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THE VORTEX AT AN INLET OF AN AIR INTAKE

by

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The formation of a vortex at the inlet of the air intake has been noted in Refs. 1, 2, and 3, and others. It was pointed out that such a vortex may contribute to the suction of particles from the ground surface and lead to damage of the mechanisms, having movable working parts, located directly behind the main suction line. If we place a thick enough filter at the entrance of the main suction line such damage can be avoided. However, in many cases such a method is not acceptable for a great variety of reasons, particularly after strong hydraulic resistance of the filter. That is why it is understandable why there is a search for other methods of preventing solid particles from the ground from entering the air intake passage.

The suction of solid particles into the air intake is possible during experimental procedures. For the sake of expediency a test is set up in a manner such that the solid particles could present no damage and allow various kinds of investigations, including the detailed study of peculiarities of vortical movement at the inlet of the suction channel.

The working component of the set up designed to take such demands into consideration, consists of a horizontal suction channel and a vertically transportable horizontal platform which imitates the ground surface.

The possibility of connecting the generator fumes is taken into consideration in the construction of the platform. The surpersonic ejector creates a stream of air at the inlet of the working component. By changing the operating procedures of the ejector, we regulate the velocity of the air stream.

Direct observation yielded some understanding of the character of air movement at the air intake inlet. Fumes or talcum were used to visualize the stream. With the aid of the fumes, we can see the vortex nucleus clearly without the shadowy picture of the movement around it. Hydrochloric acid and ammonium hydroxide were our sources of fumes. By using talcum, we were able to observe the vortex movement in a wider zone beyond the nucleus of the vortex both on the surface of the platform and in the space between it and the air intake (Fig. 1).

Movement beyond the nucleus of the vortex is clearly of a spiralling nature. On the horizontal surface are solid particles carried along by the vortex moving toward the nucleus in the direction opposite the pressure gradient. Solid particles were thrown up when the nucleus of the vortex formed and were thrust in different directions because of centrifugal force (Fig. 2). The formation of the vortex nucleus is indicated by the arrow.

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In other experiments the movement of larger solid particles (granite granules having a diameter of up to 1.5 mm) on the platform surface was the same. When the vortex absorbed large quantities of these larger particles, some of them moved along a trajectory encompassing the vortex nucleus. These particles flew in different directions and were close to the deflector and were caught in the suction channel.

In this manner, visualization of the stream by various means and with the help of various materials makes a deeper study of the qualitative processes of this phenomenon possible.

Fig. 1. No caption

Fig. 2. No caption

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