Mechanical Heritage of China's Mountain Gun Manufacturing in the 1940s: The SOMUA Rifling Machine at North Western Industrial Corporation

Qingqi Lyu[1(✉)] and Yibing Fang[2]

[1] Inner Mongolia Normal University, Hohhot, China
lvqingqi713@163.com
[2] Institute for the History of Natural Science, Chinese Academy of Sciences, Beijing, China
Yibing@ihns.ac.cn

Abrstract. This paper examines modern Chinese gun machining technology by analyzing the Jin-made 36 Type 75 mm mountain gun manufactured by the North Western Industrial Corporation. It also investigates the technical characteristics and introduction process of the SOMUA rifling machine as a mechanical heritage, while discussing artillery manufacturing during the era of the Republic of China.

Keywords: Artillery Manufacturing · Schneider et Cie · China · Mechanical Heritage · SOMUA Rifling Machine

1 Introduction

The Shanxi Machinery Bureau, which was established by the Qing Dynasty government in 189 8 [1] (now located in Taiyuan, Shanxi Province, PRC), was formerly known as the North Western Industrial Corporation (NWIC) before the establishment of the People's Republic of China (see Fig. 1) [2]. In the 1930s, NWIC gained recognition as one of three major arsenals in China alongside Hanyang Arsenal and Kiangnan Arsenal [3]. It distinguished itself among a limited number of factories capable of manufacturing advanced firearms and machinery during that period. In 1949, NWIC came under the control of the People's Republic of China [4]. The remaining equipment of NWIC holds significant historical value for studying technological advancements related to early modern weapon manufacturing in China and has been exhibited in a small museum at NWIC. This study primarily focuses on the SOMUA rifling machine, which is an important mechanical heritage that serves as a case study for investigating manufacturing techniques employed in mountain gun production during the era of the Republic of China.

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Fig. 1. Gate of The North Western Industrial Corporation (Provided by LIU Guihong)

2 The Production of the Jin-Made 36 Type 75mm Mountain Gun at NWIC

The most renowned and emblematic weapon of NWIC was the Jin-made 36 Type 75 mm caliber mountain gun (晋造36式75毫米山炮) (see Fig. 2) [5]. In 1947, NWIC successfully replicated Japan's design to produce their own version of this type [6]. The development process for the 36 Type can be traced back to an earlier model known as the Jin-made 13 Type[1] (晋造13式75毫米山炮) (see Fig. 3), which drew inspiration from Japan's design for the Model-41 mountain gun (四一式山炮,聯隊砲)[2][7]. The origin of Japan-designed Model-41 can be attributed to its licensing by Japan, based on Krupp M1908 mountain gun technology. Following the Russo-Japanese War, Japan imported Schneider et Cie's recoil system technology and subsequently upgraded it from its original design to create a more advanced and widely used model known as Japan-designed "94 Type" during World War II (2594 in Japan's Kambu era) (see Fig. 5) [8]. Although initially chosen as a prototype, not all aspects of its design were replicated in actual production of Jin-made 36 Type, a caliber mountain gun [9]. To streamline the process, they integrated into this outdated design with recoil system from 13 Type [6], due to NWIC's production capacity constraints. Figure 6 illustrates intergenerational relationships between various types of artillery (Fig. 4).

The 36 Type mountain gun barrel was manufactured at the North Western Locomotive Works (西北机车厂) (affiliated with NWIC), as shown in Fig. 7. Steel materials were provided by the North Western Steel Plant (西北炼钢厂) and the North Western Yuh-Tsai Steel & Machine Work (西北育才炼钢机器厂) [6]. The production of gun barrels involved various processes [10], as depicted in Fig. 8.

[1] The Type 13 and Type 36 numbers were designated for the years when the guns were accepted, specifically during the KMT government's reign in its 13th and 36 years.

[2] The Model-41 refers to Emperor Meiji's forty-first year of reign.

Fig. 2. The picture on the right shows a Jin-made 36 Type 75 mm Mountain Gun in the Chinese People's Revolutionary Military Museum (Photo by the author).

Fig. 3. The picture on the right shows a Jin-made 13 Type 75 mm Mountain Gun in the Chinese People's Revolutionary Military Museum (Photo by the author).

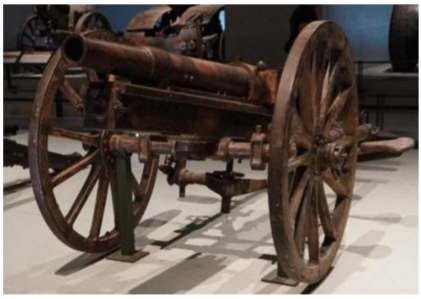

Fig. 4. The picture on the right shows a Japanese 41 Type 75 mm Mountain Gun in the Chinese People's Revolutionary Military Museum (Photo by the author).

The equipment used to manufacture 36 Type mountain gun primarily relied on two sources. While the majority of the standard equipment was self-manufactured by NWIC [8, 12], precision equipment such as rifling machines were imported with assistance from the KMT Government in the 1940s. Notably, a rifling machine provided by SOMUA, a subsidiary of Schneider et Cie in France, was of utmost significance. The SOMUA rifling machine was introduced and employed for barrel processing until the early 21st

Fig. 5. The picture on the right shows a Japanese 94 Type 75 mm Mountain Gun in the Chinese People's Revolutionary Military Museum (Photo by the author).

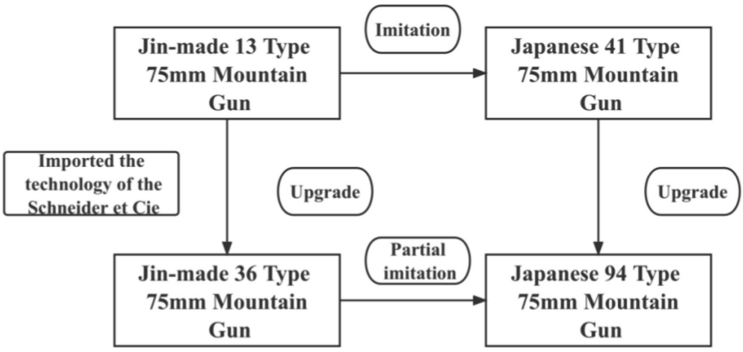

Fig. 6. Artillery Iteration Diagram

Fig. 7. The Workers Manufactured 36 Type Mountain Gun Barrels in 1948 [11]

century, making it one of NWIC's most invaluable heritages. Currently, it is prominently displayed in a small museum situated on the original site of NWIC.

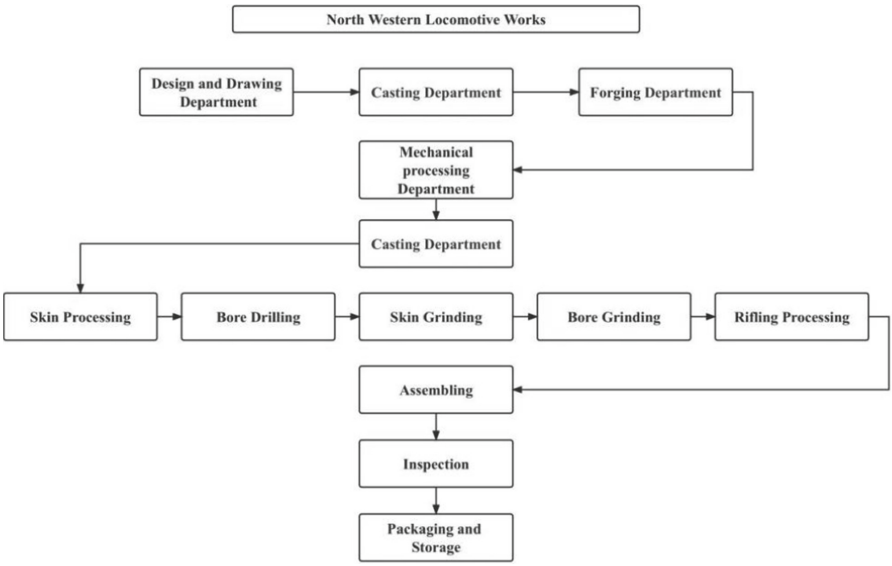

Fig. 8. Manufacturing Process Diagram for the 36 Type Mountain Gun

3 The SOMUA Rifling Machine for the Processing of 36 Type Barrels at NWIC

3.1 The Structure and Operating Principles of the SOMUA Machine at NWIC

The SOMUA rifling machine measures approximately 15 m long and 2.5 m wide (see Fig. 9).The main structure of the machine is equipped with automatic controls, power drives, and automatic indexing capabilities. The cutting tool is securely mounted on a head that precisely fits into the bore. After each stroke, the barrel undergoes indexing while the tool progressively advances until it reaches full depth within all grooves. This machine can effectively be used for rifling processes in guns with bores measuring 75, 76.2, 85, 100, 105, 120, and 125 millimeters as well as other multi-caliber firearms.

The SOMUA rifling machine served as a prime example of the prevalent artillery rifling broaching process from the 1920s to the 1940s. This machine employs multiple cutters derived from a single-point cutting tool, allowing for simultaneous machining of up to half of the required number of grooves. This innovative method was initially successfully employed in manufacturing French guns in 1918 and allowed for rough-cutting and finishing grooves using a series of cutting tools divided into segments forming a set of broaches. The SOMUA rifling machine utilizes multiple cutter technology for manufacturing mountain guns. This technological approach remained dominant throughout much of the 1930s [13]. During this period, it is worth noting that the Shanghai Arsenal (formerly known as Kiangnan Arsenal) also employed a rifling machine with a structure similar to SOMUA's, which was purchased abroad in the 1910s (see Fig. 10). However, unlike SOMUA's use of multiple cutters, the Shanghai Arsenal used single-point cutting tools, resulting in a more time-consuming rifling process.

Fig. 9. SOMUA Rifling Machine for Rifling the Barrel of the 36 Type Mountain Gun (Photo by LIU Guihong)

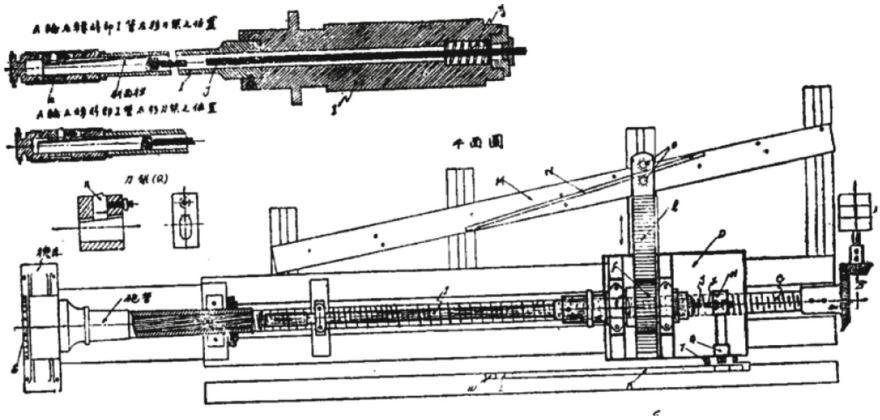

Fig. 10. The Rifling Machine's Three-View Drawing by Shanghai Arsenal [10]

In addition to its primary structure, the SOMUA rifling machine was also equipped with an electric motor that provided the necessary power for its operation. The information displayed on the nameplate of the electric motor can be identified (see Fig. 11).

The dynamical system of this SOMUA rifling machine was manufactured by CHAMPAGNE SUR SEINE, which served as a wholly-owned subsidiary of Schneider et Cie. Most motors for Schneider machinery were produced in the early 20th century (Fig. 12).[14].

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Fig. 11. Motor Name Plate of the Electric Motor for the SOMUA Rifling Machine (Photo by author)

Fig. 12. Workshop in CHAMPAGNE-SUR-SEINE [14]

3.2 The Import Process of the SOMUA Machine into China

SOMUA, an abbreviation for Société d'outillage mécanique et d'usinage d'artillerie, served as a subsidiary of Schneider et Cie in France. Established in 1861 as a machine tool manufacturing enterprise, it later came under the control of Schneider in 1914. Situated in Saint-Ouen, a suburban district of Paris, this company gradually developed

into a prominent manufacturer specializing in light weapons, equipment, and vehicles [14].

The parent company of SOMUA Schneider et Cie was founded by Joseph Eugene Schneider and Adolphe Schneider brothers in Creusot, France in 1833. Gradually transforming into a large-scale conglomerate through capital accumulated from early involvement in the steel industry, it integrated various industries including mining, metallurgy, machinery, and armament manufacturing. By approximately 1910, it had emerged as one of the world's largest mining and engineering manufacturing enterprises with a scale comparable to Krupp, and gained recognition as one of the four major global armament manufacturers [15, 16]. During the era of the Republic of China, the Ordnance Administration under the Ministry of War (OAMW) of the KMT government adopted artillery made by Schneider as their standard weaponry.

During the first half of the 20th century, Schneider exhibited a strong inclination towards penetrating the Chinese market by actively promoting sales of their diverse range of products, including weaponry and other manufacturing equipment. The advertising poster in Fig. 13 represents Schneider's marketing efforts targeted at the Chinese market during the early 20th century [17]. The presence of the SOMUA rifling machine provides concrete proof of Schneider's trade endeavors and technology transfer to China. However, the journey undertaken by the SOMUA rifling machine to reach China was arduous, with its ownership changing hands multiple times before ultimately being acquired by NWIC for service since 1947.

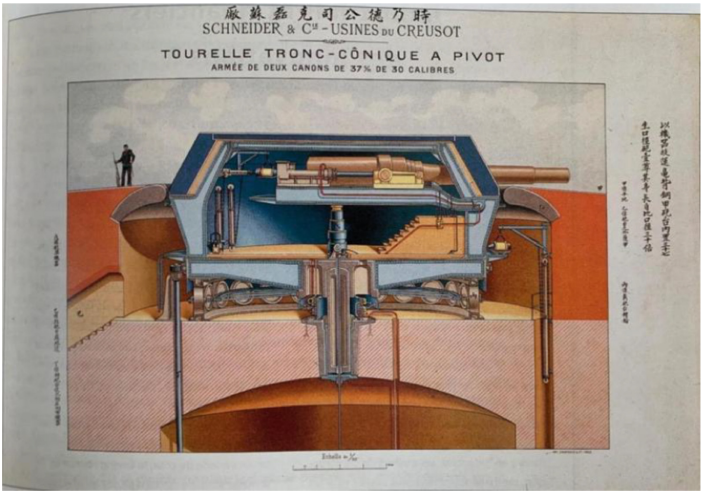

Fig. 13. Chinese Advertisement by Schneider et Cie

The acquisition of the SOMUA rifling machine was first purchased by NWIC but was acquired by Liu Xiang (刘湘, 1889–1938), the chairman of Sichuan Province. He purchased it with the intention of establishing a local artillery factory during the 1930s.The machine currently retains a Chinese nameplate bearing Liu Xiang's signature

"为母国前途奋勉之", which signifies unwavering commitment to the future of our motherland through diligent endeavors. (see Fig. 14).

Fig. 14. Chinese Name Plate of SOMUA Rifling Machine (Photo by author)

Liu Xiang was the commander of the Sichuan army. In 1930, he personally selected four engineers, namely Shen Shiling (沈士灵), Ma Junbi (马君弼), He Zhaozhong (何肇中), and Zhou Junshi (周均时) -to procure necessary equipment for establishing an Arsenal. Due to Shen's doctorate degree in mechanics, as well as master's degrees in chemical engineering and electrical engineering from France, it was only natural for them to prioritize French companies. After careful consideration and analysis, they decided to collaborate with Schneider [11].

Liu Xiang's decision to collaborate with Schneider was based on three factors. First, when comparing artillery of the same caliber, Schneider's products are lighter and more convenient for disassembly and transportation. Second, the engineer's educational background in France predisposed him towards selecting Schneider as the preferred choice. Third, in order to enhance its market presence in China, Schneider extended support to Liu Xiang by helping establish an artillery factory and offering provisions for procuring additional equipment necessary for artillery manufacturing from them.

The agreement between Liu Xiang and Schneider was formalized in 1934, with Schneider dedicated nearly two years to designing a new 105 mm mountain gun. Following standard production practices, equipment manufacturing was scheduled to commence after artillery acceptance to ensure optimal suitability for product fabrication. However, the outbreak of The War of Resistance against Japanese Aggression in 1937 significantly impacted on the establishment of Liu Xiang's arsenal. Furthermore, the French government's nationalization of the military industry caused additional delays in fulfilling orders. The unexpected death of Liu Xiang on January 20, 1938 led to his family's decision not to continue making payments for the contract. Despite some equipment already being transported to Vietnam, the war hindered their delivery [18].

Recognizing China's machinery shortage and urgent need for efficient utilization, the OAMW negotiated with Liu Xiang's relatives regarding ownership of these items [19]. The specific details of this contract are presented in Fig. 15 [20].

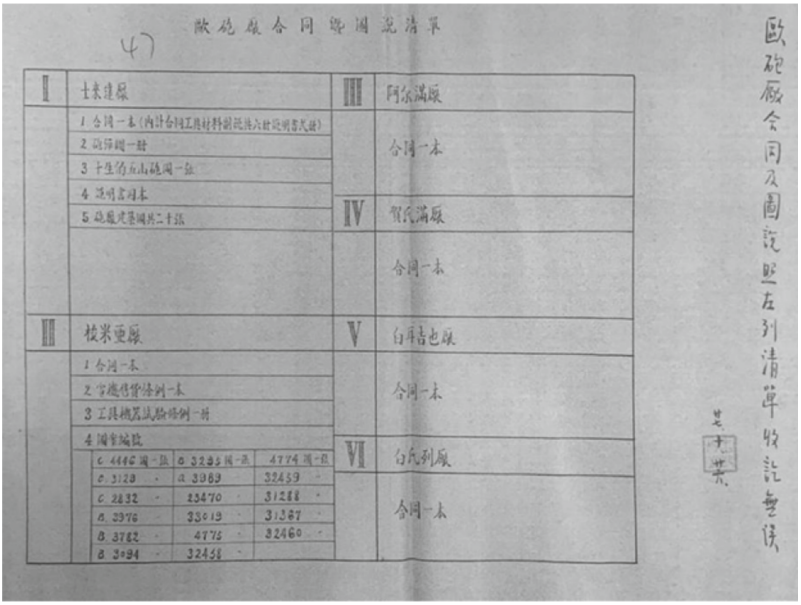

Fig. 15. Contract List of Schneider et Cie (士来达厰means Schneider et Cie, 梭米亚厰means SOMUA) (Photo by author)

Wang Rengzhi (王仍之), an official from the OAMV involved in the transfer and disposal of these equipment, mentioned in his memoirs that during that particular period, a majority of the ordered equipment primarily consisted of specialized machinery such as boring machines and rifling machines for gun barrels, while only a limited quantity of standard lathes and vertical milling machines were ordered [21]. His memo also indirectly confirmed that the SOMUA rifling machine was among these equipment.

Due to their substantial size and weight, the OAMW made a strategic decision to establish the 52nd factory along the Yunnan-Vietnam Railway as an optimal location for accommodating these equipment. However, during the War, the 52nd factory was unable to engage in artillery production [22]. After the War of Resistance against Japanese Aggression, NWIC consistently sought assistance from the KMT government to address the equipment shortages related to the production of new type mountain guns. The OAMW transferred this SOMUA rifling machine to NWIC, which played a pivotal role in the production of the 36 Type. The machine has been in operation on the production line for nearly six decades. Consequently, even after nearly a century, this machine remains in excellent condition. In 1948, a total of 113 guns of the 36 Type were produced; therefore, based on the scale of manufacturing equipment available at that time, it can be inferred that most of these guns were likely manufactured using the SOMUA rifling machine.

4 Conclusion

According to the analysis presented in this paper, the manufacturing process of the 36 Type mountain guns can be primarily characterized as a pursuit of technological emulation driven by limited advancements in artillery technology during early modern China. The trajectory of technological emulation for the 36 Type mountain gun can be traced back to the replication of the Japanese 13 Type mountain gun prior to The War of Resistance against Japanese Aggression, indicating that the Japanese mountain gun served as an exemplary model of technical advancement in weapon manufacturing during the Republic of China era.

From the perspective of rifling broaching technology, the SOMUA rifling machine exemplified the prevailing technique for artillery rifling broaching during the 1930s and served as tangible evidence for trading and disseminating this technology. In contrast to limited trade channels and technology transfers that safeguarded core technologies in the early 20th century, Schneider et Cie offered a comprehensive range of technologies including artillery design blueprints, manufacturing blueprints, relevant technical information, as well as manufacturing equipment and tools during their trade negotiations with Chinese clients. Although this particular trade did not eventually happen, it represented a more technologically monopolistic form of trading that partially reflected characteristics seen in technological exchanges between mature Western military industries and China during this period.

From an industrial heritage perspective, the SOMUA rifling machine at NWIC is one of the few remaining core machines for gun production worldwide in the 1930s. On the other hand, having undergone a complex acquisition process from France to China and possessing over six decades of operational experience across both the historical periods of the Republic of China and the People's Republic of China, the SOMUA rifling machine stands as an invaluable testament to artillery manufacturing industry development and technology introduction in modern Chinese history.

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