

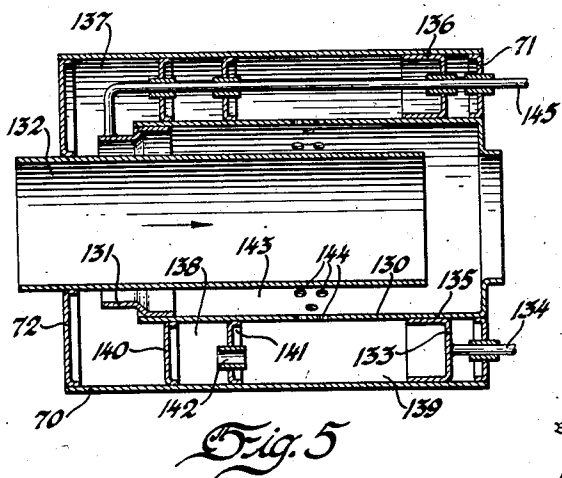
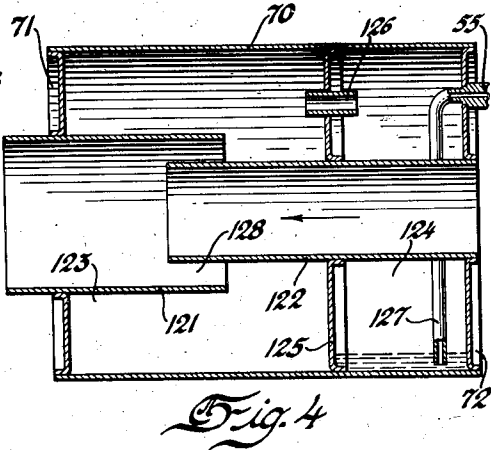
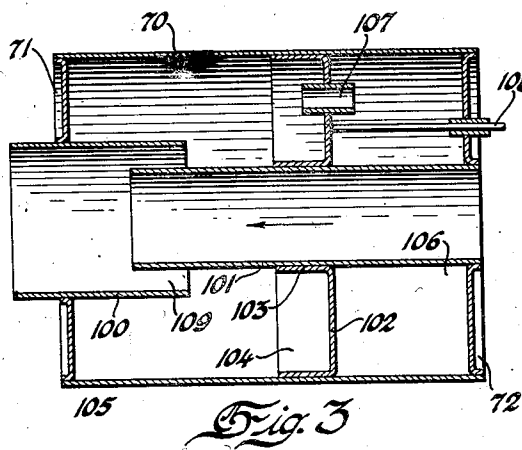
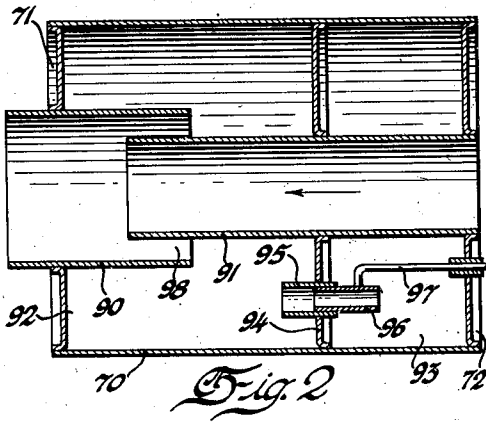
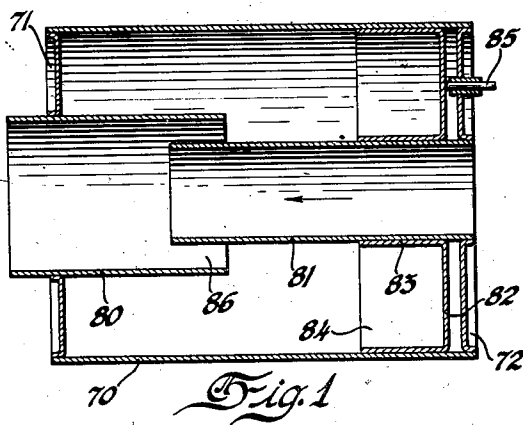
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RESONATOR SILENCER

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RESONATOR SILENCER

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2 Claims. (Cl. 181—48)

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To attenuate the objectionable sound waves which occur in the intake and exhaust systems of internal combustion engines, resonator silencers, such as those disclosed in my prior applications Serial Nos. 470,700 and 633,265 which were filed on July 25, 1930, and September 15, 1932, respectively, are now commonly used. However, because the natural frequencies of the resonators incorporated in these silencers are fixed and objectionable sound waves of different frequencies may occur in the intake or exhaust system of an internal combustion engine when it is operating at different speeds but not simultaneously, it is frequently necessary, in order to attenuate all of the objectionable sound waves which occur in the intake or exhaust system of an internal combustion engine, to provide in it one or more resonators which are operative only when the engine is operating at some speed or speeds and another or other resonators which are operative only when the engine is operating at another speed or other speeds.

The principal object of this invention is to provide resonator silencers in which it is not necessary, in order to attenuate all of the objectionable sound waves which occur in the intake or exhaust system of the engine to which the silencer is to be applied, to provide in the silencer any resonators which are not operative simultaneously and thus to minimize the number of resonators in the silencer.

This object may be attained by providing in the silencer a resonator whose natural frequency may be varied. To render the natural frequency of the resonator variable, the acoustical conductivity of its neck or necks or any of them and/or the volume of its chamber or chambers or any of them may be made adjustable. This application, however, is concerned only with certain expedients disclosed but not claimed in my application Serial No. 115,470, filed December 12, 1936, which has matured into Patent No. 2,214,894, dated September 17, 1940, of which this application is a division, by which the natural frequency of the resonator may be rendered variable.

For a better understanding of the objects and nature of this invention, reference is made to the following specification in which there are described the embodiments of my invention which are illustrated in the accompanying drawing.

In the accompanying drawing:

Figures 1 to 5 are longitudinal sections through resonator silencers in accordance with this invention.

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Each of the silencers shown in Figures 1 to 5 includes a cylindrical shell 70 with heads 71 and 72 secured over its ends and a duct through which gases may pass through the silencer. The duct is coaxial with the shell 70 and consists of two tubes of which one extends into and is sufficiently smaller than the other that the overlapping portions of the tubes are separated by an annular aperture. One of the tubes is secured in each of the heads 71 and 72. The shell 70, its heads 71 and 72 and the tubes define a compartment which communicates with the duct defined by the tubes through the aperture between the overlapping portions of the tubes.

Within the compartment defined by the shell 70, its heads 71 and 72 and the tubes 80 and 81 which define the duct of the silencer shown in Figure 1, there is disposed a false head 82 which encircles the tube 81 and may be shifted lengthwise of the silencer. On the inner and outer edges of the false head 82, there are formed annular flanges 83 and 84 which fit snugly around the tube 81 and within the shell 70, respectively. To shift the false head 82, there is provided a rod 85 which extends through a guide in the head 72 and whose inner end is secured to the false head.

The compartment defined by the shell 70, its head 71, the false head 82 and the tubes 80 and 81 constitutes the chamber and the annular aperture 86 between the tubes 80 and 81 the neck of a simple resonator. The acoustical conductivity of the neck is, of course, fixed but the volume of the chamber and, thus, the natural frequency of the resonator, may be varied by shifting the false head 82.

The compartment defined by the shell 70, its heads 71 and 72 and the tubes 90 and 91 which define the duct of the silencer shown in Figure 2 is divided lengthwise into two chambers 92 and 93 by an annular partition 94 which encircles the tube 91 and is secured to it and the shell. Through the partition 94, there extends a tube which consists of two partly telescoped tubular elements 95 and 96 and interconnects the chambers 92 and 93. The tubular element 95 is secured in the partition 94 and the tubular element 96 may be shifted lengthwise of the tubular element 95 to vary the effective length of the tube 95—96. To shift the tubular element 96, there is provided a rod 97 which extends through a guide in the head 72 and whose inner end is secured to the tubular element 96.

The chambers 92 and 93 constitute the chambers and the tube 95—96 and the annular aper-

ture 98 between the tubes 90 and 91 the necks of a compound resonator. The volumes of the chambers and the acoustical conductivity of the neck 98 are, of course, fixed but the acoustical conductivity of the neck 95—96 and, thus, the natural frequencies of the resonator, may be varied by shifting the tubular element 96.

Within the compartment defined by the shell 70, its heads 71 and 72 and the tubes 100 and 101 which define the duct of the silencer shown in Figure 3, there is disposed a partition 102 which encircles the tube 101 and may be shifted lengthwise of the silencer. On the inner and outer edges of the partition 102, there are formed annular flanges 103 and 104 which fit snugly around the tube 101 and within the shell 70, respectively. The partition 102 divides the compartment defined by the shell 70, its heads and the tubes 100 and 101 into two chambers 105 and 106 which are interconnected by a tube 107 which extends through the partition. To shift the partition 102, there is provided a rod 108 which extends through a guide in the head 72 and whose inner end is secured to the partition.

The chambers 105 and 106 constitute the chambers and the tube 107 and the annular aperture 109 between the tubes 100 and 101 the neck of a compound resonator. The acoustical conductivities of the necks are, of course, fixed but the volumes of the chambers and, thus, the natural frequencies of the resonator, may be varied by shifting the partition 102.

The compartment defined by the shell 70, its heads 71 and 72 and the tubes 121 and 122 which define the duct of the silencer shown in Figure 4 is divided lengthwise into two chambers 123 and 124 by an annular partition 125 which encircles the smaller of the tubes and is secured to it and the shell. In the partition 125, there is secured a tube 126 which interconnects the chambers 123 and 124. Through the head 72, there extends into the chamber 124 a tube 127 which terminates near the lower side of the shell 70 and through which a liquid may be introduced into or withdrawn from the chamber 124.

The chambers 123 and 124 constitute the chambers and the tube 125 and the annular aperture 128 between the tubes 121 and 122 the necks of a compound resonator. The acoustical conductivities of the necks and the volume of the chamber 123 are, of course, fixed but the effective volume of the chamber 124 and, thus, the natural frequencies of the resonator, may be varied by introducing liquid into or withdrawing liquid from the chamber 124 through the tube 127.

The larger of the tubes which define the duct of the silencer shown in Figure 5 consists of two partly telescoped tubular elements 130 and 131 of which the former is secured in the head 71 and extends well beyond the inner end of and encircles the smaller of the tubes (132). Within the compartment defined by the shell 70, its heads 71 and 72 and the tubes 130—131 and 132, there is disposed a false head 133 which encircles the tubular element 130 and may be shifted lengthwise of the silencer. To shift the false head 133, there is provided a rod 134 which extends through the head 71 and whose inner end is secured to the false head. On the inner and outer edges of the false head, there are formed annular flanges 135 and 136 which fit snugly around the tubular element 130 and within the shell 70, respectively. The compartment defined by the shell 70, its head 72, the false head 133

and the tubes 130—131 and 132 is divided lengthwise into three chambers 137, 138 and 139 by annular partitions 140 and 141 which encircle the tubular element 130 and are secured to it and the shell. The partition 140 is imperforate but there is secured in the partition 141 a tube 142 which connects the chamber 138 with the chamber 139 which communicates with the annular aperture 143 between the tubes 130—131 and 132 through orifices 144 in the tubular element 130 which may be partially or wholly covered by the flange 135 on the false head 133. The tubular element 131 of the tube 130—131, whose outer end is of smaller diameter than its inner end but of considerably larger diameter than the tube 132, extends beyond the tubular element 130 and may be shifted lengthwise of the silencer to vary the overlap between the tubes 130—131 and 132. To shift the tubular element 131, there is provided a rod 145 which extends through guides in the head 71, the false head 133 and the partitions 140 and 141 and whose inner end is secured to the tubular element 131.

The chambers 138, 139 and 137 constitute the chambers and the tube 142, the orifices 144 and the annular aperture 143 the necks of a compound and simple resonator. The volumes of the chambers 138 and 137 and the acoustical conductivity of the neck 142 are, of course, fixed but the volume of the chamber 139 and/or the acoustical conductivities of the necks 144 and 143 and, thus, one or more of the natural frequencies of the resonator, may be varied by shifting the false head 133 and/or the tubular element 131.

The silencers shown in Figures 1 to 5 were designed for installation on an internal combustion engine with the outer ends of the larger of the tubes (80, 90, 100, 121 and 130—131) which define their ducts connected to the air intake tube of the carburetor so that the air which enters the carburetor and cylinders of the engine flows through their ducts in the directions indicated by the arrows in the drawing. But any of the units shown in Figures 1 to 5 may be incorporated in an internal combustion engine exhaust silencer in which event its duct will, of course, be so disposed so that the exhaust gases of the engine will pass through it in the same direction as air passes through it when it is employed as an intake silencer.

In whichever manner the units shown in Figures 1 to 5 are to be installed the resonators will, of course, be so proportioned and dimensioned that when their adjustable elements are in one position they will respond to and attenuate by resonance objectionable sound waves of one or more frequencies which occur in the intake or exhaust system of the engine on which the units are to be installed while the engine is operating at some speed or speeds and when their adjustable elements are in another position or other positions they will respond to and attenuate by resonance objectionable sound waves of another frequency or other frequencies which occur in the intake or exhaust system of the engine while it is operating at another speed or other speeds.

To vary the natural frequencies of the units shown in Figures 1 to 3 and 5 the rods (85, 97, 108, 134 and 145) may be actuated manually and/or automatically to shift the adjustable elements of the units in accordance with the requirements. The rods 134 and 145 of the unit

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shown in Figure 5 may be actuated synchronously or nonsynchronously by the same or different instrumentalities. The liquid employed to vary the effective volume of the chamber 124 of the unit shown in Figure 4 may be obtained from the cooling system or the lubricating system of the engine on which the unit is installed or from a supply provided especially for the purpose. Any suitable means actuated manually and/or automatically may be provided to introduce and withdraw and control the introduction and withdrawal of the liquid from the chamber 124 in accordance with the requirements.

Examples of the instrumentalities that may be employed to vary the natural frequencies of the units shown in Figures 1 to 5 are disclosed in my Patent No. 2,214,894 previously referred to.

It will, of course, be understood that although I have described and illustrated my invention applied to the intake and exhaust system of internal combustion engines, it is also applicable to other devices in which objectionable sound waves of different frequencies occur under different conditions.

I claim:

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1. In a silencer, a duct which includes a smaller tube and a larger tube which encircles and is radially spaced from a portion of the smaller tube, a shell which encircles and is radially spaced from a portion of the duct, and walls which extend from the tubes to the shell and with the duct and the shell define a compartment which encircles the duct and communicates with it as a side branch through the aperture between the telescoped portions of the tubes, the wall which extends from the larger tube to the shell being adjustable lengthwise of the duct.

2. In a silencer, a shell, and a duct which extends through the shell and with it defines a compartment which encircles the duct, the duct including a larger tube and a smaller tube which extends into and is radially spaced from the larger tube to define with it an aperture through which the compartment communicates with the duct, the larger tube being of smaller diameter at the end into which the smaller tube extends than at a distance from the mentioned end.

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