The Flow of Gas under High Initial Pressures. Part I

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(Translated from Annalen der Physik, Vol. 43, p. 1186, 1914, by N. U. Mayall)

Introduction

The phenomena of the flow of gases from nozzles have been the object of many experimental and theoretical investigations; especial mention is made here of the work of E. and L. Mach, Emden, Prandl, Mazin, Meyer, Steichen. In the case of all these works, it was always a question of the flow process being fixed for the case of a large reservoir gradually discharged, so that attention was given the possibility that, within the time of observation, the pressure in the reservoir did not change. Accordingly, Prandl and his students always based their computations on the assumption that all flow lines come from a space in which a constant pressure prevailed, and in which the velocity of the total mass of gas is not essentially different from zero. Hence there resulted very good agreement between theory and experiment. Naturally the experimental tests of the deduced laws could extend only to relatively low pressures of several atmospheres if the assumptions made should hold, since otherwise the reservoir would have assumed too large dimensions. On the other hand, it appears to us worthwhile to investigate the phenomena of the flow of gases under extremely high pressures, of more than 100 atmospheres.

The apparatus would be relatively simple if a gun were used, for in this case the gases flow out under high pressure after the bullet. There was also the possibility of bringing into the field of the investigations, at the same time, several problems hitherto of a ballistic nature. The relatively simple experimental apparatus had the defect, however, that it did not permit the formulation of clear conditions for a theoretical treatment of the question, so that we were compelled to investigate, first in a purely experimental way,