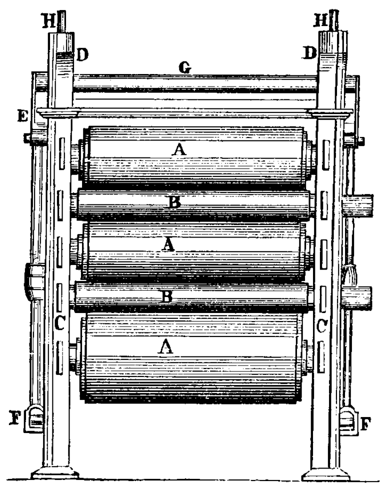
CALENDER. A machine to give a smooth, hard surface to paper, or to cotton and linen fabrics. Calendering is the finishing process by which the goods are passed between cylinders or rollers, and made of a level uniform surface. The machine consists of a number of rollers contained in a massive framework; the rollers are connected with a long lever loaded with weights at the further extremity, by which or by means of screws almost any amount of force may be applied, and the surface texture of the cloth varied at pleasure. With considerable pressure between smooth rollers, a soft, silky lustre is given by equal flattening of the threads. By passing two folds at the same time between the rollers, the threads of one make an impression on the other, and give a wiry appearance, with hollows between the threads. The rollers are made of cast-iron, wood, paper, or calico, according to the uses for which they are designed. The iron rollers are sometimes made hollow, for the purpose of admitting either a hot roller of iron or steam when hot calendering is required. The other cylinders were formerly made of wood, but it was liable to many defects. The advantage of the paper roller consists in its being devoid of any tendency to split, crack, or warp, especially when exposed to a considerable heat from the contact and pressure of the hot iron rollers. The paper takes a fine polish, and, being of an elastic nature, presses into every pore of the cloth, and smooths its surface more effectually than any wooden cylinder, however truly turned, could possibly do.

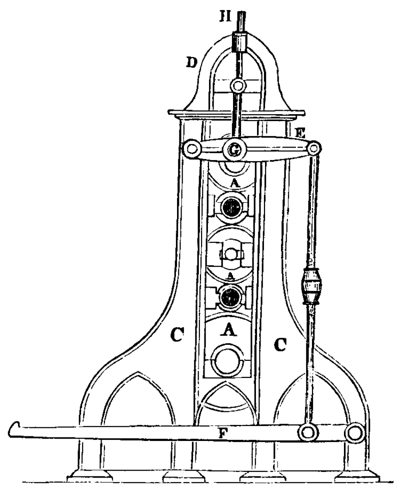
In a five-rollered machine, the cloth coming from behind, above the uppermost or 1st cylinder, passes between the 1st and 2d; proceeding behind the 2d, it again comes to the front between the 2d and 3d; between the 3d and 4th it is once more carried behind, and lastly brought in front between the 4th and 5th, where it is received and smoothly folded. At this time the cloth should be folded loosely, so that no mark may appear until it is finally folded in the precise length and form into which the piece is to be made up, which varies with the different kinds of goods, or the particular market for which the goods are designed. When the pieces have received the proper fold, they are pressed in a hydraulic press previous to being packed.

From the great weight of calendering machines, it is necessary that they should be fixed on the basement floor. After the cloth has received its final gloss from these machines, it is taken to the cloth-room to be measured preparatory to being folded and packed for sale or transportation.

601.



602.



SCALE.—1-4th inch = 1 foot.

Calender with five rollers, designed and constructed by Messrs. A. More & Son, Glasgow.—Fig. 601, a side elevation; Fig. 602, an end view. The same letters of reference denote the same parts in each view.

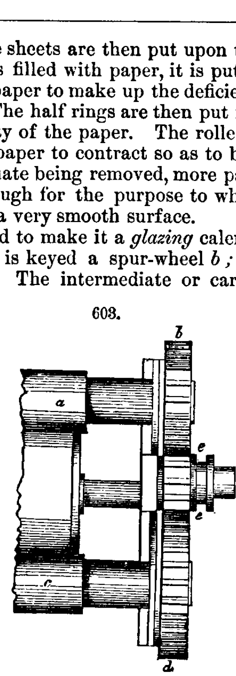
A A A, three cylinders or rollers made of paper, the construction of which will be noticed hereafter. *B B*, two cast-iron cylinders, made hollow to allow of the introduction of hot bolts of iron within them, or of steam, when it is required or preferred. *C C*, the two side-frames or cheeks, into which are fitted the several brass bushes for the cylinders to turn upon. *D D*, top guides, into which the cross-head *G* and elevating screws *H H* work. *E E*, top-pressure levers, connected by a strong rod of iron with the under-pressure lever *F*. This system of levers is connected with the cross-head *G* by two strong links of iron. The elevating screws *H H* pass through the cross-head, and rest upon a strong cast-iron block, into which is fitted the brass bush of the top paper roller. By means of the screws, the cross-head and levers can be raised or depressed as required; and when the calender is working warm and requires to be stopped, the elevating screws are screwed up for the purpose of lifting the paper rollers off the hot cylinders, to prevent their being injured by the heat.

The construction of the paper rollers or cylinders is as follows: Upon each end of an arbor of malleable iron, of sufficient strength to withstand the necessary pressure without yielding, is fastened a strong plate of cast-iron, of the same diameter as the roller to be made: the plate is secured in its proper place by a ring of iron, cut in two, and let into a groove or check turned in the arbor. When the roller is finished, the annular pieces are kept in their groove by a hot hoop put upon the outside of them, and allowed to cool. A plate is fitted on the other end, of exactly the same size, and in the same manner.

In building the rollers, one of the plates is taken off the arbor, but the other is allowed to remain in its place. The paper sheets of which the rollers are to be made have each a circular hole cut in the centre of it, of exactly the same diameter as the arbor. The sheets are then put upon the arbor, and pressed hard against the fixed plate. When the arbor is filled with paper, it is put into a strong hydraulic press, and pressed together—always adding more paper to make up the deficiency caused by the compression, until the mass can be pressed no harder. The half rings are then put in their place, to prevent the plate from being pressed back by the elasticity of the paper. The roller is now to be dried sufficiently in a stove, the heat of which causes the paper to contract so as to be quite loose. The roller is then again taken to the press, and the unfixed plate being removed, more paper is added, and the whole again compressed, until the roller is hard enough for the purpose to which it is to be applied. It is next turned truly in the lathe till it acquires a very smooth surface.

Fig. 603 shows the manner in which the calender is geared to make it a *glazing* calender. In this cut, *a* marks the top cylinder of the calender, upon which is keyed a spur-wheel *b*; and *c* is the under cylinder, upon which is also keyed a spur-wheel *d*. The intermediate or carrier-wheel *e e*, when drawn into gear, reduces the speed of the under cylinder *c* one-fourth. Now, the cylinder *a* being the one that gives motion to all the rollers, and revolving always at the same speed, the cloth in its passage through all the rollers below the cylinder *a* is carried through at a speed *one-fourth* less than if it passed only below the cylinder *a*; consequently, when it comes into contact with *a*, it is rubbed, and thereby *glazed*, in consequence of the cylinder *a* moving one-fourth quicker than the cloth, as above stated.

603.



604.

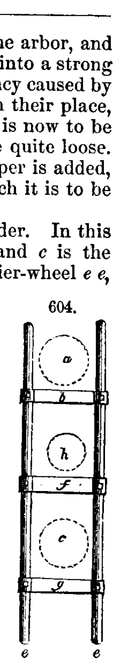
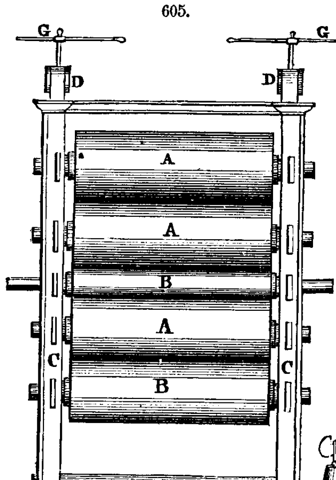


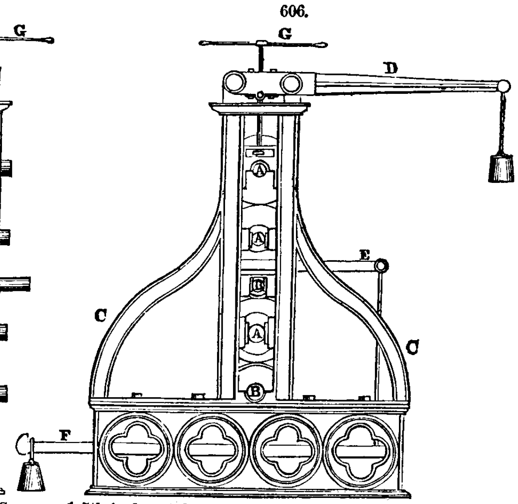
Fig. 604 shows the manner in which the rollers are lifted clear of each other when the machine is stopped. In this, *e e* are two rods of iron, attached to the block or seat of the top roller; *b f g*, three bridges of malleable iron, capable of sliding upon the rods *e e*, but held fast upon the rods when once they are adjusted to their proper places by pinching screws. The bridge *b* is placed half an inch clear of the bearing of the cylinder *a*, when all the rollers are resting upon each other; the bridge *f* is placed one inch below the bearing of the paper roller *h*; and the bridge *g* is placed one inch and a half below the bearing of the cylinder *c*. When the pressure screws of the calender are lifted, the blocks of the top roller being attached to them, the rods *e e* are lifted also, and along with them the different rollers as the bridges successively come into contact with their respective bearings.

The manner of passing the cloth through the calender varies very much, according to the amount of finish required upon it. The various methods are accomplished by different arrangements of the gearing, so that a calender calculated to do all the different kinds of finishing becomes a very complicated machine, on account of the quantity of gearing required. For common finishing, the method of passing the cloth through the calender is as follows: The cloth is passed alternately over and under a series of rails placed in front of the machine, so as to remove any creases that may be in it, and is then introduced between the lower roller *A* and cylinder *B*; returns between the lower cylinder *B* and the centre roller *A*; passes again between the central *A* and the upper *B*; and again re-

605.



606.



SCALE.—1-5th inch = 1 foot.

turns between the top pair *A B*, where it is wound off on a small roller (hid in the drawings by the framing of the machine), pressing against the surface of the top roller *A*. When this small roller is filled with cloth it is removed, and its place supplied by another, to be in succession filled as the motion of the machine progresses.

Water-Mangle, with two copper and three wooden rollers, designed and constructed by Messrs. A. More & Son.—This machine, Figs. 605 and 606, differs nothing in principle, and little in general construction, from the five-rollered calender above described, except in this—that it is intended for wet goods. It is drawn to a scale slightly less, but the views given and the lettering of the parts correspond to those of the preceding figures.

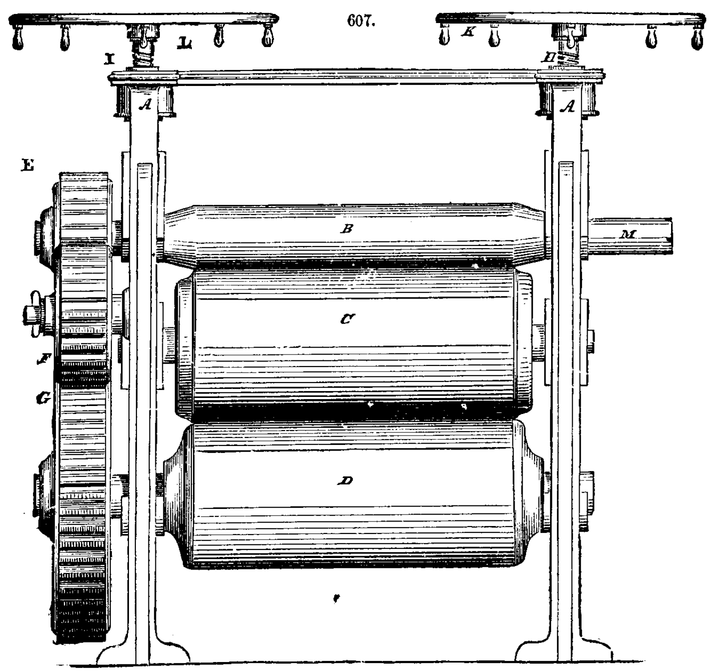
A A A, the three wooden rollers, and *B B*, the two copper rollers of the mangle. These last consist of a copper cover upon a cast-iron body, through which passes a wrought-iron arbor, differing from those of the wooden rollers in being round, whereas these are square between the bearings. The smaller of the two copper rollers, namely, the third in order, is in this arrangement the driver, the mangle being driven like the calender, by a system of reversing gear not shown in the drawings. The pressure in the mangle is brought on by a system of levers, which differ slightly from that described. In this, indeed, there are strictly two distinct pressures: that brought on the axis of the middle roller by the lever *E*, which is connected by a link with the weighted lever *F*; and that transmitted through the whole system of rollers by the single-weighted lever *D*. The weight of this last is regulated by means of a set-screw, which turns in a nut in the jaws of the lever *D*, and bears upon the set-block which rests upon the arbor of the top roller. This pressure is thus transmitted downward from the top roller throughout the whole set, and at the middle roller *B* is added to the pressure obtained by the lever *E*. By this arrangement, the pressure between the three under rollers is greater by the pressure of *E* than it is between the upper pair; but for very high pressure the lever *D* may be locked by set-pins and the set-screws turned down by the hand-wheel *G*, until the requisite degree of pressure is obtained. The manner of passing the cloth through this machine is the same as that already described in the calender, with this single exception, that before the cloth enters between the lowest roller *A* and the small cylinder *B*, jets of water from a pipe perforated with small holes, extending the whole width of the machine, are allowed to play upon the cloth, so as to impart to it sufficient moisture for causing it to receive the requisite degree of smoothness preparatory to the starching process, and at the same time allow the cylinder *B* to free it from any impurities that may be remaining in it, by forcing them back with the expressed water.

Description of Calender, Figs. 607 *and* 608.—*A*, two cast-iron frames. *B*, *C*, *D*, three cylinders. *E*, *F*, *G*, three cog-wheels. *H*, *I*, two force-screws. *K*, *L*, two fly-wheels with handles.

The cylinder *B*, which is in cast-iron, and hollow, is heated by another iron cylinder heated red-hot. The material of the cylinder *C* is pasteboard; its axle is of wrought-iron. These three cylinders must be perfectly round and parallel.

The wheel *F* forms the communication between *E* and *G*, which rest upon the cylinders *B* and *D*. The relation of *F* to the circumference of the cylinders is such that, when the machine is set to work,

607.

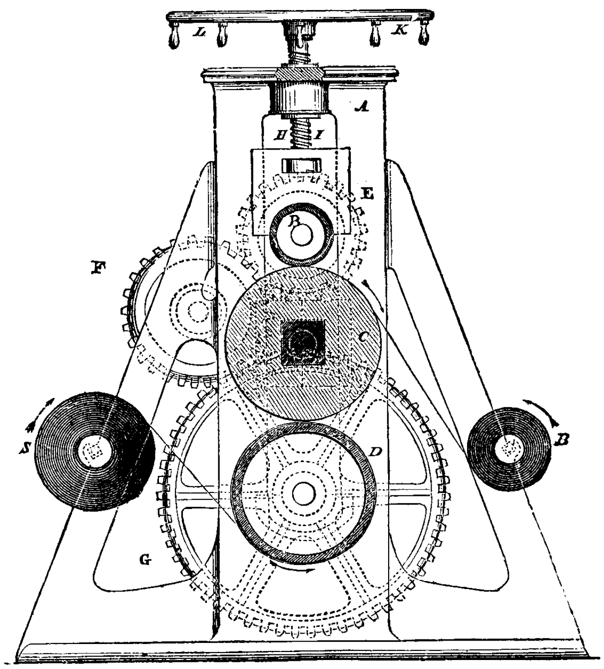


these cylinders slide, causing friction, and thus give a gloss to the cloth. The friction is variable according to the nature of the tissue.

In order to set the machine in motion, the fly-wheels *K* and *L* being turned so as to press the screws *H* and *I* against the pillows of the first cylinder *B*, the cloth is placed between the rollers in the direction indicated by the arrows.

Since the introduction of web-perfecting printing-presses, rolls for calendering paper require great truth in their roundness and parallelism. Suppose, for instance, a pair of rolls to be the 10,000th part of an inch out of parallel, and the paper rolled by them therefore the 20,000th part of an inch thicker on one side than on the other. Now, suppose a roll of such paper to be 33 inches in diameter, the mandrel upon which it is rolled being 3 inches thick, and there to be 450 thicknesses of paper to an inch; the roll would in such case be .675 of an inch in diameter or 2.12 inches in circumference greater at one end than at the other; and the effect of such a roll being placed upon a modern printing-press, through which it would require to be drawn at a speed of from 15 to 20 miles an hour, would be that the whole strain due to unwinding the paper at such a great speed would be sustained by the paper unwinding from the small diameter of the roll, causing it to tear. To remedy this defect, Messrs. J. Morton Poole & Co., of Wilmington, Delaware, have introduced a finishing process for rolls, which has achieved remarkable success, and which has been in consequence introduced in Europe. That process is as follows: After the roll has been turned as accurately as is practicable with the steel tools, it is finished in the grinding lathe or machine; and the principle upon which this lathe operates is as follows: If we suppose the lower part of a compound lathe-carriage to support the upper part so as to permit to the latter a free, swinging, cross-feed motion, and form it so as to carry two revolving corundum-wheels, one on each side of the roll, so that the horizontal centre line of the roll will be level with the centres of the corundum-wheels, it is evident that the two will form a pair of grinding calipers, and will adjust themselves to touch the roll equally on both sides, just the same as the points of a pair of calipers, held loosely, will adjust themselves to the diameter of a roll. It is also evident that a pair of wheels adjusted in this manner, if traversed along the roll, will come in contact with, and operate upon, the roll in places where the diameter of the roll is equal to or exceeds the nearest width between the two corundum-wheels, while such parts of the roll as are of a diameter less than is the said distance between the wheels will remain untouched. If, therefore, the wheels are adjusted in their distance apart and operated along the roll until all the turning-marks are effaced, the roll will be made quite parallel, except in so far as the reduction in the diameters of the grinding-wheels and the deflection or sag of the roll may prove disturbing elements.

608.



The latter element is of no practical moment, however, since its effect upon an ordinary roll 8 feet long has been computed not to affect the diameter of the roll to more than the 200,000th part of an inch. Referring to the first disturbing element, it is less in the process adopted by Messrs. Poole than in any other yet known, for the following reasons: The ordinary plan is to perform the grinding with a wheel on one side only of the roll. Now, supposing it to be practicable to move the carriage containing the wheel so delicately as to be able to put on a cut the 100th part of an inch in depth, the diameter of the roll will be reduced one-fiftieth of an inch, and the amount of the abrasion of the emery-wheel will be that due to the abrading of that quantity or weight of metal; but if the feed of one of Messrs. Poole's corundum-wheels is moved the 100th of an inch, the reduction in the size of the roll will be the 100th of an inch only; so that, with the same amount of feed, Messrs. Poole take off only one-half the amount of metal, and have twice the area of grinding-wheel to do it with. Hence the deviation from parallelism is only one-fourth as much under their process as it is under the process usually employed. From the cross-swing motion, then, of the frame carrying the corundum-wheels, the parallelism of a roll is inevitable, providing that the roll runs circumferentially true. The ordinary method of grinding a roll to run true in the lathe is to grind it up with one emery-wheel in a fixed position; and this was the plan formerly employed by Messrs. Poole, in which case the advantage obtained by their process was that, since an emery-wheel in a fixed position will grind a roll to run true, and the error arising from its use lies in the parallelism of the roll, it is necessary only to finish the roll with the two wheels in position to insure both roundness and parallelism. The only objection to this plan was that the grinding the roll true could be performed twice as quickly with the two wheels as it could be with the one, and could be proceeded with simultaneously with the truing for parallelism. The method of accomplishing this result is as follows: By placing a slight pressure upon the frame carrying the corundum-wheels, so as to offer a slight resistance to its cross-swing, the high spots or places upon the roll will press more heavily upon the respective corundum-wheels as it passes them, and, as a consequence, will suffer the most abrasion. This remark applies, however, to high spots which do not extend entirely around the circumference of the roll, and not to high places due to an increase of diameter; or, in other words, it applies to those high spots which constitute a want of truth or roundness in the roll. If then a roll, being out of round and out of parallel, is operated upon with the wheel-frame or carriage slightly resisted, the truing for both roundness and parallelism will progress jointly; then, when the roll is ground so as to run true, the wheel-carriage is allowed to swing freely while the finishing traverses are made.

J. R.