gases from the several cylinders of the engine are discharged and an exhaust pipe, silencer and tail pipe through which the exhaust gases pass successively from the manifold to the atmosphere. The resistance offered by the exhaust system to the passage of the exhaust gases creates "back pressure" which interferes with the discharge of the exhaust gases from the cylinders and prevents the engine developing the power which it would be capable of developing without the exhaust system.

The situation can, of course, be alleviated by increasing the size of the elements of the exhaust system or providing a separate exhaust system for each cylinder or for each of different groups of cylinders of the engine but these expedients are, of course, expensive and require space, particularly for the silencers, which may not be available, especially in modern automotive vehicles to which my invention is particularly applicable, and also, in the case of the expedient first mentioned, may reduce the silencing capacity of the exhaust system.

My invention resides in an exhaust system for an internal combustion engine, including a silencer, which makes it possible to decrease the resistance offered by the exhaust system of the engine to the passage of the exhaust gases and increase the power the engine can develop without the employment of more than one silencer or increasing prohibitively, if at all, the size of the elements or reducing the silencing capacity of the exhaust system.

For a better understanding of the nature and objects of this invention reference is made to the following specification and the accompanying drawing in which the preferred embodiment of the invention is described and illustrated.

In the accompanying drawing:

Figure 1 is a side elevation of the propelling engine and associated parts of an automotive vehicle equipped with an exhaust system in accordance with my invention.

Figure 2 is an enlarged lengthwise section, taken on the line 2—2 of Figure 3, through the exhaust silencer of the engine shown in Figure 1.

Figure 3 is an enlarged section through the silencer taken on the line 3—3 of Figure 1.

Figure 4 is a further enlarged fragmentary cross section through one of the exhaust gas tubes of the silencer.

In the drawing, the reference character 10 indicates a "straight eight" internal combustion engine and the reference character 11 the exhaust silencer of the engine.

The exhaust silencer 11 includes a shell 12 which is roughly elliptical in cross section and a shell 13 which is approximately circular in cross section. The ends of the shell 12 are closed by heads 14 and the ends of the shell 13 by heads 15. The interior of the shell 13 is subdivided lengthwise by a partition 16 whose outer edge is secured circumferentially to the shell. The shells 12 and 13 are disposed end to end with the axis of the shell 13 in the plane of the major axis but to one side of the intersection of the major with the minor axis of the shell 12.

Through the shells 12 and 13, their heads 14 and 15 and the partition 16 in the shell 13 extend two exhaust gas tubes 17 which are spaced laterally from each other and the shells and secured in openings in the heads of the shells. Within the shell 12 the tubes 17 are encircled by a shell 18 which is roughly elliptical in cross section and spaced from the tubes and the shell 12. The shell 18 is secured to and extends from one head of the shell 12 to a point near but at a distance from the other head. Through each of the tubes 17 within the shell 12 and within the confines of the shell 18 extend four groups of perforations 19. Through these perforations and the space between the shell 18 and the tubes and the space between the end of th shell 18 and the head of the shell 12 it terminates short of the chamber 20 defined by the shell 12, its heads 14 and the shell 18 communicates as a side branch with the tubes 17. Through the tubes 17 within the shell 13 on each side of the partition 16 extends another group of perforations 19 through which the chambers 21 defined by the shell 13, its heads 15 and the partition 16 communicate as side branches with the tubes 17.

Instead of a single manifold into which the exhaust gases from all of its cylinders are discharged, the engine 10 is equipped with two exhaust manifolds 22 and 23 which are connected, respectively, to the exhaust ports of the front four and the exhaust ports of the rear four cylinders of the engine. The exhaust silencer 11 is installed on the engine 10 with one end of one of its exhaust gas tubes 17 connected to the exhaust manifold 22 by an exhaust pipe 24 and the corresponding end of the other of its exhaust gas tubes 17 connected to the exhaust manifold 23 by an exhaust pipe 25. To the other end of each of the exhaust gas tubes 17 is connected a tail pipe 26.

When the engine 10 is operating the exhaust gases from its front four cylinders are discharged into the manifold 22 and the exhaust gases from its rear four cylinders discharged into the exhaust manifold 23. From each of the manifolds 22 and 23, the exhaust gases pass into the exhaust pipe connected to that manifold, the exhaust gas tube 17 of the silencer to which that exhaust pipe is connected and the tail pipe 26 which is connected to that exhaust gas tube and, thence, to the atmosphere. The chamber 20 and the perforations 19 and spaces through which it communicates with the exhaust gas tubes 17 and the chambers 21 and the perforations 19 through which they communicate with the exhaust gas tubes, of course, constitute resonators which are preferably so tuned as set forth in the Wilson Patent No. 2,323,955, dated July 13, 1943, that they will resonate to and thus attenuate sound waves to which the exhaust noise of the engine is attributable. Sound waves which may pass from one of the exhaust gas tubes 17 to the other will also, of course, be attenuated in the course of their passage through the perforations 19 and the intervening space and will also be attenuated by and attenuate by interference the sound waves in the exhaust gas tube into which they pass.

Because in the exhaust system herein disclosed the exhaust gases discharged from some and the exhaust gases discharged from others of the cylinders of the engine are conducted from the cylinders to the atmosphere by separate ducts, less back pressure will be developed in this exhaust system than in an exhaust system, with an exhaust gas duct and a silencer of comparable size, of the type generally provided on multicylinder internal combustion engines. Consequently, an engine equipped with the exhaust system herein disclosed will develop more power than an engine equipped with an exhaust system, with an exhaust gas duct and a silencer of comparable size, of the type generally provided on multicylinder internal combustion engines. The invention, therefore, makes it possible to decrease the resistance offered by the exhaust system of an engine to the passage of exhaust gases and increase the power the engine can develop without the employment of more than one silencer or increasing prohibitively, if at all, the size of the elements or reducing the silencing capacity of the exhaust system.

It will, I think, be clear from what has been said that the invention herein disclosed is applicable to the intake as well as the exhaust systems of internal combustion engines.

I claim:

1. In an internal combustion engine with more than three cylinders, a silencer which includes a plurality of ducts of which each is connected to the exhaust ports of a plurality of the cylinders, a shell which encircles the ducts and with them defines a compartment, a partition which subdivides the compartment into chambers of which each communicates as a side branch with a plurality of the ducts and which constitute elements of resonators which are so tuned that they resonate to and thus attenuate sound waves which contribute to the exhaust noise of the engine.

2. In an internal combustion engine with more than three cylinders, a silencer which includes a plurality of ducts of which each is connected to the corresponding ports of a plurality of cylinders, and a shell which encircles the ducts and with them defines a chamber which communicates with the ducts as a side branch and constitutes an element of a resonator which is so tuned that it resonates to and thus attenuates sound waves which contribute to the noise of the engine which issues from the mentioned ports.

3. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which each is connected to the exhaust ports of a plurality of the cylinders, and a chamber with which a plurality of the ducts communicate between their ends.

4. In an internal combustion engine with more than one cylinder, a silencer which includes a plurality of ducts of which one is connected to a port of one and the other to the corresponding port of another of the cylinders, and a shell which encircles the ducts and with them defines a chamber which communicates with the ducts as a side branch and constitutes an element of a resonator which is so tuned that it resonates to and thus attenuates sound waves which contribute to the noise of the engine which issues from the mentioned ports.

5. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which one is connected to a port of one and the other to the corresponding port of another of the cylinders, and a chamber which communicates with a plurality of the ducts as a side branch and constitutes an element of a resonator which is so tuned that it resonates to and thus attenuates sound waves which contribute to the noise of the engine which issues from the mentioned ports.

6. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which one is connected to a port of one and the other to the corresponding port of another of the cylinders and a chamber with which a plurality of the ducts communicate between their ends.

7. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which one is connected to a port of one and the other to the corresponding port of another of the cylinders, and a plurality of chambers with each of which a plurality of the ducts communicate between their ends.

8. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which each is connected to the exhaust ports of a plurality of the cylinders, and a plurality of chambers with each of which a plurality of the ducts communicate between their ends.

9. In an internal combustion engine with a plurality of cylinders, a silencer which includes a plurality of ducts of which each is connected to the exhaust ports of a plurality of the cylinders, and a plurality of chambers of which each communicates as a side branch with a plurality of the ducts and which constitute elements of resonators which are so tuned that they resonate to and thus attenuate sound waves which contribute to the exhaust noise of the engine.

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