Jan. 27, 1942. E. E. WILSON 2,271,055

COMPOUND RESONANCE UNIT

Original Filed Jan. 30, 1933 2 Sheets-Sheet 1

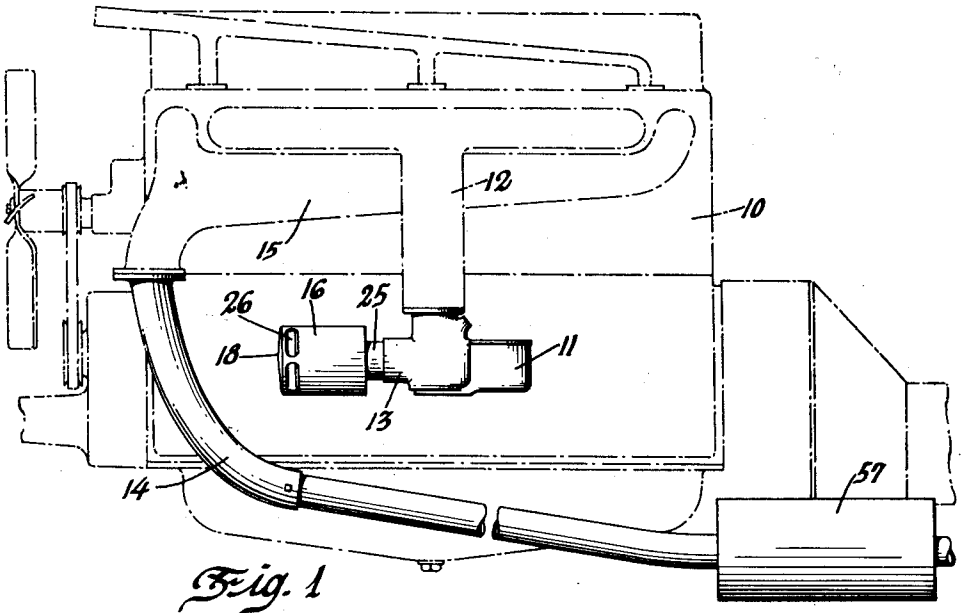


Fig. 1

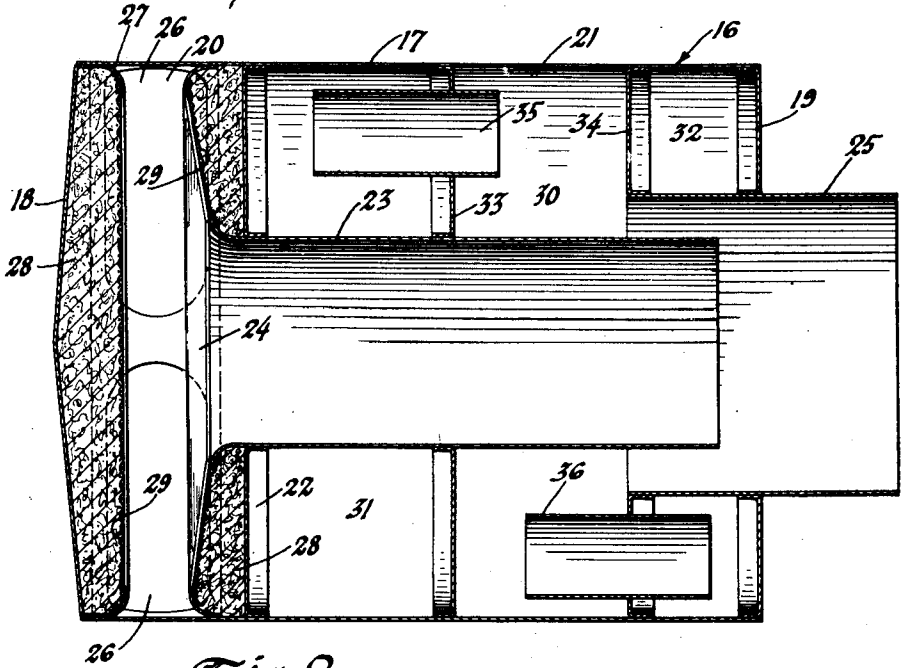


Fig. 2

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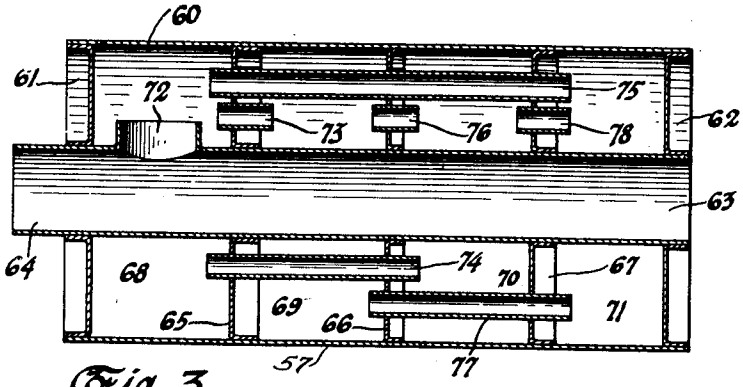


Fig. 3

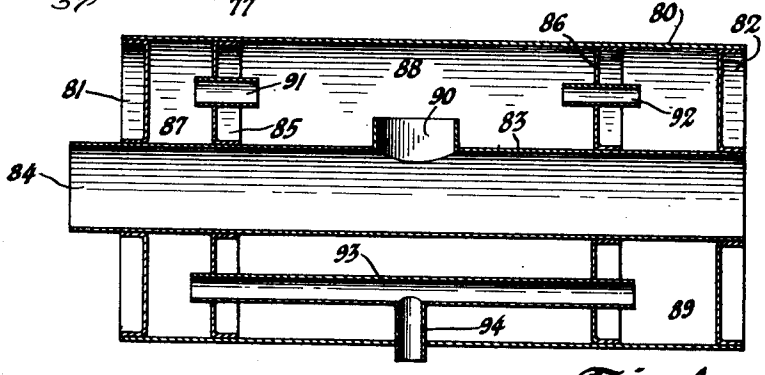


Fig. 4

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UNITED STATES PATENT OFFICE

2,271,055

COMPOUND RESONANCE UNIT

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Original application January 30, 1933, Serial No. 654,296. Divided and this application June 27, 1939, Serial No. 281,439

7 Claims. (Cl. 181—48)

This application is a division of my application Serial No. 654,296, filed January 30, 1933, on which Patent No. 2,164,365 was issued on July 4, 1939, and, in part, a continuation of my application Serial No. 470,700, filed July 25, 1930.

The invention with which this application is concerned has to do with resonance units of the type disclosed in my application Serial No. 470,700. In the main, this application is concerned with certain embodiments or features of the invention disclosed but not specifically claimed in my application Serial No. 470,700, or in my Patent No. 2,164,365, or in my application Serial No. 633,265, filed September 15, 1932, which is also, in part, a continuation of application Serial No. 470,700.

For a better understanding of the nature of the invention with which this application is concerned, reference is made to the following specification in which are described the several embodiments of the invention which are illustrated in the accompanying drawings.

In the accompanying drawings:

Figure 1 is a side elevation of an internal combustion engine equipped with intake and exhaust silencers in which are incorporated resonance units in which the invention with which this application is concerned is embodied.

Figure 2 is a central longitudinal section through the silencer installed on the intake tube of the carburetor of the engine illustrated in Figure 1.

Figure 3 is a central longitudinal section through the silencer installed on the exhaust pipe of the engine illustrated in Figure 1.

Figure 4 is a central longitudinal section through a modified form of silencer in which the invention with which this application is concerned is embodied.

In Figures 1, 2 and 3 of the drawings, the reference character 10 indicates an internal combustion engine which is equipped with a carburetor 11 which is connected to the cylinders of the engine by a manifold 12 and an exhaust pipe 14 which is connected to the cylinders of the engine by a manifold 15. To the air intake tube 13 of the carburetor and to the exhaust pipe, there are connected silencers 16 and 57, respectively, in which are incorporated resonance units of the type with which this application is concerned.

The silencer 16, which is shown in Figures 1 and 2 of the drawings, includes a cylindrical shell 17 over whose ends there are secured heads 18 and 19. The interior of the shell 17 is subdivided longitudinally into two compartments 20 and 21 by an annular partition 22 whose outer edge is circumferentially secured to the shell. Through the central opening in the partition 22, there extends from the compartment 20 into the compartment 21 a tube 23 which is circumferentially secured to the inner edge of the partition 22. To the end of the tube 23 which is located within the compartment 20, there is secured a perforated annular flange 24 whose outer edge is circumferentially secured to the shell 17. In the head 19, there is provided a central opening of larger diameter than that in the partition 22 through which there extends into the shell 17 a tube 25 which is of larger diameter than the tube 23 and whose inner end encircles and is circumferentially spaced from the adjacent end of the tube 23.

Through the side wall of the shell 17, there extend into the compartment 20 a ring of openings 26 through which air may pass from the atmosphere into the tube 23. The end walls 18 and 22 of the compartment 20 are lined with bodies of sound absorbing material which are held against the walls by an element 27 and the flanges 24, respectively. Each of the bodies of sound absorbing material preferably consists of a mat of hair felt 28 covered by a layer of burlap or other porous fabric 29 secured to the mat during the felting operation, or by "punching," of by an adhesive, but may be constructed of any other suitable material or combinations of materials.

The interior of the compartment 21 is divided into a primary resonance chamber 30 and two secondary resonance chambers 31 and 32 by an annular partition 33 whose outer and inner edges are circumferentially secured to the shell 17 and the tube 23, respectively, and an annular partition 34 whose outer and inner edges are circumferentially secured to the shell 17 and the tube 25, respectively. Communication between the secondary resonance chambers 31 and 32 and the primary resonance chamber 30 is established by tubes 35 and 36 which extend through openings in, and are circumferentially secured to, the partitions 33 and 34, respectively.

As shown in Figure 1 of the drawings, the silencer 16 is adapted to be installed on the air intake tube of the carburetor of an internal combustion engine by inserting one end of the tube 25 into the carburetor air intake tube and suitably securing it thereto. When the silencer is so installed and the engine is operating, the suction created by the cylinders on their suction strokes, will draw air through the openings 26, into

the compartment 20 and, thence, into the tube 23, whence it will pass through the tube 25, the carburetor and the intake manifold into the cylinders of the engine. Since, as is apparent from the drawings, there is an unobstructed path through the silencer into the air intake tube of the carburetor, the silencer will offer practically no resistance to the passage of air therethrough.

The resonance unit (which consists of the resonance chambers 30, 31 and 32, the passages which interconnect them and the passage which interconnects the primary resonance chamber 30 and the main passage 23—25) of the silencer 16 is so proportioned and dimensioned in the manner set forth in my application Serial No. 470,700 and the corresponding foreign patents, viz., Canadian Patent No. 348,037, British Patent No. 391,180, French Patent No. 720,611 and Italian Patent No. 300,037, that it will respond to and attenuate the objectionable sound waves of relatively low frequency which are ordinarily transmitted through the intake manifold and carburetor of the engine to the atmosphere. The objectionable sound waves of relatively high frequency which are ordinarily transmitted through the intake manifold and carburetor of the engine to the atmosphere are attenuated by the bodies of sound absorbing material with which the compartment 20 is lined. Thus, by their conjoint action, the resonance unit and the sound absorbing material effectually attenuate all of the objectionable sound waves which are ordinarily transmitted through the intake manifold and carburetor of the engine to the atmosphere and eliminate the so-called "intake noises" which are ordinarily found in internal combustion engines.

To illustrate some of the many forms which resonance units in which the invention with which this application is concerned is embodied may assume, I have included in the drawings Figures 3 and 4. It is to be understood that the structures illustrated in Figures 3 and 4 of the drawings, as well as those shown in Figures 1 and 2, may be modified in many ways as to details of construction and that modified structural features shown in any of the figures may be incorporated in the resonance units shown in any other or others of the figures.

The resonance unit which is shown in Figure 3 of the drawings includes a shell 60 over whose ends there are secured heads 61 and 62. Through the heads and the interior of the shell there extends a tube 63, which through its projecting end 64, is adapted to be connected to the air intake tube of a carburetor so as to form an extension thereof. The space between the shell 60 and the tube 63 is divided by partitions 65, 66 and 67 into resonance chambers 68, 69, 70 and 71 of which the resonance chamber 68 is directly connected to the interior of the tube 63 by a tube 72. The resonance chamber 68 is directly connected to the resonance chambers 69, 70 and 71 by tubes 73, 74 and 75 which extend through the partition 65, the partitions 65 and 66 and the partitions 65, 66 and 67, respectively. The resonance chamber 69 is directly connected to the resonance chambers 70 and 71 by tubes 76 and 77 which extend through the partition 66 and the partitions 66 and 67, respectively. The resonance chamber 70 is directly connected to the resonance chamber 71 by a tube 78 which extends through the partition 67. While the resonance chamber 68 can be considered only as a primary resonance chamber, the resonance chambers 69, 70 and 71, by virtue of the fact that each is connected directly to the other and to the primary resonance chamber 68, can be considered as secondary, tertiary or quaternary resonance chambers. In view of what was said in the sentence next preceding this, it will be apparent that the resonance unit shown in Figure 3 is the equivalent of a resonance unit of the type shown in Figure 2 in which the secondary chambers 31 and 32 are directly interconnected and to which there has been added a resonance chamber directly connected to each of the chambers 30, 31 and 32. Obviously one or more of the tubes 73, 74, 75, 76, 77 and 78 may be omitted and the characteristics of the resonance unit shown in Figure 3 thus modified.

The resonance unit which is shown in Figure 4 of the drawings includes a shell 80 over whose ends there are secured heads 81 and 82. Through the heads and the interior of the shell, there extends a tube 83, which through its projecting end 84, is adapted to be connected to the air intake tube of a carburetor so as to form an extension thereof. The space between the shell 80 and the tube 83 is divided by partitions 85 and 86 into resonance chambers 87, 88 and 89 of which the resonance chamber 88 is directly connected to the interior of the tube 83 by a tube 90. Each of the resonance chambers 87 and 89 is directly connected to the resonance chamber 88, the former by a tube 91 which extends through the partition 85 and the latter by a tube 92 which extends through the partition 86. The resonance chambers 87 and 89 are directly interconnected by a tube 93 which extends through the partitions 85 and 86 and to whose intermediate portion there is connected a tube 94 which extends through the wall of the shell 80 and connects the tube 93 with the atmosphere. While the resonance chamber 88 can be considered only as a primary resonance chamber, the resonance chambers 87 and 89, by virtue of the fact that each is directly connected to the other and to the primary resonance chamber, can be considered as either secondary or tertiary resonance chambers. It will be obvious that the tube 93 and/or the tube 94 may be omitted and that if both are omitted, the resonance unit shown in Figure 4 will be equivalent to a resonance unit of the type shown in Figure 2.

Although the resonance units herein disclosed are particularly adapted for use in attenuating the sound waves which are ordinarily transmitted through the intake manifold and carburetor of an internal combustion engine to the atmosphere, resonance units of the same type may be effectually used to attenuate sound waves in any enclosure of finite dimensions. It will, of course, be understood that, in designing resonance units for use in any installation, it is necessary so to proportion and dimension them in the manner set forth in my application Serial No. 470,700 and the corresponding foreign patents previously referred to that they will respond to the sound waves which they are intended to attenuate.

While it will be understood that effectually to attenuate the sound waves which travel through the exhaust pipe of an internal combustion engine toward the atmosphere, it is generally desirable to employ somewhat differently designed resonance units than are employed on the induction systems of such engines and that, in general, it is preferable to employ for this purpose resonance units, such as are disclosed in my application Serial No. 633,265, in which there are

provided a greater number of resonance chambers than are necessary in resonance units which are designed for use on the induction systems of such engines, I have, for the purpose of indicating the applicability of resonance units of the type with which this application is concerned to the exhaust systems of internal combustion engines, shown in Figure 1 of the drawings the resonance unit **57** which is shown in Figure 3 of the drawings installed on the exhaust pipe **14** of the engine **10** with the projecting end **64** of the tube **63** telescopically connected with the portion of the exhaust pipe which is located on the engine side of the resonance unit.

I claim:

1. In a silencer, a tubular member, another tubular member which encircles and is radially spaced from a portion of the first-specified tubular member and defines with it a duct through which gases travel and into which sound waves enter, a shell which encircles the duct and with it defines a substantially blind compartment, and partitions which encircle, respectively, the second-specified tubular member and the first-specified tubular member but not the second-specified tubular member and subdivide the compartment lengthwise into three chambers of which the intermediate chamber communicates with the duct as a side branch through the aperture between the tubular members and the end chambers communicate with the intermediate chamber independently of the duct and each other.

2. The combination, with a passage in which sound waves occur and which includes a conduit and a larger conduit into which the first-mentioned conduit extends, of a casing which surrounds the overlapping portions of the conduits and defines therewith a compartment, partitions, one secured to an end of the larger conduit and to the casing and another to the smaller conduit and the casing subdividing the compartment longitudinally into three chambers of which the intermediate chamber communicates with the passage through the space between the conduits and of which the end chambers communicate with the intermediate chamber independently of the passage.

3. In a silencer, a duct through which gases travel and into which sound waves enter, and a substantially blind side branch which includes a chamber which communicates with the duct and chambers which communicate with the first-specified chamber independently of the duct and each other and with each other independently of the first-specified chamber.

4. The combination, with a passage or other enclosure within which sound waves occur, of a side branch which includes a compartment which communicates with the enclosure and a plurality of compartments which communicate with the first-mentioned compartment independently of the enclosure and of each other and with each other independently of the first-mentioned compartment and is so proportioned and dimensioned that it responds to and attenuates by resonance objectionable sound waves which occur within the enclosure.

5. In a silencer, a duct through which gases travel and into which sound waves enter, and a substantially blind side branch which includes a chamber which communicates with the duct, chambers which communicate with the first-specified chamber independently of the duct and each other, and a chamber with which both of the second-specified chambers communicate independently of the other and the first-specified chamber.

6. The combination, with a duct through which gases and sound waves travel, of a resonator which is arranged as a branch of the duct and is so tuned that it responds to and attenuates by resonance sound waves of preselected frequencies which travel through the duct, the resonator including a chamber which communicates with the duct, and a plurality of chambers which communicate with the first-specified chamber independently of the duct and each other and with a fourth chamber independently of the first-specified chamber and the duct.

7. In a silencer, a tubular member which constitutes a duct through which gases travel and into which sound waves enter, a shell which encircles the tubular member and with it defines a substantially blind compartment, partitions which subdivide the compartment lengthwise into three chambers, an aperture through which the intermediate chamber communicates with the duct, apertures through which the end chambers communicate with the intermediate chamber independently of the duct and each other, and a duct through which the end chambers communicate with each other independently of the intermediate chamber.

ERNEST E. WILSON.