

to improved metallurgy and machine tooling. Others were a reflection of the impetus to firearms improvement encouraged by the shortcomings and requirements of the Crimean War, the American Civil War and various Prussian wars in Europe. In fact, this was an era where the term “arms race” could be applied. Events during this period would serve as a precursor for future rapid development programs designed to achieve qualitative SALW superiority over a potential adversary. While qualitative improvements were expensive for modern armies to undertake, failure to do so could mean defeat on the battlefield. Obsolescence in turn meant surpluses and the requirement for disposal and cost recovery programs in order to help finance improvements. This marked the beginning of significant resales of older military arms to armies with less financial resources, together with sales to commercial companies for civilian resale.

The development of the self-contained cartridge in conjunction with the breech-loading rifle significantly increased the effectiveness of small arms. First, small arms could be loaded much more quickly, increasing the firepower of armies by an order of magnitude. The development of repeating systems using lever or bolt actions fed by a box or a tubular magazine further improved the firepower potential of firearms. This in turn increased the vulnerability of a target by exposing it to more frequent fire within a given range. The use of the brass cartridge also provided a tighter seal, something which in turn gases from escaping and thus increased both the accuracy and the range of the firearm. The invention of smokeless powder and the steel/copper jacketed bullet significantly reduced fouling, thus permitting a reduction in caliber size. By the beginning of the 20<sup>th</sup> century, individuals could fire a round approximately every four to five seconds from a 10 round magazine<sup>13</sup> out to an effective range of 1,000 metres and even beyond. This represented a significant increase over a round every 15 seconds (highly skilled soldiers only) and the 200 metre effective range of personal fire arms less than 80 years earlier.<sup>14</sup>

The mechanical machine gun was introduced during this same time period. Most such weapons were multi-barreled, cylinder fed, multiple-fire guns which required cartridges to be fed through by mechanical means. The most renowned mechanical machine guns were the Gatling Gun, the French Mitrailleuse, the Swedish Nordenfelt and the American Hotchkiss. With these weapons, a second person was normally required to ensure a continuous supply of ammunition, feed it into the weapon, and help move the gun when required – hence the name “crew served weapon”. The first widely used true machine gun was the Maxim. (A true machine gun is one that is automatic – that is, one that uses the kinetic energy created by the burning of the propellant and/or the expelled gases to manipulate internal mechanisms in a manner which permits the empty casing to be ejected and a new cartridge inserted in the chamber and fired, with the firer only required to keep the trigger depressed.) It was introduced in 1885;

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<sup>13</sup> A skilled rifleman could probably get a round off every 2 seconds with effect out to 300 metres, not counting time to change magazines or reload magazines.

<sup>14</sup> Hogg, *Guns and How They Work*, p. 51.