

potential that the terminals F_2 just prevented the spark discharge, and hence a discharge through the illuminating spark F_1 occurred only with the passage of the bullet at F_2 . Since the initial velocity of the bullet is known ($v = 890$ m./sec.), then by changing the distance of F_2 from the muzzle, the instant for the photographic exposure may be varied or fixed in a very simple way. From the successive photographs, a picture sequence may be collected in a manner similar to that earlier carried out by one of us. It is, of course, possible to use motion picture photographs instead, although we have temporarily abandoned this method since the pictures are relatively narrow, and we are already near the limit of observing phenomena at greater distances from the muzzle. Besides, it is also apparent that the deviations of different shots lie entirely within the limits of measuring errors.

Two adjacent spark gaps and two objectives will be considered later in the case of stereoscope bullet photographs taken by the Toepler schlieren method.

1. Description of the Flow Phenomena of Powder Gases from Gunshots.

In order to explain the origin of the flow pattern, as it is represented in Fig. 2 (Plate XI), it is first necessary to obtain the velocity distribution of the streaming gas particles within the pattern. Since the motion of the individual gas particles cannot be made directly visible in the case of normal shots, nor by means of the schlieren method, there remains only the possibility of measuring the velocity by indirect means. We therefore proceed in the following manner: A fine steel point is placed in a vertical plane through the bore-axis and in the flow pattern, in such a way that its point is located at the place at which the velocity is to be measured, and its direction approximately in agreement with that of the flow lines. Since it was established by several experiments that these in general emanated from the center of the muzzle, the above condition was satisfied without difficulty. Now if the gases flow against the fine point, then at this place there are formed Mach "head-waves" which permit the velocity of the gas particles in the vicinity of the point to