The Analysis of Engine Noise and Noise Reduction Measures

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Abstract. With the rapid development of automobile industry, the impact of engine noise on the social environment and human body can’t be ignored any longer. Noise pollution has become an important source of environmental pollution. This paper analyses the harm and classification of engine noise, putting forward noise reduction measures of the engine in view of the increasingly serious noise pollution. The noise reduction technology of engine plays an important role in the rapid development of automobile industry.

Noise, from the perspective of environmental protection, refers to the sound that hinders people's normal study and work, as well as the sound that interferes with the sound that people want to hear, while it refers to the sound produced when the voice generator vibrates irregularly from the perspective of physics. The rapid development of automobile industry not only brings convenience to human life, but also brings a large number of social problems such as environmental noise pollution. Noise pollution is an important pollution that can’t be ignored in modern life.

1 The hazards of engine noise

1.1 The influence of engine noise on human physiology and psychology
High decibel and long-term road traffic noise will damage people's hearing and lead to the abnormality of human circulatory system, which can cause heart disease, cerebrovascular disease, digestive system disease, nervous system disease and other diseases. At the same time, high decibel and long-term road traffic noise can easily lead to people's tension and bad mood, so as to seriously affect people's rest and sleep quality.[1] If things continue this way, people will feel fidgety and inattentive.

1.2 The influence of engine noise on buildings
Engine noise is harmful to buildings on a certain extent. When the natural frequency of bridges and buildings is consistent with the frequency of engine noise, resonance will be caused which will damage the structure of the building and reduce the seismic capacity that even causes collapse in serious cases.
1.3 The influence of engine noise on traffic

If the driver is in the noise environment for a long time, it is easy to cause fatigue and confusion of thinking which can distract attention, thus causing traffic accidents and life risks. When pedestrians are crossing the road, if the engine noise is too loud, it will affect judgment and cause traffic accidents.

2 The classification of engine noise

There are three types of engine noise: combustion noise, mechanical noise and aerodynamic noise. Combustion noise and mechanical noise radiate from the outside of the engine, while aerodynamic noise radiates directly to the atmosphere in the process of intake and exhaust. The combustion noise is the main noise source when the engine is running at low speed, while the mechanical noise and aerodynamic noise are the main noise sources when the engine is running at high speed [2].

2.1 Combustion noise

Usually, the part of noise radiated by the vibration of engine structure surface caused by the cylinder pressure which is transmitted to the cylinder head and engine body through piston, connecting rod, crankshaft and main shaft, is called combustion noise. The combustion noise of the engine is produced in the cylinder. In the combustion process, the pressure wave of the gas in the cylinder impacts the combustion chamber wall, the vibration and radiation noise produced by which are of high frequency characteristics. The pressure in the cylinder changes periodically in a working cycle arousing the vibration of the internal parts of the cylinder, the frequency of which is related to the engine speed, at the same time the noise radiates out through the engine body. The vibration and radiation noise are of low frequency characteristics, the strength of which depends on the pressure growth rate and the duration of the highest pressure growth rate.

2.2 Mechanical noise

The mechanical noise of engine refers to the noise caused by impact and vibration of moving parts under the action of gas pressure and inertia force. It mainly includes piston knocking noise, oil supply system noise, valve mechanism noise, timing system noise, auxiliary machine system noise, bearing noise, body vibration and noise caused by unbalanced inertia force, etc. When the engine is working, the mechanical vibration of the parts is aroused and the noise is produced because of the impact, friction, uneven rotation and unbalanced force. Especially when the frequency of exciting force is consistent with the natural frequency of components, it will cause intense resonance and noise. The mechanical noise of engine increases rapidly with the increase of speed.

2.3 Aerodynamic noise

Aerodynamic noise refers to the noise caused by the flow of gas such as periodic intake and exhaust or the movement of objects in the air, the impact between the air and objects, the eddy current generated by the air, the sudden change of air pressure, the formation of air disturbance and expansion such as the injection of high-pressure gas into the air. Generally speaking, aerodynamic noise radiates directly to the atmosphere, which is mainly divided into intake noise, exhaust noise and fan noise.
3 Engine noise reduction measures

3.1 Noise absorption method

The noise absorption method is to suppress the noise at the sound source, the radiated sound energy of which can be reduced by the measures that can eliminate or reduce its generating conditions according to the mechanism of noise [3].

In any finite space, noise is composed of direct sound and reflected sound, which is one of the scientific bases of noise absorption method. If some devices that can absorb sound energy are arranged in the limited space around the sound source, the sound energy reflected from the wall around the sound source can be reduced to achieve the purpose of noise reduction. There are two ways to improve the noise environment by means of noise absorption: one is to use noise-absorbing materials, while the other is to use noise-absorbing structure. The porous sound absorbing materials are mainly applied at present, including glass wool, cotton and hemp plant fiber, foam aluminum and clay brick, which can absorb medium and high frequency noise and generally have poor performance to low frequency sound on noise-absorbing. Therefore, resonance absorption structure is often used to solve the problem of low-frequency sound absorption in many cases. The commonly used absorption structures are air layer absorption structure, membrane resonance absorption structure and plate resonance absorption structure.

3.2 Noise insulation method

The noise insulation method is to control the noise in the transmission, which can isolate all or part of the noise source to achieve the purpose of noise reduction.

The noise insulation method is one of the commonly used techniques in modern noise control engineering. When noise propagates in the air, the measures which make the noise energy blocked in the transmission path and can't pass directly is called noise insulation. In many practical cases, it is difficult to deal with the noise source due to the limitations of various conditions, so that measures can be taken to reduce the noise in the noise propagation path. According to the different shapes, noise insulation components can be divided into noise insulation wall and noise insulation cover. The noise insulation cover is widely used in construction machinery for noise isolation of engine and cab, which is a comprehensive structure with sound insulation, sound absorption, damping, vibration isolation, ventilation, noise elimination and other functions.

3.3 Noise elimination method

The noise elimination method adopts the protection measures for the noise receiver to reduce the noise.

The noise elimination method uses a kind of device to reduce the noise of air flow, which can effectively prevent or reduce the sound energy from spreading outwards while allowing the air flow to pass smoothly. Therefore, the noise control equipment can be installed at the inlet and outlet in order to reduce the noise to solve the problem of noise control based on air flow noise, which can be called silencers. There are many kinds and structures of silencers. According to the different silencing principles and structures, the common silencers are resistance silencers, resistance silencers and impedance composite silencers.
4 Conclusion

With the rapid development of automobile industry, the harm of engine noise is becoming more and more serious with each passing day. The development of effective engine noise reduction technology is of great significance to the development of automobile industry and plays an important role in promoting the wide application of engine, which is the inevitable requirement of environmental protection.

References

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