

The projectile will commence to move when the force of the gas has become equal to the resistance offered to motion.

The time necessary for the conversion into gas of the quantity of the powder required to move the projectile will depend upon the nature of the gunpowder used, the form of the cartridge, and the point of ignition of the latter.

The maximum strain upon the metal of the gun will mainly depend upon the rapidity of the conversion of the powder into gas.

The initial velocity of the projectile may not, however, be in proportion to the maximum strain, but its square varies as the work done on the shot, or as the pressures into the spaces through which they act, or :

$$P. s. = \frac{W V^2}{2g}$$

Where P = pressure of gas in pounds.

s = space in feet through which P acts,

W = weight of projectile in pounds.

V = velocity of projectile in feet per second.

g = accelerating force of gravity.

and if s. be a very small interval a fair approximation to the mean strain exerted through it in the bore of a S. B. gun may be calculated by this formula.

$$\text{Recoil. } \frac{W V^2}{2g} = \text{Energy of recoil if } \frac{W}{V} = \text{weight of gun} \\ \text{velocity of gun.}$$

Momentum  $\frac{W V}{g}$  of gun = momentum of projectile.

Distance of recoil depends on the friction opposing the recoil, &c.

B. *Forces affecting the projectile after leaving the bore of the gun.* The projectile on leaving the muzzle of the gun is submitted to the influence of 2 forces which affect its motion. The forces are:—1, gravity; 2 resistance of the air. - If these forces did not exist a projectile fired from a gun, would travel indefinitely in a straight line through equal spaces in equal times. Thus it would travel from A to B (fig. 1) during say the first second of time, from B to C equal space during the second second of time, from C to D in the third, and so on.

*Force of Gravity.*—But as the force of gravity acts on the projectile in motion it will, as it proceeds onward, fall 16 feet, B, E, in the first second of time, and at the second second it will have fallen 64 feet, C, E, and at the third second of time 144 feet, D, C, (or as 16 mul-

\* If 1 foot and 1 second are the units, as usual.

g = 32.2 approximative.

This value differs at different points of the earth's surface. For the purposes of this Manual, the number 32 is sufficiently accurate.