TEXTILES IN THE MACHINE AGE

1. The factory system

Textiles were very early associated with a factory system, long before the Mechanical Revolution (usually called the Industrial Revolution). Even where cottage spinning and weaving was used, the industry was often organized on a capitalist, centralized basis.

Spain had flourishing textile industry in 16th century

Germany, etc.,

Holland had peak in 17th century

Britain supreme in 18th and 19th centuries

Governments were much concerned with control of this industry, after the power of the guilds had waned. Processes were regulated, spinning schools set up (in Scotland a spinning wheel was presented to each proficient student). English law, from 1666 to 1786, prescribed that a corpse must be buried in wool, in Scotland, it had to be linen.

Reverting to the factory system, John Winchcombe had a factory at Newbury, Berks at beginning of 16th century, with 200 looms, 200 spinners and 100 carders. Before 1550 there were similar factories at Malmesbury, Burford, Lavenham, Newbury, Cirencester, Bath, Halifax, Manchester and Kendal. In France, in 17th century, Colbert had a model factory at Abbeville employing 1692 workers.

Of the organized cottage industry, one example is that around Blackburn in Lancs in 1736 two brothers named Livesay employed 2400 spinners and 600 weavers. Since Blackburn itself had then a population around 4000, it can be seen what a high proportion of the population were engaged in textiles. Under this system the workers had some freedom and independence, but even so the introduction of hand machines - well before power entered the scene - was producing some factory work.

2. The Inventors

Naturally a great many people tried to improve textile processes. The period of invention was the 18th century.

1733 John Kay invented a machine for beating wool with spring-loaded laths raised by tappets on a wheel.

1733 John Kay invented the fly-shuttle.

1740's James Hargreaves (1720-1778) - of whom more later - improved the carding process. One card had already become mounted on a wooden

bench or "stock" so that both hands were free to operate the other, which could thus become larger and heavier. Hargreaves enabled weight and size to be increased, and several cards to be operated together, by suspending one or more from the ceiling by means of pulleys and underweights.

1748 Lewis Paul invented two carding machines. One was a cylindrical type. Cards were mounted on a large roller, and on a cylindrical concave segment which fitted close to roller for carding, but could be swung away for removing the fibres in a strip form called "slivers".

1748 Daniel Bourn (of Leominster) invented carding machine, in which wire-covered rollers worked against each other. (Modern carding machines work on the cylinder principle, rather like Paul's).

1764 Hargreaves invented the "spinning jenny", for which he is famous. Patented 1770, but invention probably 1764 or earlier. This jenny enabled a large number of threads to be spun at one time instead of the one which was all the ordinary spinning-wheel could manage. Science Museum model may be close to original, with 16 threads; but later 120 threads could be dealt with.

The operation is shown diagrammatically for one thread in the slide (diagram) in which

Fig. 1 shows the slubbing (or roving: coarse string formed from slivers in a drawing machine - see later) threaded from the slubbing bobbin A through the drawbar clamp B to the top of a spindle C. The open clamp (shown dotted) is drawn away from the spindle a pre-determined distance and then closed so that the slubbing is held secure.

Fig.2. The closed clamp is moved away from the spindle, drawing out the fibre. At the same time the spindle is revolved to put a few turns of twist into the thread to give it stability.

Fig.3. When the closed clamp is in the full draw position, the spindle is revolved to impart a twist to the thread. This is achieved by having the spindle set at an angle of about 10° to allow the thread to slip over the spindle tip at each revolution.

Fig.4. As the closed clamp is moved forward the deflection wire D guides the thread evenly on to the revolving spindle. During the winding, a further length of slubbing is pulled from A by the movement of the closed clamp, providing the next length of slubbing for the spinning cycle.

(Description from Aspin and Chapman, "James Hargreaves and the Spinning Jenny", Helmshore 1964.)

1769 Richard Arkwright (1732-1792) patented the "water-frame" spinning machine. So-called because it was usually driven by water-power, although Arkwright had originally intended it to be driven by horse-power. The principle here was different from that of Hargreaves. Instead of the roving being drawn out by movable stamps, it was here drawn out continuously by passing through two pairs of rollers, one going faster than the other.

The twisting was done by a flyer as in the 15th century onwards.

1779 Samuel Crompton (1753-1827) invented the "mule", another kind of spinning frame combining the rollers of Arkwright's water-frame with the movable carriage of Hargreaves jenny.

1775-1785 Arkwright developing carding machine, which undoubtedly formed basis of later machines. A large cylinder known as the "swift" had wire teeth all over it. A half (or smaller) cylinder ("flat") surmounted it, interior also covered in wire teeth. The carded cotton emerging from this was removed by a "doffer" cylinder revolving in the opposite direction. Later a better method for getting a continuous sliver was developed (1785); the fleece of carded cotton was taken off by a comb working on a crank, and then passed under rollers and through a funnel to narrow it to a sliver, which then fell in coils in a can.

1780 Arkwright developed a drawing frame using rollers as before, which gave more uniform and longer roving.

1786 An unknown inventor developed the "billy" - rather like a jenny in form, but move like a mule in operation. This was developed, along with other less successful machines, in an attempt to get something less expensive than Arkwright's expensive machines.

From 1800 There were inventions in many other countries, but there seem to have been few changes in the principles of carding, drawing and spinning. Cast-iron replaced wood in the frames, steam replaced water-power (first steam-driven factory was at Popplewick, Notts, where Boulton and Watt set up an engine in 1785).

1805 Only significant improvement in the loom (still a hand loom) was that of Radcliffe and Johnson, providing an automatic means of "taking up"

the woven cloth, i.e. winding it on to the 'cloth beam" or output roller. Known as the "dandyloom".

1784-1822 Numerous attempts made by Cartwright of Doncaster, Miller of Glasgow, Johnson, and Wm Horrocks of Stockport, to introduce power loom. Horrocks was the most successful, and between 1813 and 1820 the number of power-looms in Britain increased from 2400 to 14,150 largely due to Horrock's design.

1822 Richard Roberts (1789-1864) set up a firm for loom-making - Roberts, Hill and Co. - and introduced the Robert's power-loom which spread widely, including overseas.

3. Weaving

Revise the principles:-

Warp: longitutdinal threads, moved forward over roller as weaving progresses.

Alternate threads (or sometimes groups of threads) are threaded through loops in a vertical card attached to 2 or more lifting bars, so that alternate threads may be lifted or lowered to allow the shuttle (carrying the weft) to pass between.

The weft is then pressed forward to close the weave after each passage of the shuttle, by means of a large comb.

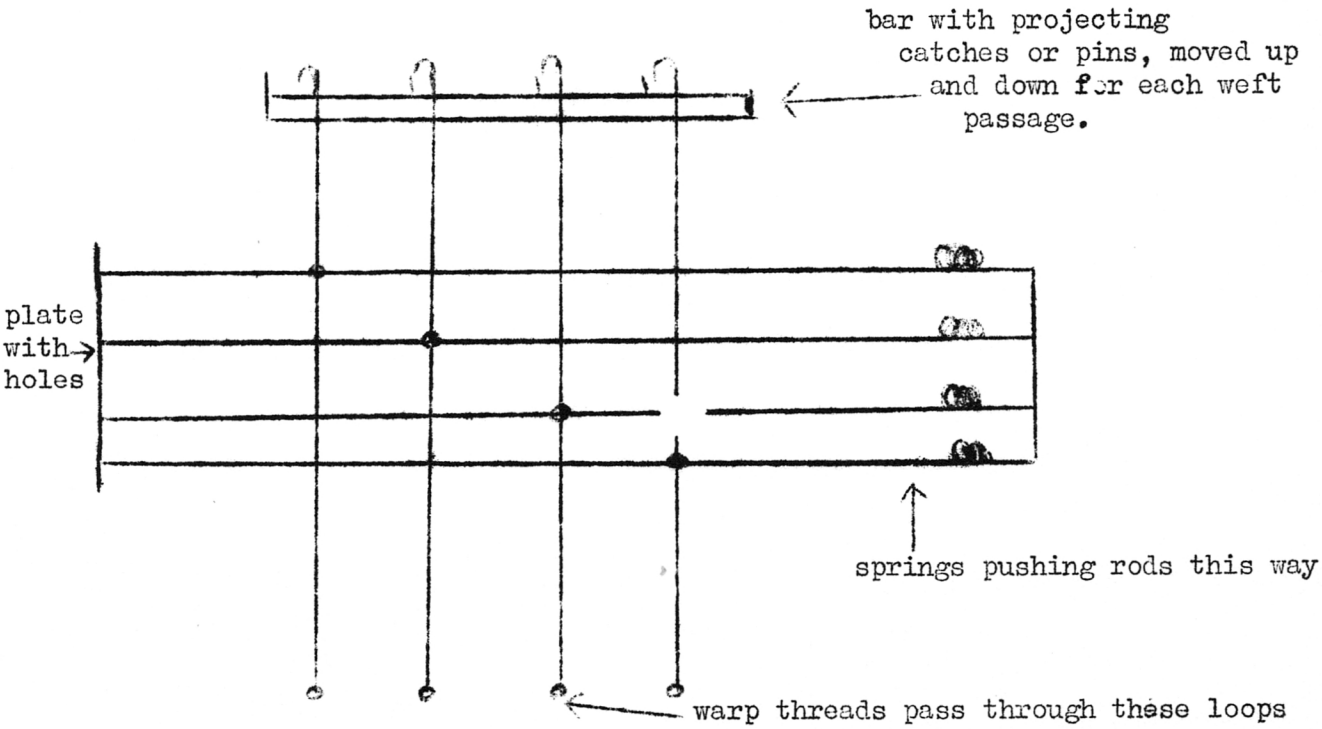
The power loom is very similar. The shuttle is propelled by an impulse from a lever.

Different colours of weft can be put in by using a double shuttle arrangement. One shuttle or the other is propelled across by raising and lowering the shuttle holder at one end rather in the manner of capitals and smalls in a typewriter.

Pattern weaving:

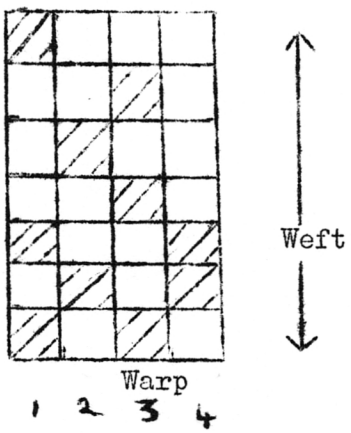
J.M. Jacquard (1752-1834) invented the Jacquard loom in 1801, and by 1812 there were 11,000 of these looms in France. They may have been introduced into Britain about 1810, although they were apparently not numerous here until 1820 or so. The principle is to obtain the pattern by raising appropriate warp threads where they become exposed at top surface of cloth to form the pattern. This is done for each passage of the shuttle according to the pattern of holes in a plate.

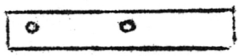
Simplified example, for 4 warp threads only:-

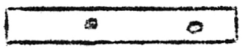


If there is a hole in the plate in position 2, then the springs push cross bar no. 2 into the hole. The hook at the top of warp-carrying bar no. 2 then moves to left, so that when the lifting bar moves upwards, it carries warp bar no. 2 up and raises warp thread no. 2 - but not the others.

So the pattern is coded onto plates thus:-



So far 1st weft, plate is 

and for 2nd weft, ...  and so on.

The plates are automatically moved into position for each throw of shuttle.

4. Finishing

Machines were developed for the various finishing processes for the cloth.

(a) nap-raising machines or gig-mills. A teazle-covered roller rotates while the cloth passes under it. Developed 1790 onwards, introduced into France 1802, universal in West of England by 1830's, but hand processing still used in Yorkshire in 1850.

(b) nap-shearing machines: 1784 Delaroche of Amiens)
1787 J. Harmer of Sheffield) first inventors

- either rotating shears, or shears drawn across the cloth, or the cloth drawn under shears.

1794 first rotary machine, invented by American Samuel Dorr.

1815 J. Lewis of Brimscombe near Stroud patented successful rotary machine much used in England.

Hand-shearing almost extinct by 1840.

N.B. It was these finishing machines that caused the great riots, including the Luddite riots of 1812 in Yorkshire.

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