

The Cloth Shearing Machine of Leonardo Da Vinci

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It is well known that the great Italian painter and sculptor, Leonardo da Vinci, was occupied also with technical matters to a certain extent. This was about the year 1500. Leonardo is said to have been interested particularly in the problem of flying. Only a few know that this artist's chief profession was really that of an engineer, and that at the present time there exist over 10,000 technical sketches and drawings which he made.

Leonardo was the son of a simple country girl. His father became a famous lawyer. Young Leonardo was brought up in the home of his father's parents. When Leonardo was a young man he was sent to serve as an apprentice with an artist. He was 29 years old when he gained his master degree in painting, and he went to the court at Milan at the age of 31, being introduced by a document which recommended highly a number of technical inventions relating to war purposes. In 1494, Leonardo began in Milan the equestrian statue of Francesco Sforza, which, however, was never completed. The bronze horse of this statue was to have been 25 feet high and its life size model was executed, but there was a continued lack of money to buy the 176,000 pounds of bronze required to cast the statue. In Milan, Leonardo also began in the same

year the famous painting "The Last Supper" in the convent of Santa Maria delle Grazie. Before Milan's power was broken, Leonardo turned to Mantua, and later on to Florence. After various trips throughout Italy, he was made "Engineer General" by the powerful Cesare Borgia, who occupied the Papal Throne under the name of Alexander VI. After the reign of this pope had come to its disastrous end, Leonardo returned to Florence. It was there that he painted the lovely portrait of Lisa Gherardini, wife of the Florentine Francesco del Giocondo. In 1506, Leonardo went back to Milan, and from there the following year he became the court painter of Louis XII of France. In 1516 François I brought Leonardo to the Chateau of Cloux, where he died on May 2, 1519 at the age of 67 years.

During his lifetime Leonardo did not have any of his numerous technical articles printed. When he died his papers and documents became the property of his favorite pupil, who kept them carefully for 50 years, but when this man died, the inheritance became scattered. It is known that quite a few of Leonardo's manuscripts were lost, one a "Book about Elementary Machinery" and another, entitled "Book of Motion," etc. A later owner of Leonardo's works had 1700 large drawings

and sketches removed from his works and had them bound. This manuscript, which is now in Milan, is known as the "Codic Atlantico," i.e., Manuscript bound like an Atlas.

In the book "Leonardo, the Technician and Inventor" (last edition, Jena, 1922, published

Figure 1 gives the general appearance of the machine. Four shearing tables are shown, each provided with large shears, details of which are found in some other sketches of Leonardo's. The large cloth maker shears were known in the distant past when they were

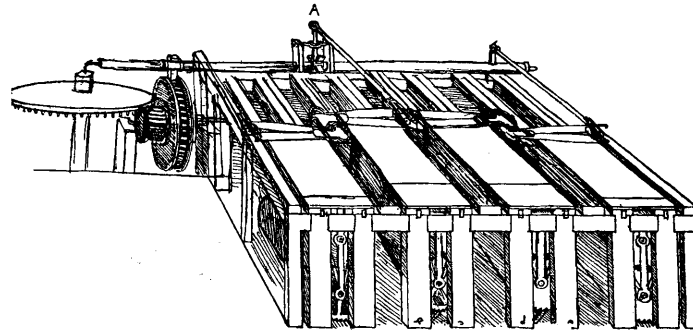


Fig. 1
Four shearing tables, each provided with large shears, driven by one swinging shaft.
Hand drawing by Leonardo da Vinci; about the year 1500.

by Eugen Diederichs), there are combined 143 technical hand drawings by Leonardo with the original text and explanation. However, the material developed by Leonardo is so exten-

manipulated by hand, until Leonardo invented a mechanical drive for the benefit of the North-Italian cloth industry. This drawing, found on sheet 397 Ra of the "Codic Atlantico," shows

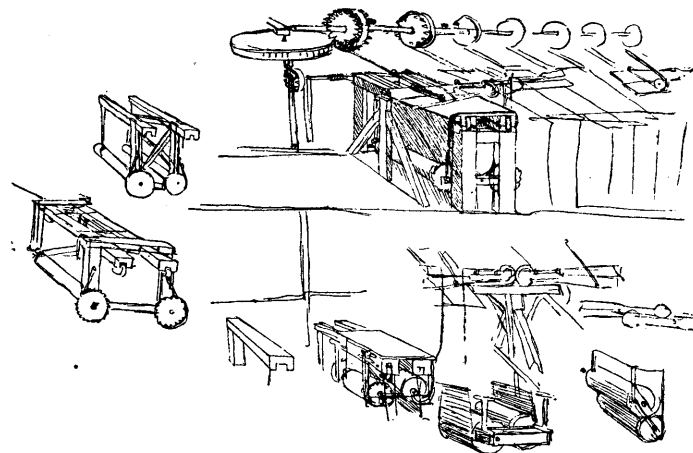


Fig. 2
Various types of cloth shearing tables (in detail).
Hand drawing by Leonardo da Vinci; about the year 1500.

sive that some of his inventions could be outlined only briefly, such as the most interesting sketches of a Cloth Shearing Machine. The present description, therefore, contains reproductions of photographs of drawings of Leonardo's Cloth Shearing Machine taken from the manuscript.

the mechanical gear in the background. A shaft, visible to the left, is driven by water power or by a lever. A large cog wheel with vertical axle catches a peg, attached to a roller shaft which runs behind the four shearing tables. This shaft swings. A drawbar attached to the right hand shearing table opens and

closes the shears of this table. On top of the drawbar we find in Leonardo's "reversed" handwriting, "This is good, but not (A)." We notice ("A") again above a mechanism fitted to the center of the swinging shaft, details of which, however, are omitted entirely,

Fig. 3. The rolls may be moved in the same direction by means of a hand wheel. The right hand sketch of Fig. 3 shows how the gears of the cog wheels catch directly, so that the two tension rolls revolve in opposite directions if the lower roll is moved by hand crank.

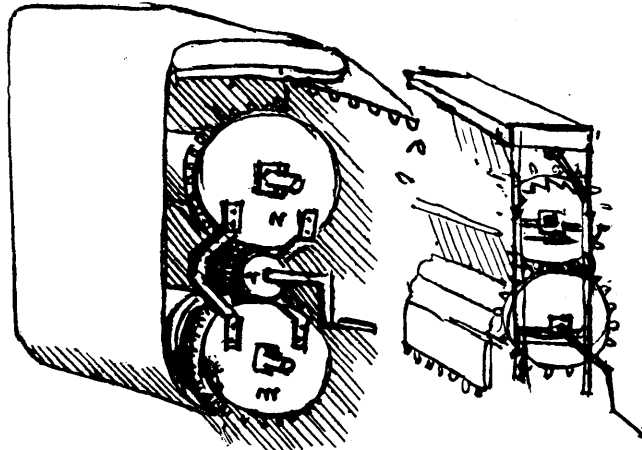


Fig. 3
Various types of shears. Hand drawing by Leonardo da Vinci; about the year 1500.

as Leonardo condemned it. He had planned originally to make this a revolving shaft.

The shaft of the cog wheel which moves the peg proceeds under the shearing table by means of ropes. Details are shown in Fig. 2.

Concerning these sketches, Leonardo writes: "The cloth or the roll (m) has a number of loops, or, if you prefer it that way, a strip of coarse cloth, same as the embroidery frames, to which the cloth is sewn and attached. Then

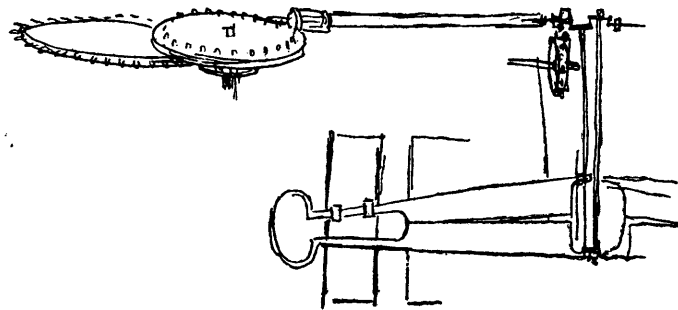


Fig. 4

(Cod. Atl., Sheet No. 367 Rb.) To the left are the carriages which are moved by ropes, in order to pass the cloth under the shears. The top drawing shows the gear shaft with the rope pulleys, not visible in Fig. 1. In Fig. 1 the tension rolls of the shearing tables are arranged vertically, in Fig. 2 horizontally. The vertical arrangement is shown in detail in

the cloth is held well stretched, also in width, at the section marked (a b), until it is almost completely rolled up on roll (m), whereas the other end remains at (a b) where it is attached to the loops of the upper roll by means of rope, under strong tension. The sheared cloth is then wound on roll (n) by and by, by means of the gear (r)." The letters (m), (r) and

(n) will be found on the lower roll, on the gear, and on the upper roll, respectively, all in "reversed" handwriting. (a) and (b) may be found near the very apparent loops on the upper end of the cloth.

Fig. 4 shows a different gear for the shears. An axle with 3 right angle bends moves, with two of those bends, the webs of the shears by means of tension rods. The third bend catches a cog wheel with every turn, and the shearing table is thus gradually moved on. It is not quite clear why Leonardo fixed the leg of one web of the shears with clamps to a board underneath them. This arrangement would not be feasible, as the web could not move.

In Fig. 5 Leonardo shows (to the left) a gear for the shears, to which he remarks: "These shears close just as quick as the others, but open much quicker than the others." Here Leonardo attaches the upper web of the shears to a board, using two clamps. The lower web of the shears is fastened to a belt which by its other end moves around a roll. The edge of the roll has a clutch which is driven by four leaves of a rotating axle. This is the gear which Leonardo rejected in Fig. 1, under (A).

A gear for shears without a spring is depicted in the right hand drawing of Fig. 5. Leonardo was correct in assuming that such shears would move easier, as the resistance "of the spring will not have to be moved." It would "only be necessary to clip the hair of the cloth and not necessary to bend the spring, by using a great deal of effort."

Thus Leonardo first used the antique shears with springs and then, in the course of the construction of his machine, came to the conclusion that the spring was obso-

lete in an automatically operated machine.

Leonardo gives some details about the shears of Fig. 6. He says: "It could be that the cutting edge (t o) goes down when the

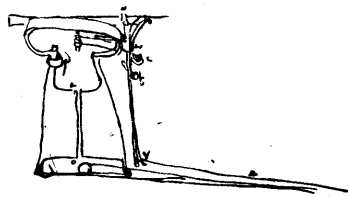


Fig. 6

shears are closed, and comes close to the root of the hair. This is caused by the wire (a r) which first pulls forth the peg (m) under the shears, by means of lever (a n). Therefore, wire (a r) must be a little shorter than the two wires which close the shears. And in order to prevent the cutting edge (t o) from moving any further when the shears are closed, peg (m) is arranged so that it does

not come out further. For this purpose you will drive in a nail (f) and see to it that the other part (f a) is movable, so that it (i.e., its end) may move with the two other wires which close the shears. When the shears are opened, spring (c) presses underneath and removes the

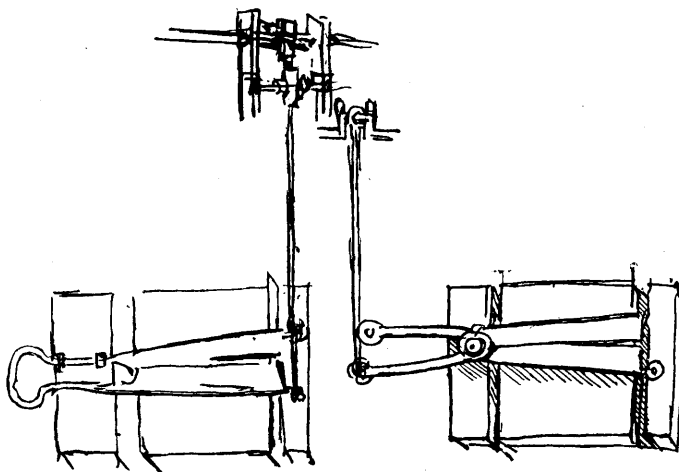


Fig. 5

shears to their horizontal position.

In 1758 the Englishman Everett, of Wiltshire, invented a cloth shearing machine in exactly the same way as Leonardo had done 250 years ago. One man alone could then operate 4 to 6 shearing tables.

Political conditions and poor technical understanding prevented the realization of Leonardo's ideas. The technique of textiles could have been improved greatly if Leonardo had published his ideas.