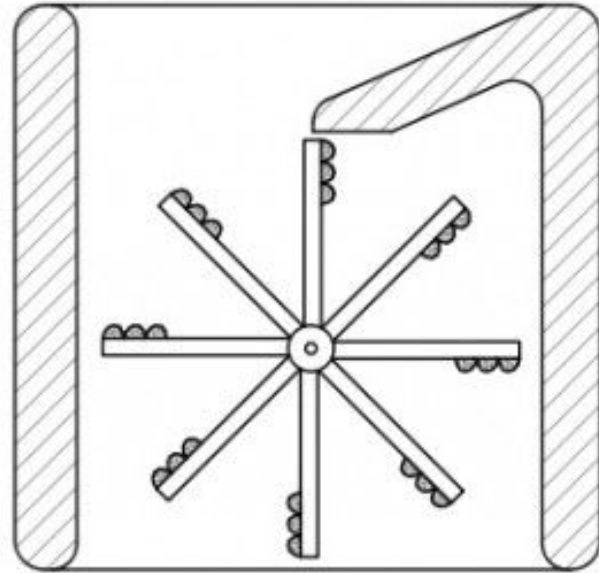
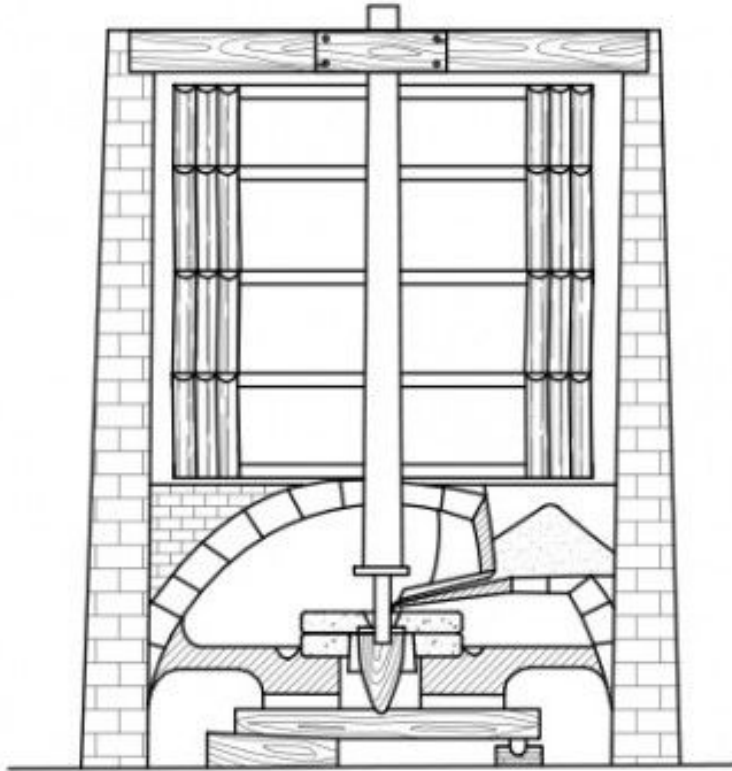


Mechanical Devices & Engineering in Dar al-Islam

1. Windmills

Horizontal windmills, called panemone windmills, were first recorded by Persian geographer Estakhri in the 9th century. using sails that rotated in a horizontal plane, around a vertical axis, they were used to grind grain or draw up water. Vertical windmills began appearing in Europe in the 12th century, likely adapted from the horizontal windmills seen by Crusaders in the Middle East or acquired from Al-Andalus (Muslim ruled Spain).

The Horizontal Panemone Windmill



2. The Astrolabe

Astrolabes were navigational devices, essentially handheld models of the universe, invented in ancient Greece. 8th century mathematician Muhammad al-Fazari improved the astrolabe to make it more accurate, and it was widely used afterward to determine latitude. In the Islamic world, it was instrumental in determining the direction of Mecca. Astrolabes would be used by European navigators during the “Age of Discovery.”



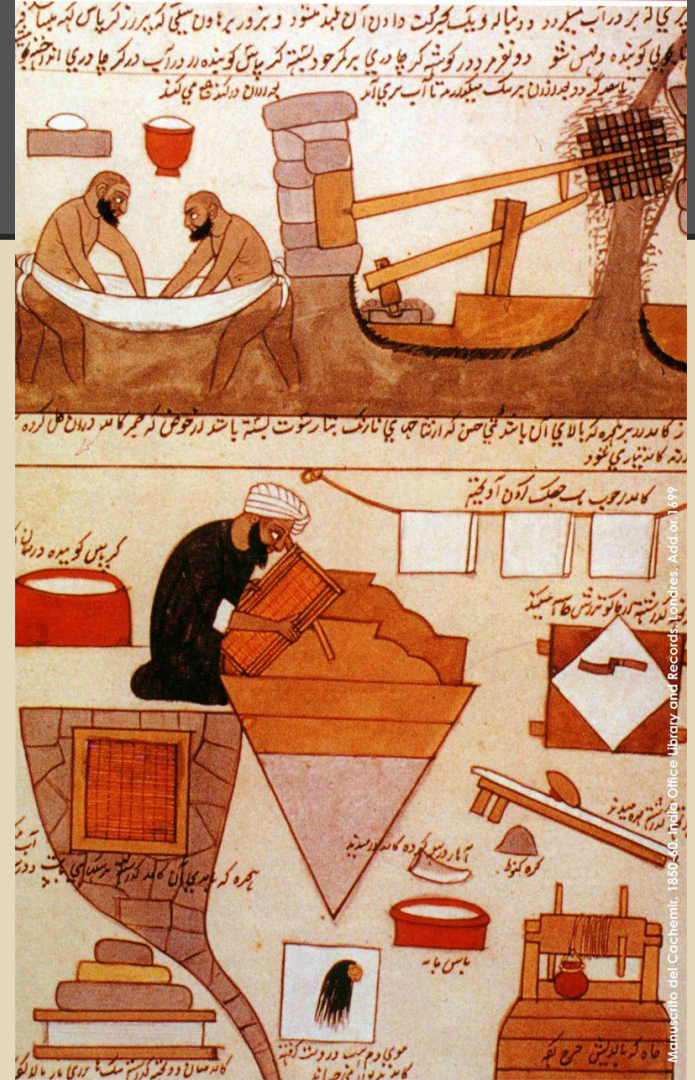
3. Water Wheels

Like the astrolabe, water wheels existed in the ancient world. In the Islamic world, water wheels were adopted and used to power mills, such as paper mills, sugar mills, and flour mills. Historian George Sarton posited that “it is probable that the Crusaders saw more of [the water wheels] and better ones in the East and brought back home that improved type or at least a clearer conception of their usefulness.”

A water wheel raising water from the Orontes River in Syria



Water wheels aided in the development of paper mills in Baghdad and Syria, which became major paper suppliers. The paper industry also spread to Africa and Europe.



4. Flying Machine

"Abbas ibn Firnas was the first person to make a real attempt to construct a flying machine and fly," said professor Salim al-Hassani. In the 9th century he designed a winged apparatus, roughly resembling a bird costume. In his most famous test flight near Cordoba in Spain, Firnas flew upward for a few moments, before falling to the ground and partially breaking his back. His designs would undoubtedly have been an inspiration for famed Italian artist and inventor Leonardo da Vinci's hundreds of years later.



A recreation of Firnas' "flying machine"

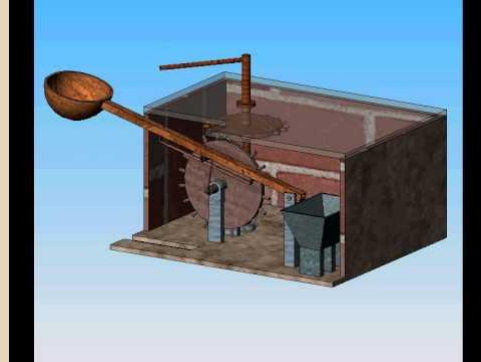
5. Al-Jazari's *Book of Knowledge of Ingenious Mechanical Devices*

Al-Jazari is considered the “father of robotics” and a master engineer. His book contained 50 mechanical devices, a few of which you can see on the next slides. Some of the most important included the crankshaft (still used in engines today), water raising machines, and clocks. As historian Donald Hill states “It is impossible to over-emphasize the importance of al-Jazari’s work in the history of engineering...The impact of these inventions can be seen in the later designing of steam engines and internal combustion engines, paving the way for automatic control and other modern machinery. The impact of al-Jazari’s inventions is still felt in modern contemporary mechanical engineering...”

Some of Al-Jazari's Devices



Water Wheel Pump



Water Raising Device
with Crankshaft



Elephant clock



An overview of
Al-Jazari's Machines

Diagram of one of al-Jazari's inventions. The diagram provides instructions for building a water-powered perpetual flute that would play music, published in 1206 CE. Al-Jazari invented numerous automated devices (usually powered by water), such as musical sets and early forms of "robots," like a waitress who could serve water or tea.



6. Banu Musa Brothers' *Book of Ingenious Devices*

The Banu Musa brothers worked in the House of Wisdom during the Abbasid Caliphate (9th century). They were inspired by earlier Greek, Persian, Indian and Chinese but also contributed their own original inventions. Some of their most notable devices include automatic controls and cranks, valves, water dispensers, automatic fountains and musical machines.

Animation of the Banu Musa Water Trick Devices



7. Torpedoes!

Want to sink the Lusitania? Hasan al-Rammah came up with a prototype for the first torpedo, propelled by rockets and kept on course with a rudder. By the 1200s, gunpowder from China had reached the Islamic world, but its use as a weapon was limited.

