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Chapter 1

A STUDY OF EARLY KOREAN ROCKETS (1377-1600)^{*}Chae, Yeon Seok[†]

The first Korean rocket was fired between 1377-1389 and began the Korean development of rockets as a tactical weapon. Although Korea has successfully demonstrated the use of rockets as firearms in the 15th Century, there had been no effort to present the historical development of the early Korean rockets in a paper which will be useful to both historians and scientists. The book entitled *Kuk Cho Ore Sorye* (1474) in the Korean language provided extensive rocket system descriptions; however it required considerable research to interpret them. This paper is the first study of early Korean rockets and launchers. The major effort in this study is directed toward the development of design concepts and details of early Korean rockets. Also, to substantiate support of the historical data presented, some versions of the early Korean rockets were made according to their specifications and fired successfully by the author in 1981. Modern working drawings were made from the ancient descriptions, and were used to construct and fire modern copies of the ancient weapons.¹

The oldest book in the field of firearms in Korea is *Kuk Cho Ore Sorye*², published in 1474. The chapter "Firearms Illustrations" contained figures and very detailed descriptions of 23 kinds of firearms that were developed between 1448-1452, excluding a description used in the process of manufacturing of black powder in Korea. "The Introduction and Development of Firearms in Korea (1356-1474)" was written by Ho, Son-Do³, who has been studying Korean ancient firearms since early 1960. He has written several papers on Korean firearms except the rocket propelled arrows.⁴ He mainly used the *Cho Son Wang Cho Silok*⁵ for his study, which is an important source of history of Korean firearms. Other papers on Korean firearms are those by Jeon⁶ and Boots.⁷

Ancient Korean rockets have otherwise received little attention even though Koreans have used gunpowder since 1377 and have made many kinds of firearms for several hundred years.⁸

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The first black powder in Korea was made by Choi Mu-Son in 1377. During the third year of Shin Yu (1377), the office of a Hwa-tong-do-gam, which means a general bureau of gunpowder artillery, was first established. This was suggested by a certain Choi, Mu-Son, who lived in the same city with Lee Yuan, known for getting saltpeter for the Yuan army. Choi Mu-Son learned from him the procedure for preparing gunpowder. He trained his own workmen, and proposed the above-mentioned establishment of a general bureau of gun powder artillery.

THE FIRST ROCKET IN KOREA

Choi Mu-Son made many kinds of firearms and gunpowder, according to *Koryo Sa* and *Cho Son Wang Cho Silok*. The running-fire and fire arrow are among the firearms which were made by Choi Mu-Son between 1377-1391. Some types of the Chinese fire-arrows were rocket-propelled arrows, but Choi's fire-arrow was not a rocket-propelled arrow. It was only an incendiary arrow shot from a bow, (Figure 1).

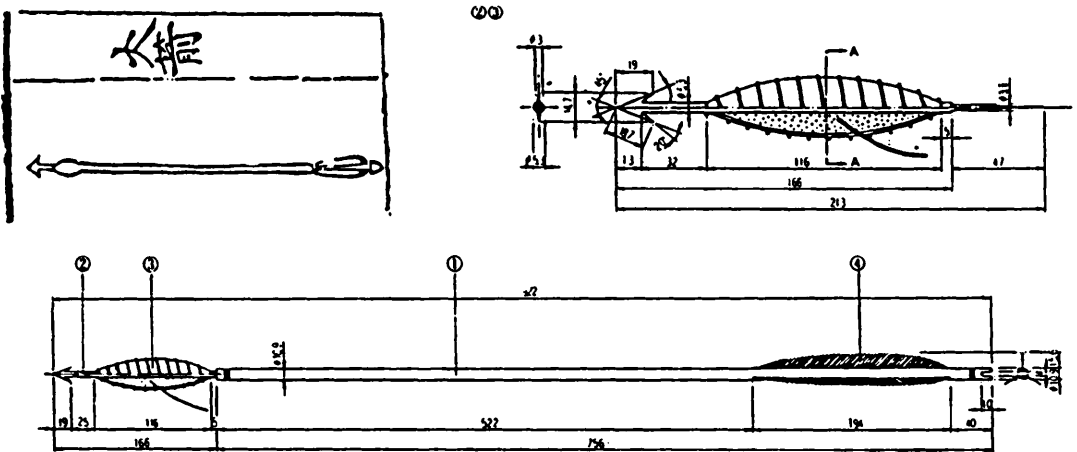


Figure 1 Fire-arrow's drawing in the *Kuk Cho Ore Sorye* (1474) and new plan in the *Early Firearms in Korea* (1377-1600), 1) arrow shaft, 2) arrow head, 3) black powder, 4) fins.

The structure of the Choi's fire-arrow was as follows, according to the "Firearms Illustration" of *Kuk Cho Ore Sorye*, which used Korean measures for description of firearms. The author converted the Korean measurement system into the metric system, chuck (312.4 mm), chun (31.24 mm), pun (3.124 mm), le (0.31 mm).¹²

Fire-Arrow (Hwa-Jeon)

"The arrow shaft is made of bamboo stick. Its length is 756 mm long, circumference 34.36 mm, the arrow head is made of iron, weight 11 g. Its blades are 14.68 mm wide and 18.74 mm long. Its root is 47 mm long. The tail fins of the arrow are made for feathers, 15.6 mm wide, 194 mm long. The incendiary powder which is 116 mm long, circumference 93.72 mm, is covered with paper or cloth and is covered with oil as a protection against wind and rain. Its is attached to the stem of arrow head and is shot from a bow."¹³

The first Korean rocket was called ju-hwa, which literally means running-fire, and was manufactured between 1377-1389 near the end of the Koryo Dynasty (918-1392) by Choi Mu-Son. The detailed descriptions of running-fire are not available, but indirect information would indicate that it was a rocket-propelled arrow.

The great king Se Jong said to an official of Pyeong-An, Jan-Gil province:

"Running-fire is very efficient and incomparable because it can be fired easily using a quiver by a mounted soldier. It is detrimental to the enemy. Its loud noise and shape instill fear and incite surrender. Once used at night, its exhaust flame lights the fields and shakes the enemy's spirits. When used where the enemy is lying in ambush, its flame and smoke cause the enemy to disclose themselves for fear. Running-fire does not fly straight and it spends more powder and requires more precaution than cannon. . . ."¹⁴

There are several reasons that point to running-fire being a rocket-propelled arrow.

1. "Running-fire can be fired easily using a quiver. . ."

A quiver was not a firearm, it was only an arrow carrier, but running-fire can be fired from a quiver which was made of bamboo, paper or cloth, because the rocket launcher was a simple tube to guide the direction of a launching rocket. Therefore, running-fire had a rocket engine.

2. "Its loud noise and shape. . ."

A rocket engine is a jet propulsion device that produces thrust by ejecting combustion gases.¹⁵ Thus, it made loud noises as it ejected combustion gases.

3. "Once used at night, its flame lights the field. . .its flame and smoke"

If running-fire were a rifle or a cannon, it could not produce exhaust flames and smoke during flight.

4. "Running-fire does not fly straight"

Motion of the ancient rockets depended on its stabilizing stick which was made from bamboo and a hole in the powder in the propellant case. Thus, rocket-propelled arrows did not easily fly straight.

5. "Running-fire spends more powder"

The weight of a solid propellant rocket is, for most part, propellant weight. While the rocket-propelled arrow is propelling, it continues to eject combustion gas. Thus, running-fire used more powder than gun or cannon. Thus, running-fire appears to be a rocket-propelled arrow for the above-given reasons.

THE KOREAN ROCKET OF THE 15TH CENTURY

The King of the Great Se Jong, who was very concerned about firearms development, was the Fourth King of the Yi Dynasty (1392-1910). Many types of new Korean firearms were developed during the reign of King Se Jong (1418-1450). Development of firearms in the region of King Se Jong is notable as a turning point in the art of making firearms. The Yi Dynasty had stopped imitating the Chinese models and had created a distinctive Korean style.

By the 29th year (1447) of King Se Jong's reign, running-fire was developed into three kinds of rocket-propelled arrows: small-running-fire, medium-running-fire and large-running-fire.

Korea used many running-fire rocket-propelled arrows until 1448. After 1448, it was not seen in *Chon Son Wang Cho Silok* and at the same time, new firearms, magical-machine-arrows, begin to be seen in the same book. According to the *Hwa Po Sick Eon Hae*,

"The powder tube of the running-fire is equal to the powder tube of the medium-magical-machine-arrow. The tube of the medium-magical-machine-arrow is made from one tenth of a paper which is 2.5 sheets of uncut Korean paper, the length of the powder case is 200 mm, weight of black powder in a powder tube is 44 g."¹⁶

Dimensions of the medium-magical-machine-arrow of the *Hwa Po Sick Eon Hae* are the same as in the "Firearms Illustrations's". The length of the running-fire powder tube in the *Hwa Po Sick Eon Hae* and length of the medium-magical-machine-arrow's propellant case in the "Firearms Illustration" are the same, which was 200 mm. Therefore, running-fire was replaced with magical-machine-arrow (sin-gi-jeon).

Four kinds of the magical-machine-arrow were constructed: small (so), medium (chung), large (dae) and multiple-bomblets-magical-machine-arrow (san-hwa-sin-gi-jeon).

Large-Magical-Machine-Arrow (Dae-Sin-Gi-Jeon)

"The propellant case is made of paper, length 695 mm, external circumference 299.9 mm, thickness 17.8 mm, internal diameter 63.1 mm, the length from the end of the propellant case to the attachment twine is 48.42 mm, the diameter of the hole in the bottom is 37.5 mm. The shaft is made of bamboo stick 5.31 m long, the upper circumference is 31.28 mm, lower circumference is 93.72 mm. The tail fins are made of feathers, 31.28 mm wide, 843.48 mm long. The length from the end of the bamboo stick to the fins is 843.48 mm."¹⁷

The detailed internal structure of the large-magical-machine-arrow's propellant case and warhead was as follows (Figure 2).

The propellant case was charged with black powder and the top of it was sealed with paper several times. On top of it, a large-magical-machine-arrow-explosive tube (dae-sin-gi-jeon-bal-hwa-tong) was attached and the fuse connects the powder of the propellant case to the large-magical-machine-arrow explosive tube.¹⁸ The magical-machine-arrow-explosive-tube used a cylindrical paper tube filled with black powder with both ends capped. Explosive-tube was divided into 4 groups: large-magical-machine-arrow, large, medium and small-explosive-tube.

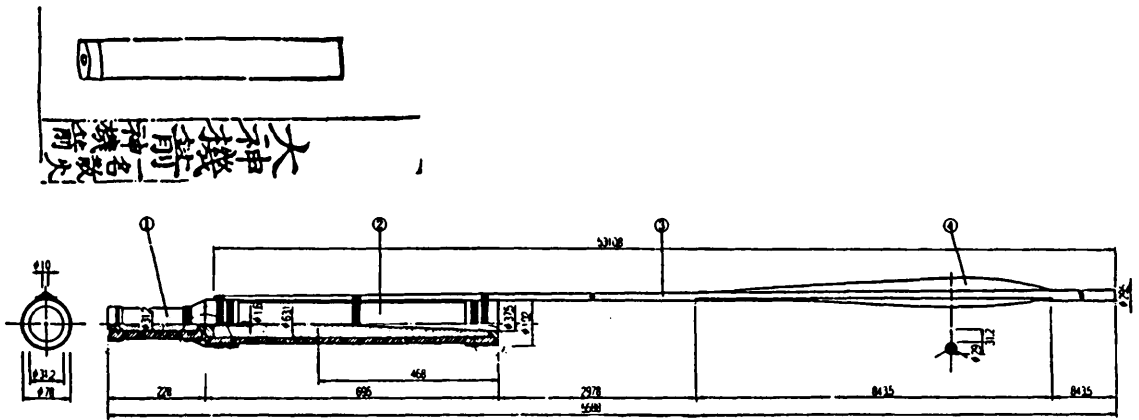


Figure 2 Drawing of the large-magical-machine-arrow's propellant case in the Kuk Cho Ore Sonye (1474) and new plan of the large-magical-machine-arrow in the Early Firearms in Korea (1377-1600), 1) warhead, 2) propellant case, 3) bamboo shaft, 4) fins.

According to the "Firearms Illustration", the large-magical-machine-arrow explosive tube was as follows:

"The large-magical-machine-arrow-explosive-tube is 228.1 mm long, 234.3 mm in circumference, 23.1 mm thick, 31.24 mm in internal diameter and is made of paper. Length from the end of the cylindrical case to the attachment twine is 15.62 mm. It has a hold 3.12 mm in diameter at the bottom into which a fuse was inserted."¹⁹

Multiple-Bomblets-Magical-Machine-Arrow (San-Hwa-Sin-Gi-Jeon)

"The multiple-bomblets-magical-machine-arrow has almost the same dimensions as the large-magical-machine-arrow, but the former's warhead was a large-magical-machine-arrow explosive-tube attached on the head of its paper-propellant case, but the multiple-bomblets-magical-machine-arrow's explosive system was in the propellant case.

The detailed internal structure of the multiple-bomblets-magical-machine-arrow's propellant case and explosive system is as follows (Figure 3).

The lower part of the propellant case was bound with twine as was the large-magical-machine-arrow. The propellant case was charged with powder up to 579.5 mm, leaving 115.59 mm empty. Then several layers of paper were attached to the top surface of the powder. Then several land-fire-tubes (ju-hwa-tong) attached to small-explosive-tubes (so-bal-hwa-tong) were placed into the top of the propellant case with their fuses attached to the propellant charge."²⁰

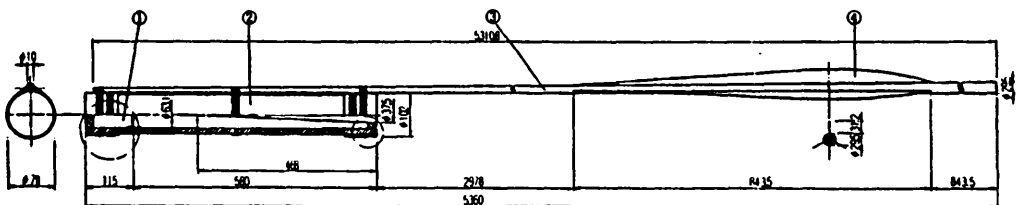


Figure 3 New Plan of the multiple-bomblets-magical-machine-arrow in the Early Firearms in Korea (1377-1600), 1) warhead, 2) propellant case, 3) bamboo shaft, 4) fins.

Medium-Magical-Machine-Arrow (Chung-Sin-Gi-Jeon)

"The arrow shaft is made of a bamboo stick. Its length is 14.55 mm, upper circumference is 14.68 mm and lower circumference is 24.99 mm. The arrow head is made of iron, weight 5.5 g. The stem of the arrow-head is 37.4 mm long and 16.56 mm in circumference. Its blades are 13.4 mm wide and 181.2 mm long. The propellant case, 200 mm long, is made of paper, its external circumference is 8.75 mm and its thickness is 6.2 mm, internal diameter is 16.6 mm. The length from the end of the propellant case to the attachment twine is 9.37 mm, the diameter of hole in the bottom is 7.19 mm."²¹

The detailed internal structure of medium-magical-machine-arrow propellant case is as follows (Figures 4 and 5).

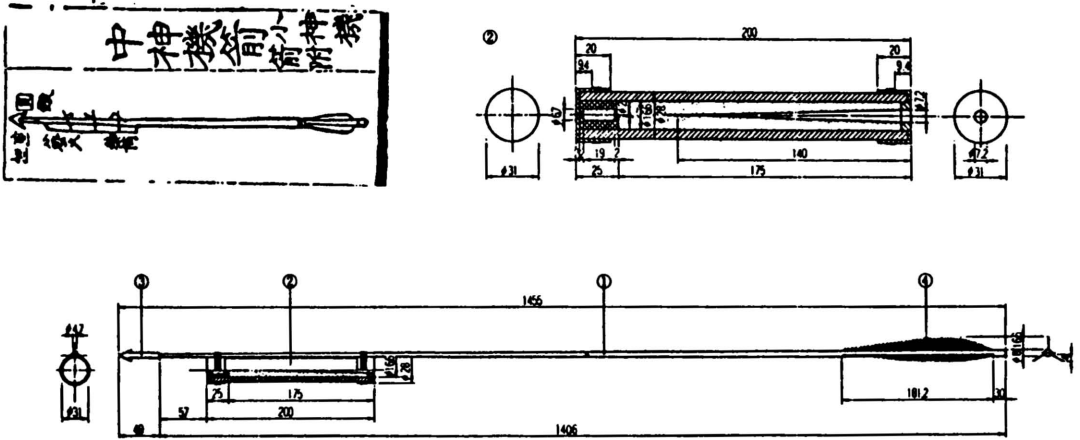


Figure 4 Drawing of the medium-magical-machine-arrow in the Kuk Cho Ore Sorve (1474) and new plan in the Early Firearms in Korea (1377-1600), 1) arrow shaft, 2) propellant case, 3) arrow head, 4) fins.

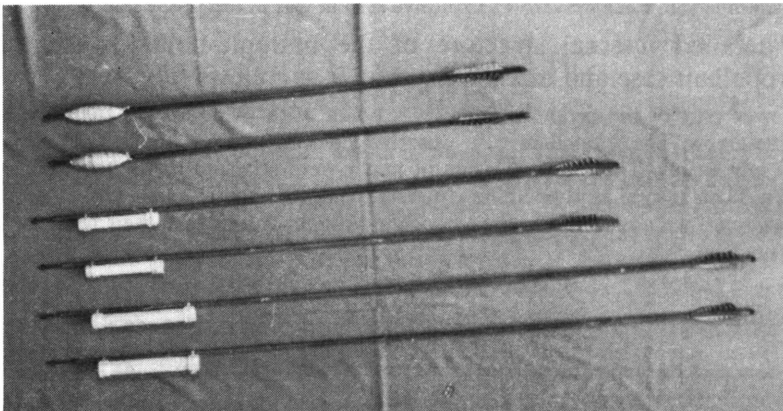


Figure 5 Fire-arrows, small and medium-magical-machine-arrows (Hang-ju castle memorial museum).

"The lower part of the propellant case was bound with twine as in the large-magical-machine-arrow's propellant case. The propellant case was charged with powder up to 175.09 mm leaving 24.99 mm. A small-explosive-tube (so-bal-hwa-tong), 56.23 mm long,

47.8 mm in circumference, 4.37 mm thick and 6.87 mm in internal diameter was inserted. The length from the end of the cylindrical case to the attachment twine was 6.25 mm and the diameter of the nozzle was 2.19 mm. Finally, the powder of small-explosive-tube and the powder of the medium-magical-machine-arrow's propellant case were connected with fuses."²²

Small-Magical-Machine-Arrow (So-Sin-Gi-Jeon)

"The arrow shaft is made of bamboo stick 1030.9 mm long. Its upper circumference is 14.68 mm and the lower circumference is 24.99 mm. The arrow head of the small-magical-machine-arrow is the same as that of the medium-magical-machine-arrow. The three tail fins of the arrow are made of feathers, 14.68 mm wide and 146.83 mm long. The 153.08 mm long propellant case is made of paper. Its external circumference is 67.17 mm, 5.0 mm thick, internal diameter 11.56 mm, length from the end of the propellant case to the attachment twine (bound the same way as large-magical-machine-arrow's propellant case) is 9.37 mm. It is charged with powder in the same way as the land-fire-tube, the diameter of the nozzle in the bottom is 4.06 mm. It does not have any explosive tube."²³ (Figure 6)

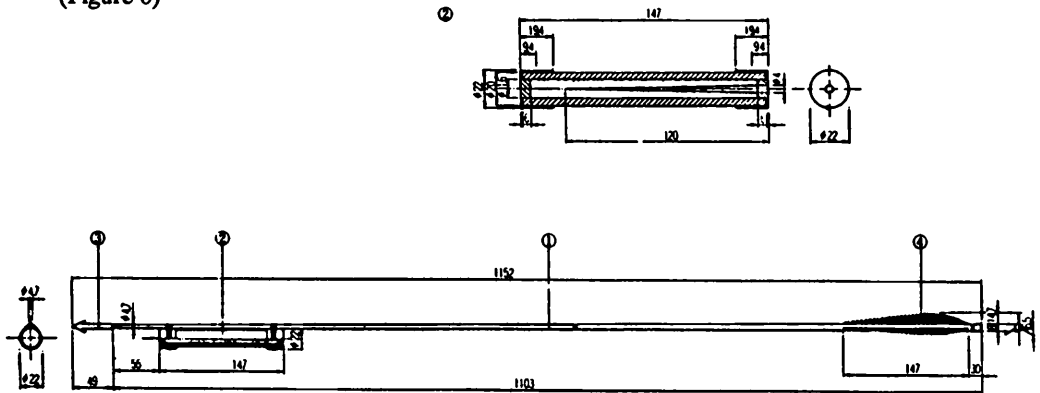


Figure 6 New plan of the small-magical-machine-arrow in the Early Firearms in Korea (1377-1600)

The Manufacturing Method of the Rocket's Propellant Charge

"A long cone-shaped awl was inserted through the hole in the bottom of the propellant case,²⁴ then a small quantity of powder was spread and hardened with empty cylindrical iron stick. This process was repeated until the case was filled up to a desired level. Then the long awl was taken out leaving the cone-shaped central cavity in the charged propellant case, then it received a fuse.

The external diameter of the cylindrical iron stick was equal to the internal diameter of the propellant case. The internal diameter of the cylindrical iron stick was equal to the diameter of the hole in the propellant case's bottom."²⁵

According to the *Wu Pei Chih*, "If the rocket-propelled arrow is to fly straight, the hole must be straight, otherwise it will go off at a tangent",²⁶ Therefore it was very important to make the rocket engine correctly.

Korean rockets had a paper tube rocket engine which was attached to the top of a bamboo stick serving the function of a stabilizing bar that helped the magical-machine-arrow fly straight. Notably the large Korean rockets had three fins attached to the bamboo stick.²⁷ The cylindrical paper propellant case had a hole in

the bottom believed to be the place for the nozzle where the flame of the burning propellant was ejected for the propulsion of the shell. The Korean rocket's ratio of nozzle diameter to the internal diameter of propellant case was 1:2.3. Large, multiple-bomblets and medium-magical-machine-arrows had a warhead or explosive in front of the propellant case so as to explode over the target area.

Korea had 33,000 running-fires and magical-machine-arrows in 1447,²⁸ which was a large number for those type weapons, and they were a significant part of the total armaments.

ROCKET LAUNCH DEVICE

King Mun Jong was very interested in development of firearms. When he was the Crown Prince, he was one of the persons responsible for the Bureau of Weapons. He invented the fire-cart (hwa-cha) shown in Figure 7, used to launch large numbers of rockets rapidly - also to transport and aim during the battle.

According to the *Mun Jong Silok* (Veritable records of the King Mun Jong era), the fire-cart was invented and tested in February 1451 by King Mun Jong who was the 4th king of Yi Dynasty.²⁹

There was a wooden launcher on top of this vehicle, on which were installed 100 medium-magical-machine-arrows or 50 four-arrow-guns.

The detail structure of the fire-cart according to the "Firearms Illustrations" follow.

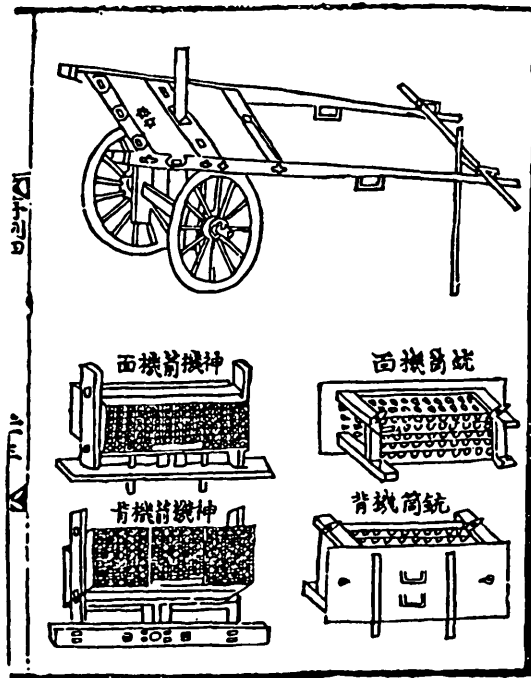


Figure 7 Drawing of the fire-cart and magical-machine-arrow-launcher in *Kuk Cho Ore Soye* (1474).

Fire Cart

The diameter of the wheel is 874.7 mm. The hub is made of wood, 224.9 mm wide and 206.2 mm in diameter. Each wheel has 15 spokes. The axletree is made of wood, 1312.1 mm long and consists of three parts: a middle square pillar 687.3 mm long and two 312.4 mm long end columns which are inserted into two wheels. Two wide posts, 546.7 mm long, 234.3 mm wide and 62.5 mm thick were set up at both ends of the top side of the middle square pillar. A small post, that has a square bottom pillar of length 231.2 mm and a round upper pillar of length 453.0 mm, is set up at the center of the square pillar. Thin wooden boards are attached between each wide post and the small two-part post. A lower center crossbar, 546.7 mm long, 118.7 mm wide and 46.9 mm thick, which has a hole in the center for the small post, is placed on the two wide posts. Two yokes, 2311.8 mm long, are set up at both ends of the wide posts. It consists of two parts: a four cornered part, 874.7 mm long, 94.7 mm wide, 103.1 mm thick and a column part, 1437.0 mm long and 46.7 mm in diameter. An upper center crossbar, whose length, width and thickness are the same as that of the lower center crossbar is placed between the end of both wide posts. It has a hole in the center for the small post. A rear crossbar whose length and width are the same size as center crossbars, but is 78.1 mm thick. It is attached at the rear (four-cornered part) of both yokes. Then several thin wooden boards are attached between the rear crossbar and the upper center crossbar. This forms a wood box to hide some arms. Its length and width are 624.8 mm by 515.5 mm. Four U-shaped nails are driven into the front and middle of the column part of the yokes to insert rods, which are used to pull the fire-cart.³⁰

The cart could be drawn by two men on level ground. It would require another man pushing from behind when going uphill, and two more men had to push the cart when it was going up a steep hill.³¹

New plans for the fire-cart, (Figure 8) were made from the above explanations and an original drawing of the fire-cart in "Firearms Illustration".

It carried a multiple-rockets-launcher (sin-gi-jeon-gi) or a box installed with 50 four-arrow-guns³² which can shoot 200 thin-arrows³³ at the same time.

Magical-Machine-Arrow-Launcher (Sin-Gi-Jeon-Gi)

The first crossbar is 1171.55 mm long, 109.3 mm wide, 46.9 mm thick and has a 62.4 mm diameter hole in the center into which the small post of the fire-cart is inserted. Two small square columns which are 171.8 mm long, 62.4 mm wide and thick, are set up on either side of the hole in the crossboard. Two columns, 687.3 mm height, 78.1 mm wide and 31.2 mm thick, are set up near the end of the first crossboard. The spacing of the columns is 843.5 mm. The second crossboard, 843.5 mm long, 109.3 mm wide and 31.2 mm thick, has a hole in the same position as the first crossboard. It is positioned 87.5 mm above the first crossboard. Two detailed boards, 359.3 mm long and 87.5 mm wide, are set up on top of the second crossboard such that the outside ends of both detail-boards are attached to both columns. Two assistant columns, 203.1 mm long, 31.2 mm wide and 15.6 mm thick, are set below the two detailed boards, the spacing of the assistant columns is about 187.4 mm. Both ends of the assistant columns project 31.2 mm below the first crossboard. Four wide boards are attached between the two columns and the second crossboard. This construction is a shallow rectangle box. The top and bottom wide boards have a length of 827.8 mm, a width of 281.2 mm and a thickness of 21.9 mm. The right and left wide boards have a length of 437.4 mm; the width and thickness are the same size as top and bottom. At the center of the bottom wide board there is a hole, which is the same size as the

second crossboard's. A rectangle block of wood, 265.5 mm in length, 234.3 mm in width and 56.2 mm in thickness, has the same size hole in it as does the second crossboard. The cylindrical-hole-wood-block is 234.3 mm long, 56 and 22 mm wide and thick has a cylindrical hole, 234.3 mm long, 46.9 mm in diameter bored through it to be loaded a medium-magical-machine or a small-magical-machine-arrow (rocket).

There are 100 cylindrical-hole-wood-blocks in the shallow rectangle box. It consists of seven rows of cylindrical-hole-wood-blocks. The first row has five cylindrical-hole-wood-blocks on both sides of the rectangle block of wood and all of the other rows have 15 cylindrical-hole-wood-blocks. The end of the cylindrical-hole-wood-block is pierced with a wire, then both ends of the wire are attached at right and left wide boards.

Finally, the third crossboard, which measures 843.4 mm in length, 62.4 mm in width and 31.2 mm in thickness, is set up on the top wide boards.³⁴

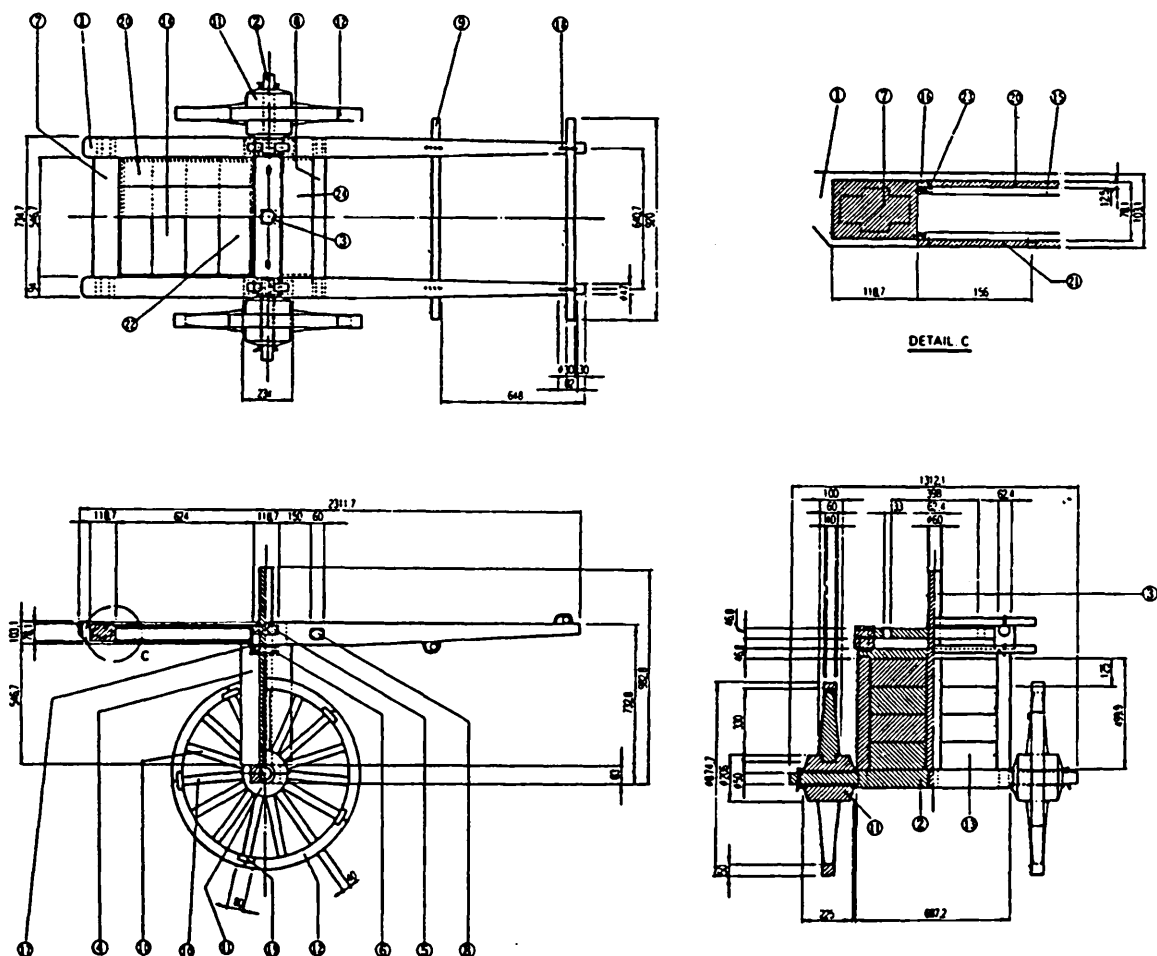


Figure 8 New plan of the magical-machine-arrow launcher in the Early Firearms in Korea (1377-1600), 1) yoke, 2) axletree, 3) small post, 4) wide post, 5) upper center crossbar, 6) lower center thin wooden board, 15,16,21,23) thin wooden beam, 18) U-shape nail.

The author made a plan (Figure 9) of the magical-machine-arrow-launcher from the above explanations and a drawing (Figure 7) of the magical-machine-arrow-launcher, and constructed a magical-machine-arrow-launcher and fire-cart (Figure 10) from these plans.

The fire-cart with the magical-machine-arrow-launcher was scientifically designed. A cart body that was raised above the axle by short pillars so as to regulate the angle of the cart body from zero to forty-three degrees, so that one can control the rocket's launch angle from zero to forty-three degrees. The magical-machine-arrow-launcher had 100 rocket launching holes. Therefore, it could launch 100 medium or small-magical-machine-arrows in groups of 15 at a time, in quick succession. In peace time, the fire-cart, without its launcher, was used as a simple cart. It was a useful multiple-rocket launcher cart.

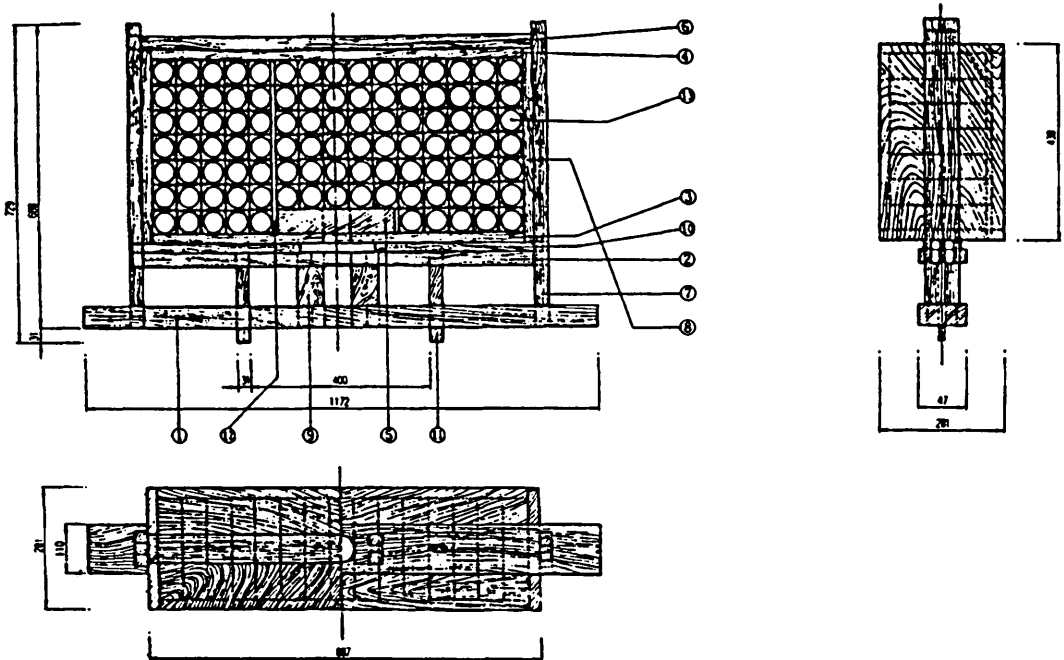


Figure 9 New plan of the magical-machine arrow launcher in the *Early Firearms of Korea* (1377-1600), 1) first crossboard, 2) second crossboard, 3-4) top, bottom wide boards, 5) rectangle block of wood, 6) third crossboard, 6) column, 8) side wide board, 9) small square column, 10) detailed board, 11) assistant column, 12) thin column, 13) cylindrical-hole-wood block.

According to the *Mun Jong Silok*, 700 fire-carts were built in Korea in 1451.³⁵

Documents on the large-magical-machine-arrow's launcher have not been found, but the large-magical-machine-arrow's total length was 5.7 m; therefore it used a large special launcher.

These weapons are believed to have been used as weapons to fight against the Northern Chinese and Southern Japanese bandits.

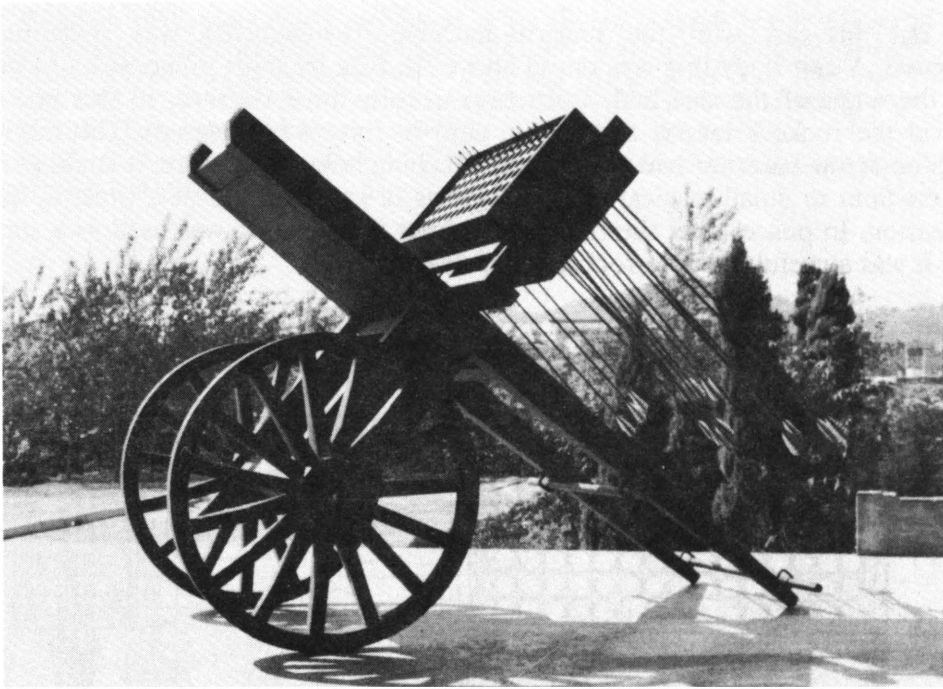


Figure 10 Author's construction of fire-cart and magical-machine-arrow launcher (Hang-ju castle memorial museum).

CONCLUSIONS

1. The first Korean rocket whose Korean name is "ju-hwa", called running-fire, was used between 1377-1447. In 1448; it was replaced with the magical-machine-arrow (sin-gi-jeon) which was built in four configurations, small, medium, large and multiple-bomblets-magical-arrow. Especially, the large-magical-machine-rocket-propelled-arrow's cylindrical paper case was 70 cm long and 9.5 cm in exterior diameter. It was attached to a 5.3 m bamboo guide stick. The warhead was attached to the head of the propellant case. It was a large paper propellant case rocket.
2. The detailed structure of the four kinds of magical-machine-arrow in Korea after 1448 will furnish information on the early oriental rocket's detailed structure.
3. The fire-cart, multiple-rockets-launcher-cart, was scientifically designed to launch 100 medium or small-magical-machine-arrows in groups of 15 at a time, in quick-succession. The angle of launch was controllable from zero to forty-three degrees.
4. Korea made precision rockets and firearms in the 15th century, because at that time the minimum unit of the Korean measurement system was a "1e" (0.31 mm) for design of rocket, fire-cart and other firearms.

NOTES AND REFERENCES

1. New plans which were already introduced in the book, *Early Firearms in Korea (1377-1600)*, Il-ji Publishing Co., Seoul, 1981, by Chae, Yeon, Seok, were made from the descriptions and drawings in the *Kuk Cho Ore Sorye*. These plans were used to build modern copies of all the firearms used from 1448 to 1451 (4 kinds of rockets, 13 kinds of guns or cannons, 6 kinds of bombs, 13 kinds of projectiles, a rocket launcher cart and an armed cart), and some of those were fired in January 1981. All of these firearms are on permanent display at the Hang-ju castle memorial museum, which is near the city of Seoul in Korea.
2. It was officially compiled by the Board of Rites in 1474 in Korea.
3. Ho, Son-Do, *Rok Sa Hak Po*, Vol. 24, 1964, pp.1-60, Vol. 25, pp.39-98, Vol. 26, 1965, pp.141-165.
4. "The Development of Firearms in Korea 1474-1592", *Rok Sa Hak Po*, Vol. 30, 1966, pp.40-107, Vol. 31, pp. 67-127, "On the Chon-ja Cannon Dated 1555, *Mi Sul Cho Ryo* (National Museum of Korean Art Magazine), Vol. 10, 1965, pp.5-14.
5. Veritable record of the Yi Dynasty, 1413-1865, which was compiled by the veritable record office, Yi Dynasty.
6. "Modern Firearms", in Jeon, Sang-Woon, *Science and Technology in Korea: Traditional Instruments and Techniques*, MIT Press, Massachusetts, 1974, pp.184-206; He seems to have misunderstood the meaning between "arrow" and "rocket". The Korean name "Jeon", literally means the arrow, but he translated it by the English word, rocket. Generally an arrow is not a rocket, but some special arrows were rockets.
7. Boots, T. L., "Korean Weapons and Armor", *Transactions of the Royal Asiatic Society*, Korea Branch, December 1934.
8. Winter, F. H., "The Genesis of the Rocket in China and Its Spread to the East and West," XXXth Congress IAF-79-A-46, p.13 (see *History of Rocketry and Astronautics*, Vol. 10, *AAS History Series*, ed. by Å. Ingemar Skoog, AAS 90-401, pp.3-24, 1990). He mentioned Korean rockets as follows, "Elsewhere in Asia, Montross says the Koreans. But Hagerman, in his detailed study of these engagements, mentions no rockets, only cannon, Partington does not mention Korean rocket weapons..."
9. Wang Lin, "On the Invention and Use of Gunpowder and Firearms in China", *Isis*, Vol. 37, 37, July 1947, p.176.
10. History of Koryo Dynasty, which was officially compiled by Chong, In-Ji et al. in 1451, modern reprints, Yonsei University Press, Korea, 1955.
11. Chae, Yeon-Seok, "A Study of the Korean Fire-Arrows", *Journal of Korean Science History*, 1979, "3. Korean Fire-Arrow", *Early Firearms in Korea (1377-1600)*, pp.22-38, Sun, Fang-Toh, "Rockets and Rocket Propulsion Devices in Ancient China", XXXI Congress, IAF-80-LAA-02, p.9 (see *History of Rocketry and Astronautics*, Vol. 10, *AAS History Series*, ed. Å. Ingemar Skoog, AAS 90-402, pp.25-40, 1990).
12. Park, Heung-su, "A Study of the Korean Measures", *Dai Dong Mun Hwa*, Vol. 4, 1967.
13. *Kuk Cho Ore Sorye*, Vol. 4, p.21.
14. Ho, Son-Do, op. cit. (part 3), *Rok Sa Hak Po*, Vol. 25, p.71.
15. George P. Sutton, Donald M. Ross, *Rocket Propulsion Elements: An Introduction to the Engine of Rockets*, 4th ed., Wiley Sons, New York, 1976, p.1.
16. Lee So, *Hwa Po Sick Eon Hae*, 1635, p.32.
17. *Kuk Cho Ore Sorye*, Vol. 4, pp.20-21.

18. There is an "explosive tube" in the description of the large-magical-machine-arrow but the large-magical machine-arrow-explosive-tube was among the kinds of explosive-tubes in the "Firearms Illustration". Therefore the explosive-tube of the large-magical-machine-arrow meant a large-magical-machine-arrow-explosive-tube.
19. *Kuk Cho Ore Sorye*, Vol. 4, pp.17-18.
20. *Ibid.*, pp.20-21.
21. *Ibid.*
22. *Ibid.*
23. *Ibid.*
24. Tenney L. Davis & James R. Ware, "Early Chinese Military Pyrotechnics", *J. of Chemical Education*, Vol. 24, November 1974, p.532. He called it "the central cavity in the Rocket propelling charge" in his study.
25. *Kuk Cho Ore Sorye*, Vol. p.17.
26. Tenney L. Davis, *op. cit.*, p.532.
27. Other large rocket-propelled arrows did not use fins on stabilizing bar, Å. Ingemar Skoog, "The Swedish Rocket Corps 1833-1845", *Essays on the History of Rocketry and Astronautics*, NASA CP-2014, Vol. 1, p. 10-20, Fig. 2, 12 (see *History of Rocketry and Astronautics*, Vol. 7, Part I, *AAS History Series*, ed. by R. Cargill Hall, AAS 86-501, pp.9-22). F. W. Foster Gleason, "Lost Causes" *Gun Digest*, ed. John T. Amber, pp. 36-39. Winter, F. H., "On the Origin of Rockets", *Chemistry*, Vol. 49, No. 2, p.19.
28. Chae, Yeon-Seok, *Early Firearms in Korea (1377-1600)*, p.69.
29. Ho, Son-Do, "The Introduction and Development of Firearms in Korea 1356-1474", part 2, p.52.
30. *Kuk Cho Ore Sorye*, pp.22-24.
31. Jeon, San-Won, *Science and Technology*, p.199.
32. It was one of the Korean rifles in 1448. It was able to shoot 4 thin-arrows (bullets) at the same time. Its barrel length was 180.1 mm and the diameter of the muzzle was 21.9 mm. Therefore, it was called a four-arrow-gun.
33. It was one of the bullets in Korea in 1448. It was like a small arrow. Its total length was 218.6 mm.
34. *Kuk Cho Ore Sorye*, Vol. 4, pp.25-26.
35. Chae, Yeon-Seok, *Early Firearms in Korea (1377-1600)*, p.169.