FULLING, the art or act of cleanſing, ſcouring, and preſſing cloths, ſtuffs, and ſtockings, to render them ſtronger, cloſer, and firmer; called alſo *milling*. See BLEACHING.

Pliny, lib. vii. cap. 56. aſſures us, that one Nicias, the ſon of Hermias, was the firſt inventor of the art of fulling: and it appears by an inſcription quoted by ſir G. Wheeler, in his travels through Greece, that this ſame Nicias was a governor in Greece in the time of the Romans.

The fulling of cloths, and other ſtuffs, is performed by a kind of water-mill; thence called a *fulling or ſcouring-mill.*

Theſe mills, excepting in what relates to the mill-ſtones and hopper, are much the ſame with corn-mills. And there are even ſome which ſerve indifferently for both purpoſes; corn being ground, and cloths fulled, by the motion of the ſame wheel.

Hence in ſome places, particularly France, the fullers are called *millers;* as grinding corn, and milling ſtuffs, at the ſame time.

FULLING *Mill*, in the *Manufactures*, is a machine employed for waſhing, ſcouring, or fulling of cloth, either with a view of cleanſing it, in which caſe it is termed ſcouring, or for the purpoſe of thickening woollen cloth, worſteds, &c. when it is termed milling; in either caſe the fulling-mill employed is the ſame: its operation is to conſtantly agitate and expoſe a new ſurface to the action of water or other menſtrua, with which the goods to be operated upon are conſtantly ſupplied; this is performed by two beaters or mallets, which are ſucceſſively raiſed by the action of a water-mill, or ſteam-engine, and let fall upon the cloth, which they ſtrike and turn over in the trough where it is placed; a conſtant ſtream of water paſſing through it, carries away the dirt and impurities which are looſened from the cloths by the agitation of the mallets, or ſtocks, as they are termed.

An inſpection of *Plate* XXIX. *Mechanics*, will give a clearer idea of the conſtruction of this machine. Here *fig.* 4. is a perſpective view of a pair of ſtocks, or fulling-mill, in the action of ſcouring a piece of goods; the other figures are explanations of the parts of the machine by a ſection, *fig.* 5, and elevation, *fig.* 6. A fulling-mill generally contains four, ſix, eight, or ten pair of ſtocks, according to the quantity of work it is required to perform; theſe are all moved by the ſame water-wheel, or ſteam-engine: in the former caſe, the axis of the water-wheel is employed to move two or three pair, whilſt the others receive their motion from one of two ſimilar and parallel ſhafts, turned by cog-wheels from the ſhaft of the water-wheel. A portion of this ſhaft is repreſented at A in the plate, beneath the floor of the mill; and the cog, which gives it motion, is denoted by N, *fig.* 4: it revolves upon gudgeons at its ends, which are ſupported on braſſes reſting on the frame work or maſonry, as ſhewn in *fig.* 6. Four levers or lifters, B, B, D, D, are fitted upon the ſhaft which alternately, as they paſs the beaters E and F, lift them up, and they deſcend by their own gravity: theſe beaters are formed from a large block of wood E and F, affixed to a long ſtem G, moving on a centre at *g*, which is ſupported at the top of the frame H I K of the whole machine; the principal part of this is a large block of wood H I, hollowed out into a large cavity *a a*, for the reception of the cloth; this is termed the trough. K are pieces of wood fixed to the piece H I, and curved to a ſegment of a circle ſtruck from the centre *g*, on which the beaters move; in the ſpaces between theſe beams the ſtems G of the beaters project ſo as to be intercepted by the lifters B, D, as they revolve; the beaters are alſo curved at the loweſt ſide to the ſame circle as the beams K, ſo that they apply as cloſe as poſſible to each other without touching; this is neceſſary to prevent the cloth getting between them, and being pinched or cut thereby. The ends of the beaters, which act upon the cloth, are armed with three ſmall boards at *h*, *i*, and *k*, *fig.* 5. which project like teeth, and act more effectually to bend and diſturb every portion of the cloth placed in the trough *a a*. The beaters act very cloſe to each other ſideways, that the cloth may not introduce itſelf between them; and in the ſame manner they fit the ſides of the trough, formed by boards nailed to the block H I, and the beams K, which alſo give a great ſtrength to the machine. At one ſide theſe boards are not ſo high, for the convenience of taking the cloth out of the trough; but when the machine is in action a moveable board M, *fig.* 4. is placed on the top of the loweſt ſide, to raiſe it to the ſame height with the other, and prevent any danger of the cloth getting over. R is a pipe bringing water to the trough, and furniſhed with a ſtop cock to regulate the ſupply; the pipe paſſes through the back of the block H I, and the water ſtriking againſt a board *x*, placed before the aperture, it falls down in a ſheet upon the cloth, and keeps it conſtantly ſaturated. When the cloth is to be put into the machine, a workman with a lever ſupported on an iron hook *k* receives the beater when at the higheſt point of its motion, and prevents its deſcent; he then thruſts a long iron bolt *r*, *fig.* 6. through a hole in the beams K, and by that means retains it; the other beater is then taken up in the ſame manner, and retained

tained by the ſame bolt, being puſhed farther forwards; the looſe board M is now removed, and the cloth thrown into the trough *a a*; the beaters are then ſet in motion by removing the bolt *r*, which held them up. As the ſhaft A revolves, the lifters alternately engage one or other of the beaters which falls againſt the cloth, and, ſtriking it at the under ſide, thruſts it up into the curved part of the trough *a a*, and by that means it falls down upon the head of the beater; when the lifter raiſes the beater another time, the cloth falls into the ſpace left by its being raiſed; in this manner it continues turning the cloth over in the trough, and ſtriking it by its teeth *h, i, k*, ſo as to waſh it thoroughly. As the two beaters fall alternately, that is, one is up when the other is down, the cloth is alſo turned round diagonally in the trough: by this means, after milling a piece of cloth for ſome hours, there is little chance but that every part ſhall be ſubjected to the action of the beaters, though a whole piece is in action at once, and conſequently folded in innumerable creaſes. The water which enters at the upper end of the trough beneath the looſe board *x*, (which is intended to ſpread the water out into a thin ſheet, that it may fall equally upon the whole of the cloth,) eſcapes ſlowly through the grooves between the beam K, in which the ſtems G move, carrying with it all the filth contained in the cloth; it falls into a pit repreſented by the dark ſpace in *figs.* 5. and 6, in which the ſhaft revolves. This pit uſually has a communication with the water of the mill, to waſh away the ſediment which accumulates in the pit, from the foul water continually falling into it. The machine is fixed over this pit by a tennant at the lower part of the block H I, which is bolted between two beams L, L, ſupported on maſonry; M are two braces to ſuſtain the ends of the beams K, and keep the whole machine firmly in the ſame poſition: the beams L, L, are extended to a conſiderable length, and have three or four machines placed parallel to each other between them.

The true method of fulling with ſoap is delivered by Monſ. Colmet in an authentic memoir on that ſubject, ſupported by experiments made by order of the marquis de Louvois, then ſuperintendant of the arts and manufactories of France. The ſubſtance of which we ſhall here ſubjoin.

FULLING, *Cloth and woollen Stuffs, with Soap, Method of.* A coloured piece of cloth, about forty-five ells, is to be laid in the uſual manner, in the trough of a fulling-mill, without firſt ſoaking it in water, as is commonly practiſed in many places.

To full this trough of cloth, fifteen pounds of ſoap are required; one half of which is to be diſſolved in two pails of river or ſpring-water, made as hot as the hand can well bear it. This ſolution is to be poured by little and little upon the cloth, in proportion as it is laid in the trough: and thus it is to be fulled for at leaſt two hours; after which it is to be taken out, and ſtretched.

This done, the cloth is immediately returned into the ſame trough, without any freſh ſoap; and there *fulled* two hours more. Then taking it out, they wring it well, to expreſs all the greaſe and filth.

After the ſecond fulling, the remainder of the ſoap is melted, as the former, and caſt, at four different times, on the cloth; remembering to take out the cloth every two hours, to ſtretch it, and undo the plaits and wrinkles which it has acquired in the trough. When they perceive it ſufficiently fulled, and brought to the quality and thickneſs required, they ſcour it out for the laſt time in hot water, keeping it in the trough till it be quite clean.

As to white cloths; becauſe theſe full more eaſily, and in leſs time, than coloured ones, a third part of the ſoap may be ſpared.

FULLING *of Stockings, Caps, &c.* may be performed ſomewhat differently; viz. either with the feet or the hands; on a kind of rack, or wooden machine, either armed with teeth of the ſame matter, or elſe with horſes or bullocks' teeth.

The ingredients made uſe of herein are urine, green ſoap, white ſoap, and fullers'-earth. But water ſoftened with chalk is far preferable.

Note, woven ſtockings, &c. ſhould be fulled with ſoap alone; for thoſe that are knit, fullers'-earth may be uſed with the ſoap.

Indeed, it is frequent to full theſe kinds of works with the mill, after the uſual manner of cloths, &c. But that is too coarſe and violent a manner, and is apt to damage the work, unleſs it be very ſtrong.

FULLING, in the *Manufacture of Hats*, is the completion of *felting* (which ſee), and has for its objects the intimate connection of the fibres, and a more perfect and durable coheſion of the whole maſs. For this purpoſe the mere mechanical act of preſſure is inſufficient. In this way the reſult would be a formleſs maſs, without conſiſtence. Experience (ſays Chauffier, cited in Nicholſon's Journal, vol. i.) has long ſhewn, that for the fulling it is neceſſary to make uſe of a bath of water heated nearly to ebullition, into which are put 10 or 15 pounds of lees of wine, for each hundred pounds of water. The heat is kept up during the whole time of working, and every three or four hours a new quantity of lees is added. Into this bath the workmen plunge their felt, and begin their ſecond proceſs. The felt is dipped in, and immediately again taken out and ſqueezed, bended and rolled, by preſſure in different directions, ſometimes with the hand defended by leather, and ſometimes by means of a roller or other ſimilar inſtrument. The immerſion and working of the felt are repeated, and the operation continued, till the ſtuff is well condenſed, and has acquired the requiſite ſolidity.

Since the operation of fulling is employed to form a denſe and compact ſtuff with the fibres or hairs, and to determine the intimate coheſion of its component parts; and ſince the mere mechanical operation is not ſufficient for this purpoſe, even with the aſſiſtance of a water-bath at the boiling heat, without the addition of lees as a neceſſary condition;—this laſt muſt be conſidered as a chemical ſolvent, which acts directly on the ſubſtance of the hairs themſelves, and produces, either by ſoftening or ſwelling them, an alteration neceſſary to inſure the coheſion of the different fibres of the ſtuff. But the lees being compoſed of the mucilaginous and colouring parts, which are ſeparated, together with a great quantity of tartar, or the acidulous tartrite of pot-aſh, it became neceſſary to aſcertain, in a poſitive manner, what might be the principle of its action. The editor of the Encyclopedié affirms without heſitation, that it is the alkali or pot-aſh of the lees which determines the fulling. But in order to ſhew (ſays Mr. C.) how erroneous this aſſertion is, nothing more is neceſſary than to dip a piece of blue paper into the bath, by which the former becomes inſtantly red; and if, after ſeveral hours' work, the ſtate of the bath be again examined, it is found that the acidulous tartrite of pot-aſh is partly exhauſted, and the workmen ſoon perceive, from the difficulty of continuing their work, that a new quantity is required to be added. And again, if we conſider the ſparing ſolubility of the acidulous tartrite of pot-aſh in cold water, it is eaſily ſeen why in this proceſs the water muſt be kept nearly boiling. Whence

it is evident that it muſt act by the portion of acidate which it contains. Hence our author was induced to think, that the ſulphuric acid might be advantageouſly ſubſtituted in the place of the lees; and as 12 pounds of lees are uſually added to 100 of water, he eſtimated by approximation that one gros of ſulphuric acid would be equivalent to at leaſt one pound of the lees, and conſequently that 12 gros of ſulphuric acid would be ſufficient for 100 pounds of water. His conjectures were ſoon confirmed by experiment; and after a fair trial it was aſcertained that the uſe of the ſulphuric acid is much preferable to that of wine-lees; that it is not only much more economical, but ſtill more convenient in the uſe; and, what is yet more important, the health of the workmen is not injured by the exceſs and duration of the heat, the thick vapours, and the diſguſting odour, which exhales from the bath, particularly when the lees have been altered by mouldineſs and putrefaction, which is very common in theſe manufactories. When the ſulphuric acid is employed, it is uſeleſs to keep the bath nearly boiling, as was formerly done. A degree of heat of 25 or 30 degrees (90° or 100 of Fahrenheit) is ſufficient for good fulling. The ſaving of fuel is an object of importance in manufactories; and as very little fire is neceſſary when ſulphuric acid is uſed, cauldrons of lead may be ſubſtituted inſtead of copper-boilers, the firſt coſt and annual repair of which are very conſiderable.

The felts prepared by this new proceſs are alſo of a very ſuperior quality to thoſe which have been worked in the bath with wine-lees. In fact, the mucilaginous and colouring matters of the lees, which are ſuſpended in the bath, penetrate the texture of the ſtuff, and adhere with more or leſs force; and when, after having paſſed the hats through the dye, they are beaten, a fine black duſt flies off in great abundance, which not only weakens the texture of the felt, but by diffuſing itſelf through the manufactory greatly incommodes the workmen, and frequently occaſions coughs and diſorders of the throat.

Hats felted in this manner, ſays a manufacturer who had adopted this proceſs, are not only clear of the powder which abounds in the others, but they take the dye better, and are cleaner.

FRICTION AND FULLING MILL.

Fig. 1.

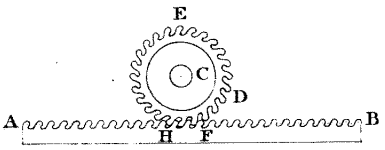


Fig. 2.

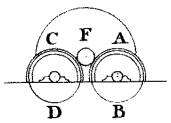
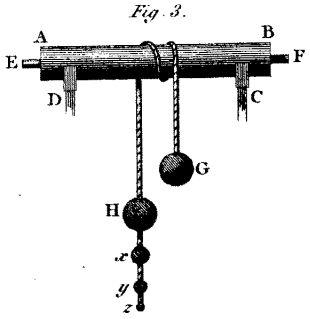


Fig. 3.



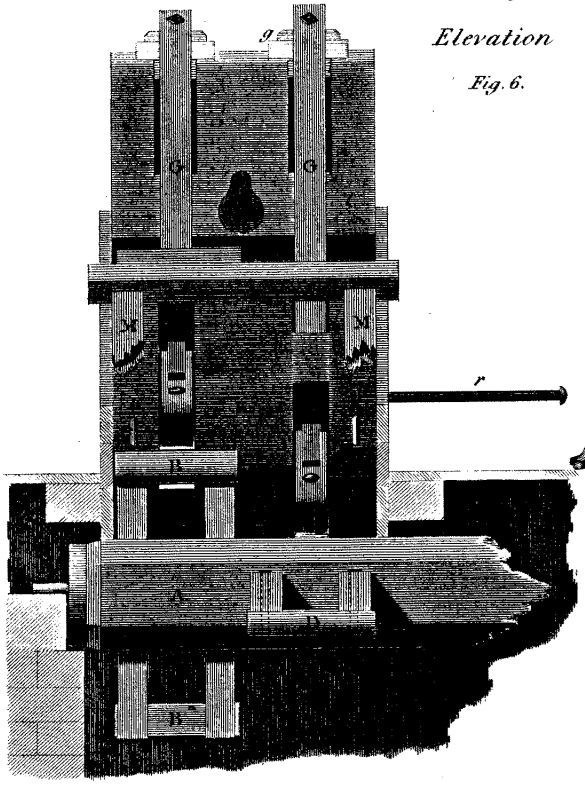
Perspective View

Fig. 4.

Note, these Stocks are for Scouring; for Milling cloth the trough a. a. is differently formed. see Woollen.

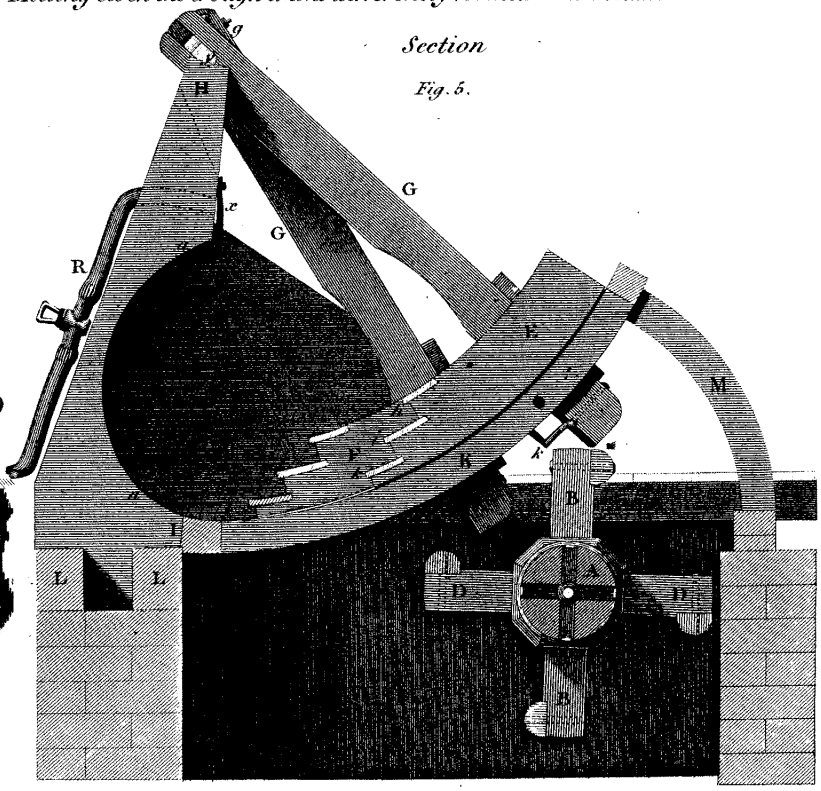
Elevation

Fig. 6.



Section

Fig. 5.



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