

since the introduction of the band-saw for outside work and of friezing or shaping cutters for inside ornamentation. The latter finish the surface as well as shape it, and for many classes of work are superseding the scroll- and fret-saw. The latter must, however, be still employed until the type of ornamentation for certain work shall undergo a considerable change.

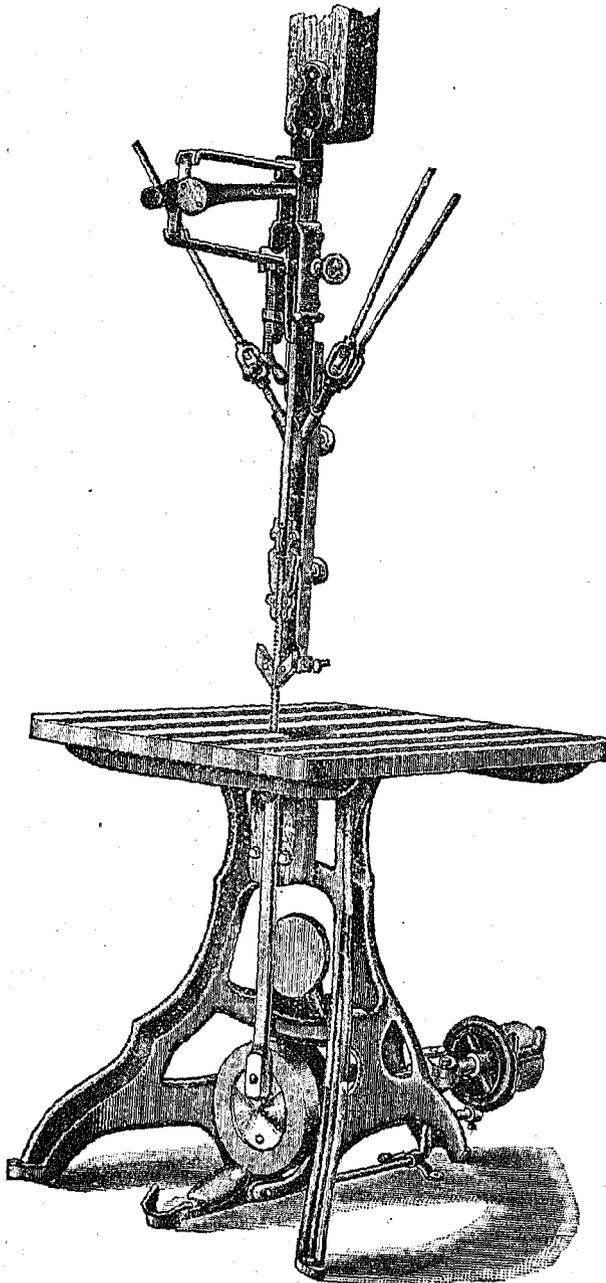


Fig. 416.

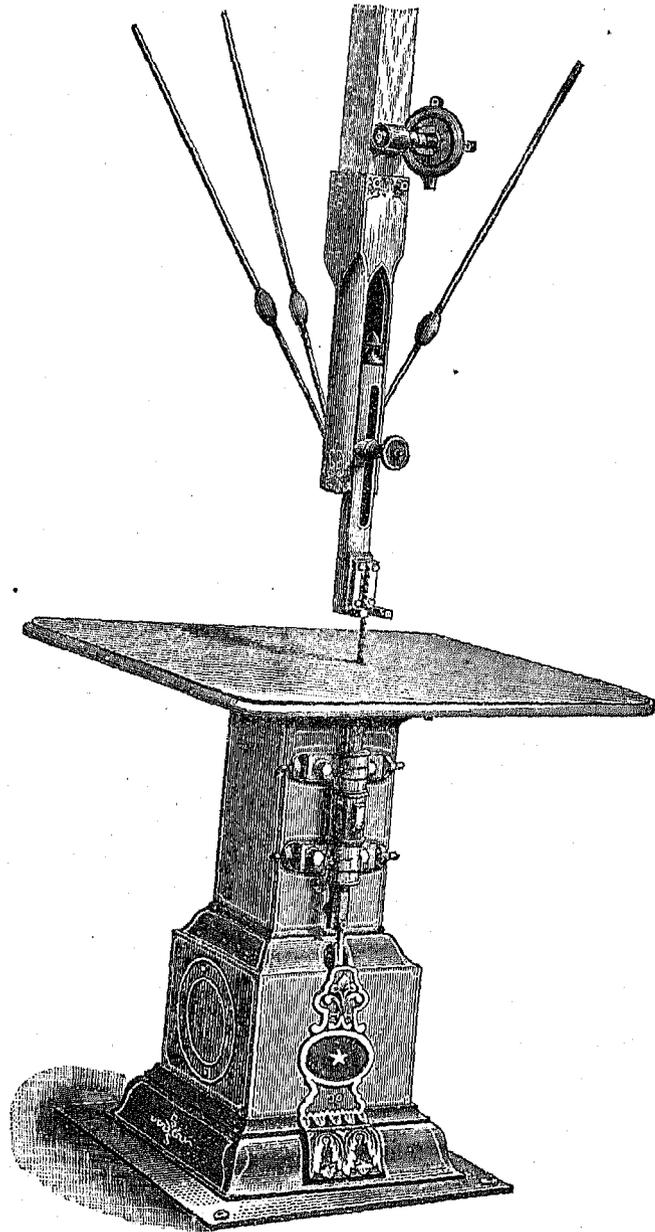


Fig. 417.

Sawing machinery as a class is fundamental to the other processes. Considerable thought has been expended in improving it, and the results are to be seen in the types illustrated. The improvement since the earlier days is very marked, and is daily advancing.

## § 42.

## G.—TOOLS ACTING BY PARING.

## SURFACERS, PLANERS, AND MATCHERS.

After the wood has come from the resaws, or from the forest-saws, its surface is rough. It will have the marks of the saws upon it, it may be gritty and disfigured, and it may be in wind or out of truth. It is therefore passed through a machine, in which cutters act upon it in the direction of its fibers or grain. The edges act to pare away the surfaces, taking off chips, and not dust. A class of machinery, therefore, very different from the

saws results from this difference in the direction of the grain relatively to the cutters. The cutters will be fewer in number, but with longer face; the feed-motions will always be by power, and special devices for steadying the work and preventing splitting will be necessary. Where, beside the production of surface, the tool must bring to exact plane dimensions, a carriage or dimension-planer will be required. For ordinary board work, which is yielding, a surfacer is used.

Surfacers may be of two kinds: the bed may be stationary while the stock passes over it driven by feeding-rolls, or the bed may travel under the revolving cutter, carrying the stock with it. The larger tools are of the first class, with stationary bed; many small ones are now built with the traveling bed. There is also a difference due to the method of adjusting for thickness; the rolls may rise or the bed may fall. The surfacing-cutters are knives of a length suitable to the size of the machine, which are bolted to flat surfaces on a cylinder. This cylinder is made to revolve rapidly, while the stock passes against the revolving edges. These knives are of an appearance and shape shown by Fig. 418. The slots are for the bolts which fasten the knife to the cylinder. In that form there is

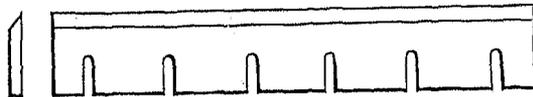


Fig. 418.

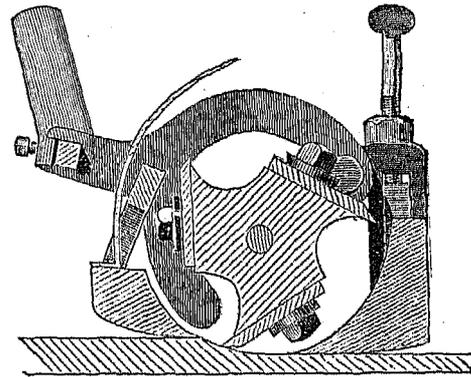


Fig. 419.

chance for adjustment, as the knives are ground narrower. The cylinders carry either three or four knives usually. The flats for the knives are shaped so as to act as a cap or chip-breaker. The cylinder is made of forged steel in the best practice, all in one piece. Very good results are obtained by the use of wrought-iron bodies, into which the spindles are forced or shrunk, and one builder casts the body around the spindle, using a so-called welding compound to effect the joint. The planing of T-slots in the faces of the cylinder for the heads of the knife-bolts is best practice. Many builders plane slots in two sides, and have the other two sides with tapped holes only. Some have no slots, but tap all holes. This obliges all knives to have equally-spaced slots, and twisted bolts or stripped threads are serious annoyances. This cylinder, with its knives, is driven at 3,000 to 4,000 revolutions per minute. Inasmuch as the cutters turn against the incoming stock, some form of pressure-bar is required to prevent the splitting of the surface in front of the cutter and to steady it after it leaves the cutter.

Fig. 419 illustrates an approved form of bar on each side of a three-knife cylinder. The stock is moving from left to right, while the cutting-cylinder turns in the direction of the hands of a watch. The front bar rises upon an arc of a circle around its pivot, behind the knife. This pivot is raised with the adjustment of the cylinder-boxes, and the bar always swings in an arc close to the cut. Some use a roll for a pressure-bar and have a separate pressure from the shaving-guard to serve as chip-breaker. The rear pressure-bar is either stationary or rises and falls beneath rubber compression-springs, which are adjustable. Some claim a yielding bar produces waves in the surface. Weighted levers are used for the front bar in most frequent practice. In the design of Fig. 432 the pressure-bar is pivoted on the outside of the cylinder-boxes, so that the lip of the bar is always one-fourth of an inch from the cutting-edge of the knife. A handle rests on the feed-rolls to prevent an extra-thick piece from catching on the corner of the pressure-bar. A few use rubber for the front bar as well as for the rear. In another design the bars rise and fall in grooves struck from the cylinder center, and so keep the bars close to the cut. The reason for seeking the closeness of these bars is that the knives may cut short pieces without striking the first end or spoiling the last end. The machine with this latter device has planed a 2-inch square of black walnut, and has reduced a slip of white pine from nine-sixteenths to one-sixteenth of an inch.

A few use a large friction-roller under the knife, to relieve the friction due to the downward pressure of the cut. This is opposed by some of the best builders, on the ground that the board bends over the roll if the latter projects enough to be of any use and the work will not be true. That this pressure downward is considerable may be proved by the fact that the tables are apt to wear hollow at that point. The design of Fig. 420, which is shown in detail by Fig. 421, and to which also Fig. 419 belongs, has a false plate below the cylinder, which may be renewed when worn. Often a strip of steel is let into the table at that point.

Fig. 421 shows one method of connecting the boxes at the two ends of the cylinder. The cylinder and knives in the first class of machines, with roll-feed and stationary table, must have a vertical adjustment for different thicknesses of work. The boxes, therefore, are fitted to move up and down and clamp in planed ways. This vertical adjustment is effected by screws, which are geared together by a shaft across the bed with bevel-gears

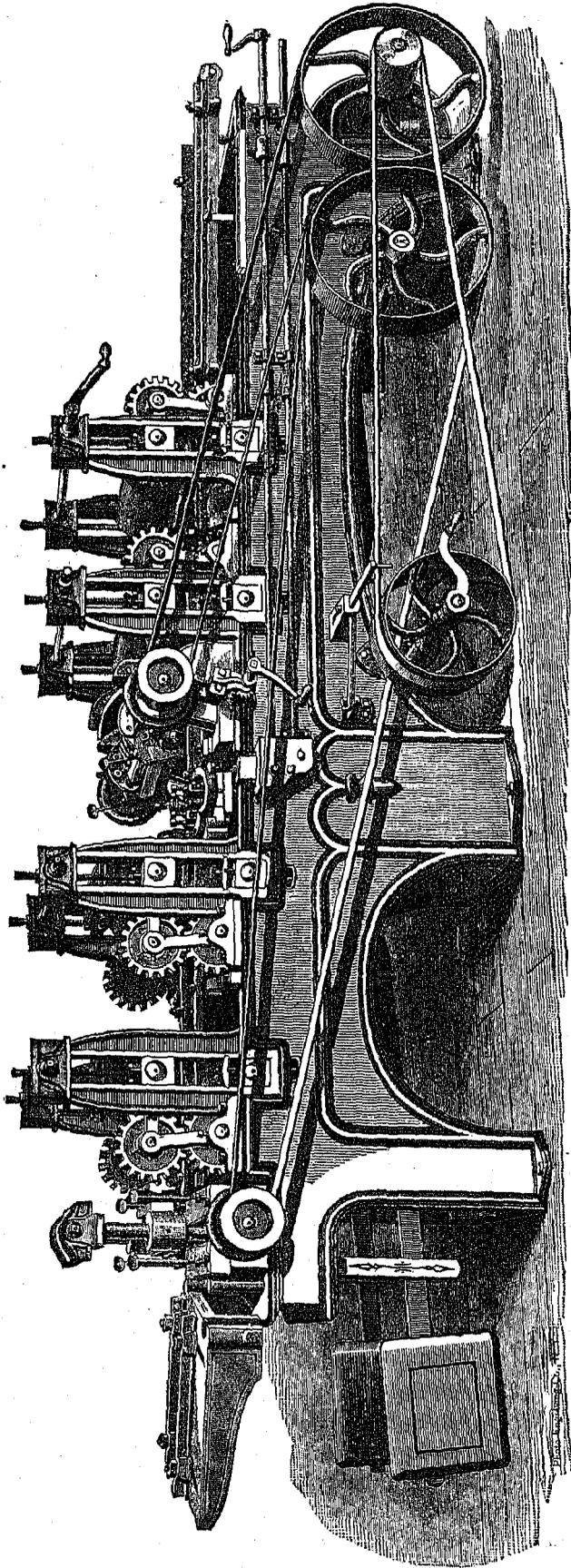


Fig. 420.

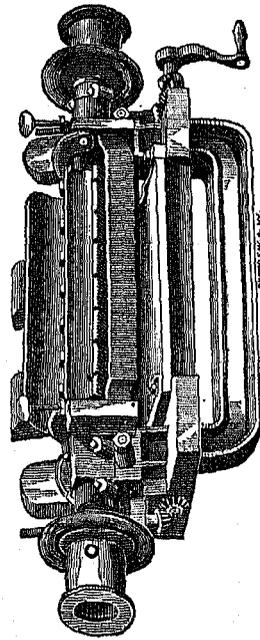


Fig. 421.

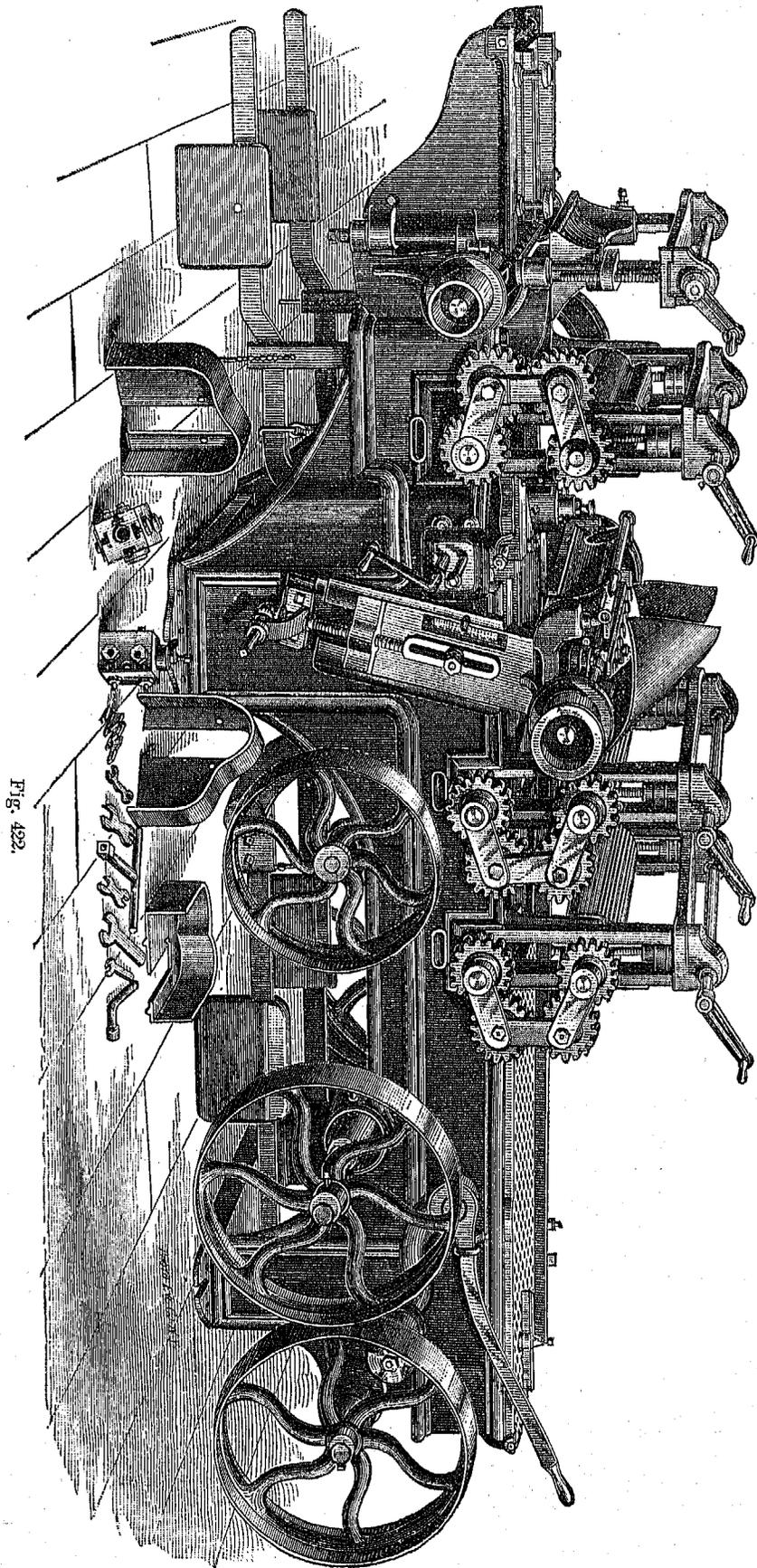


Fig. 422.

Many designers are content to depend upon the screws and the fit of the box-slides to keep the cylinder true and the boxes in line and free from bind; the best practice approves, however, the uniting of the boxes upon a yoke or cross-girt.

Fig. 421 shows the connection below the cylinder; Figs. 429 and 433 show the connection over it. Fig. 422 shows the type of arrangement in which the boxes are united through the screws only. The boxes are borne upon long oblique slides with wide bearing. The yoke below permits easy access to the cutters from above. Otherwise, the yoke must be high, as in Fig. 433, when it must be heavy in order to be stiff. A graduated scale indicates the thickness of the finished stock for each position of the cylinder. Babbitted boxes, with oil-cellers, are almost universal for these high-speeded spindles. In the best practice the babbitt-metal is bored out and scraped to a fit.

The larger types of tools which have been selected for illustration surface on the bottom as well as on the top. For this purpose a lower cylinder is used, driven so as to take a smoothing chip from the stock which passes over it. This lower cylinder in the majority of designs is put near the delivery end of the table. It is so placed that access to it shall be easy. Either the end of the table swings laterally out of the way (Fig. 420), or else the cylinder moves out straight sidewise upon ways (Fig. 434), or the whole roll and projecting table gear may swing. There is usually no adjustment necessary for this roll, and it always takes a standard cut. Its pressure-bars may be, therefore, of the simplest type, either fixed or with rubber springs. The lift of the cut is resisted by a short platen, adjustable by geared screws. In the design of one builder (Fig. 434) the lower roll comes first in the series. There seems a certain logic in this arrangement, especially where the tool is a matcher as well as a planer. The

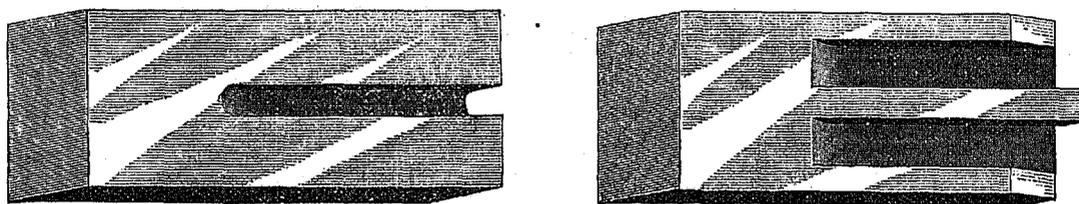


Fig. 423.

Photo-Engraving Co., N. Y.

bottom of the stock is trued first, and from that faced surface as a basis the other cutters operate. Otherwise the first three cuts are made while the stock is guided by an unfinished and possibly untrue lower side. There is less objection to the older arrangement where the tool is a planer and surfacer only. The lower cylinder is most usually driven from a belt-wheel on the machine, which is turned by the friction of the belt to the upper cylinder (Fig. 420). The large wheel of the former pair acts as a kind of guide-pulley to the belt of the latter. The cylinders are driven from both ends in the best and largest types.

To secure largest output and income from a machine demands that it shall surface all four sides of rectangular lumber by once passing it through the machine. Therefore, beside the upper and lower cylinders (Fig. 422), there

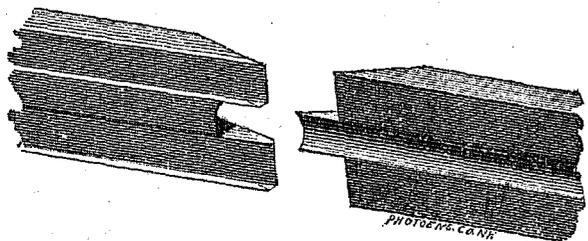


Fig. 424.

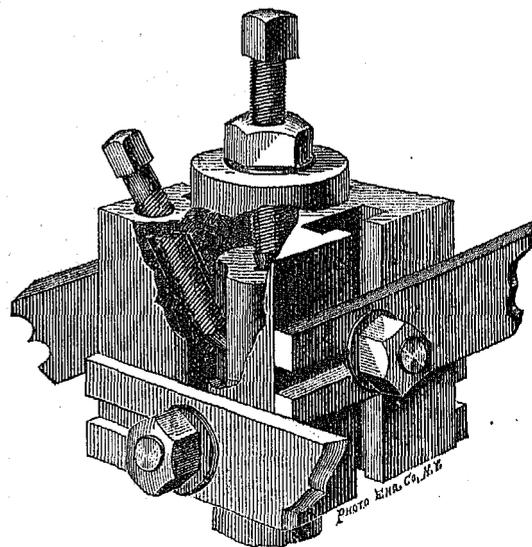


Fig. 425.

will be two vertical cutter-heads for operating on the vertical edges of the stock. These lie usually between the horizontal cylinders, and are driven by quarter-twist belts from a long drum or wide pulleys on the shaft at the extreme right. These belts are inside the bed, and some builders have special devices to keep them from overlapping. For board-machines there may be plain, narrow cutters, or there may be matching-cutters, to produce a tongue on

one side and a groove on the other. These matching-cutters may be milled from the solid (Fig. 423) or may be of the sectional type (Fig. 424). The general construction of an approved form of side head is shown by Fig. 425. It is here shown for molding-cutters, but any form of cutter may be used. The set-screw, which confines the head to the spindle, enters obliquely from the top, instead of radially from the side. The taper-point enters the spline and wedges the head fast without burring up the spindle.

Fig. 426 shows the more usual form, with radial screw. It is shown mounted upon a convenient device for insuring the proper adjustment of the cutters before the heads are put in place. When working upon thin boards, and especially upon brittle kiln-dried lumber or knotty and cross-grained stuff, the side heads are liable to split

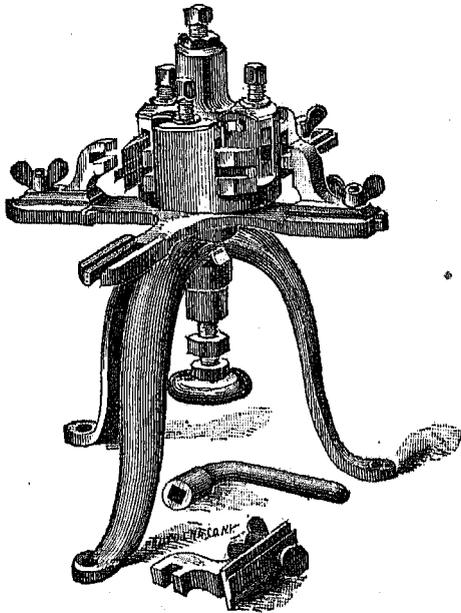


Fig. 426.

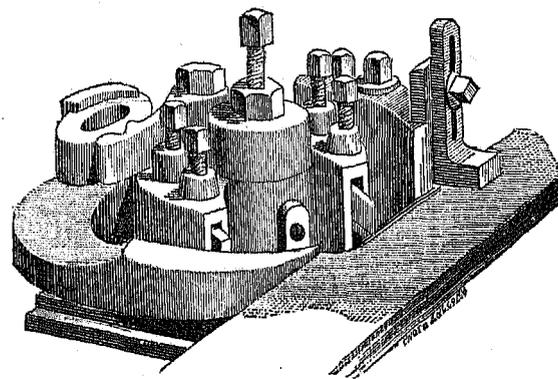


Fig. 427.

off slices or make a rough cut. To avoid this a side-pressure bar is used, consisting of a lever pressed by a spring in front of the cut, or in a patented design (Fig. 427) of a hinged chip-breaker, pressed against the side of the board exactly as the top pressure-bar of the same builders (Fig. 419). It is claimed that higher feeding-speed is possible with a device of this class. Both side heads act at once in planing- and matching-machines. It becomes

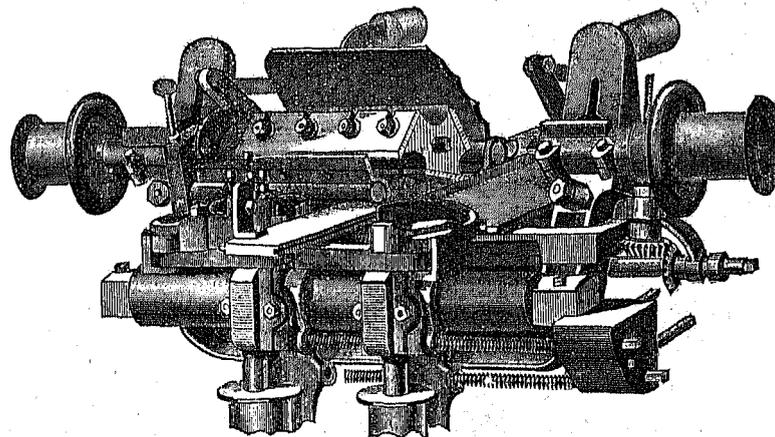


Fig. 425.

necessary to have the side heads adjustable laterally for standard widths of stock. This is effected usually by having the boxes for these side heads movable laterally. The boxes are upon slides, which are gibbed to transverse ways, and the slides may be set at any point by screws from the sides (Fig. 428). In some older designs the two heads were on one right and left screw, which moved both equally from the center. It is approved now to have each head controllable by a separate screw. The whole width of the planer-knives may be dulled before regrinding is necessary, and the bed does not wear so hollow in the middle. The lower boxes in the best practice have a special separate lateral adjustment to bring the spindles truly perpendicular or at a desired angle to the table, and there will be a slight vertical adjustment for exact setting of the cut. A steel tail-screw supports the foot of the spindle. When desirable to surface over the whole width of bed, the side heads in the design of Fig. 429 and many others may be lowered together out of the way by the rack and pinion device shown. The side heads themselves are made of gun-metal in the best practice.

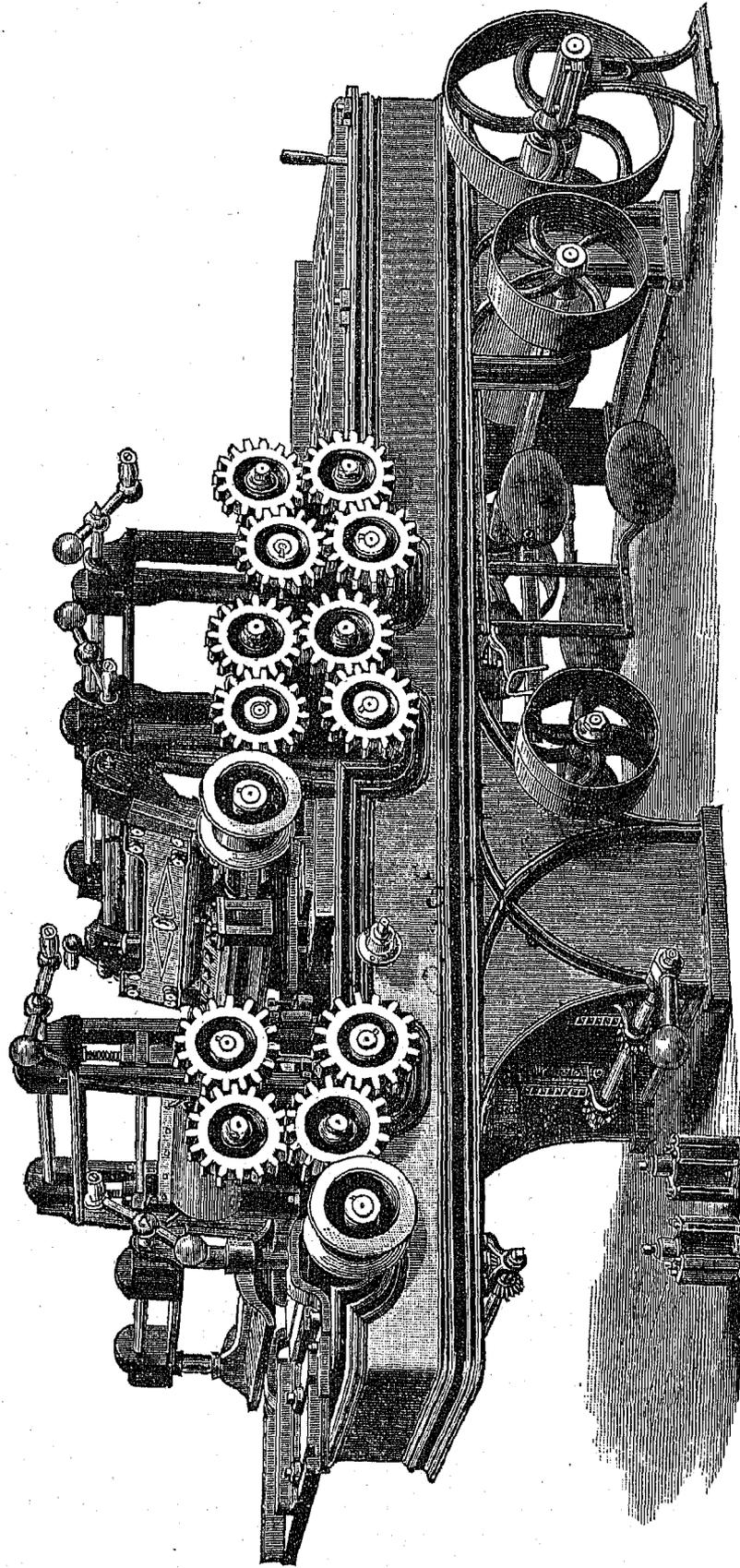


Photo-Engraving Co. N. Y.

Fig. 429.

Fig. 430 shows the application of a small cutter-head at the extreme end of the machine, for beading or working up novelty siding. It will be driven from the main cylinder. This may be applied to any of the designs if called for.

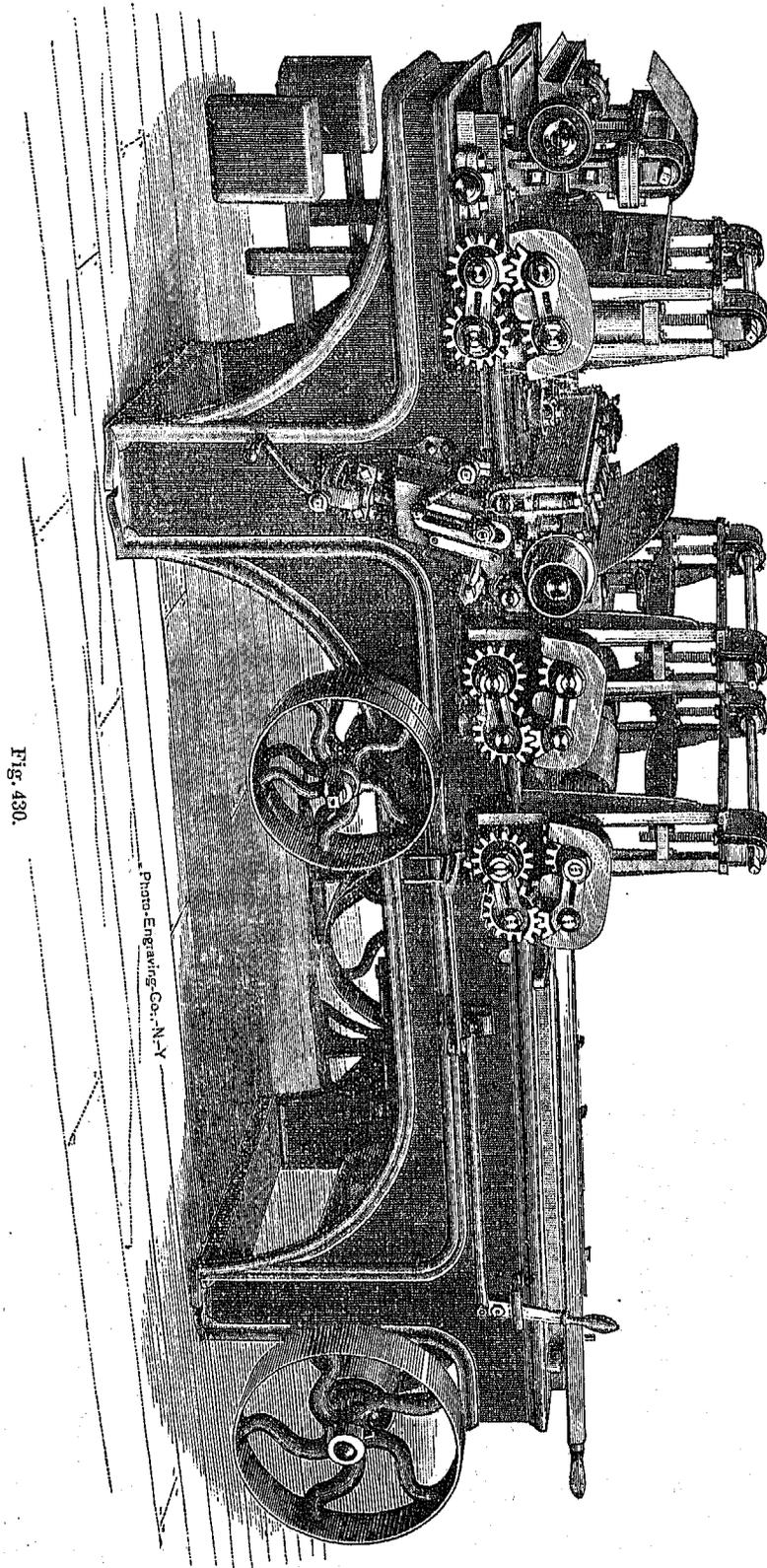


Fig. 430.

Photo-Engraving Co., N. Y.

Since the action of the cutters is very forcible against the motion of the stock, it is necessary that the latter be fed in by power to the knives. In the tools of the class under discussion this feeding is done by driven rolls, which are weighted to grip the stock between them with sufficient pressure. The lower one is stationary, lying

just above the bed, while the upper one is adjustable for great variations of thickness by geared screws, and for slight incidental variations by the yielding of the weighted levers. The lower rolls (of which there may be two, four, or six) are geared together, the first one being driven by a belt from the cylinder usually, or else from the driving-shaft. The feed-belt is often made too long, so as to hang loose, and the feed is engaged by moving a lever which tightens the belt by guide-pulleys. There may be two belt speeds for feeding hard or soft lumber (Fig. 433), and they may have other special devices for reducing the speed or for engaging and disengaging. The cog-wheels which gear the lower rolls together are usually made large, and are on the right side of the machine. They are shielded in best practice. To permit the rise and fall of the top roll as thicknesses may vary is the object of the "expansion gearing", as it is called. In its original and simple form this consists in two idle wheels, which are upon floating pins linked together and to the upper and lower roll respectively (Fig. 422). The driving-motion from the lower geared roll passes through the train to the upper roll in whatever relative position the train may be, and thus a variation of 10 inches of capacity between the rolls is made attainable. The upper and lower roll of course turn in opposite directions. In its earlier forms these links for the gears bore on the axes of the rolls. Better practice fits them to the outside of the roll-boxes, and thus the wear on their fit is much reduced. They are also doubled in good practice to prevent the overhang of the intermediate studs. Most machines are geared at one end only. The machine of Fig. 420 carries the motion across by light shafts swung on the links (Fig. 431). These replace

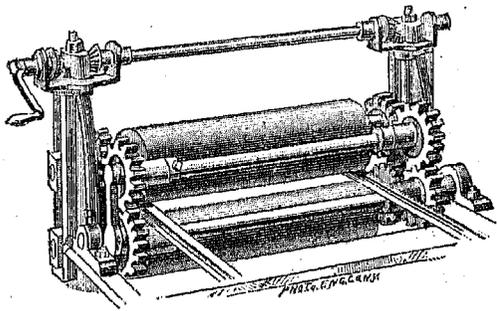


Fig. 431.

the studs of early designs. By this means a very strong and even feed is secured, and there is less danger of the cramping and wear of the gears. But a drawback to this feed-system by simple links is found in the supplementary motion imparted to the upper roll when it rises while revolving. Beside the driving speed it receives an additional rotation from the motion of the axes of the wheels around the centers to which they are linked. Whenever this occurs a variation in feed-speed occurs, and a wave or ripple is made in the work. To avoid this the design of Fig. 429 has the expansion in the upper pair of wheels only. The second wheel from the lower roll is stationary on a stud. The third wheel is upon a stud which has a horizontal motion in a slot, while the fourth wheel is linked to the third from the outside of the box. The first and

the third and fourth are on different vertical planes, while the second has a very wide face.

Fig. 430 shows what is called the Burleigh expansion-gear applied to the rolls, and Fig. 432 shows a similar device for compounding the motion of the third wheel. When the second wheel is lifted the curved slot gives a neutralizing motion to the train.

Fig. 433 illustrates a type of large planer and matcher in which the expansion-gear is partly inside the frame. The lower roll drives a gear upon an arbor, which passes through the framing, and an equal gear on the outside carries up the motion to the upper roll. The same design illustrates a usual type of guide for the stock that any tendency to "slew" may be prevented and to guide the material straight when the machine is used as a molder. There is also an illustration of a type of carriage for use upon grindstones to cause a straight edge on the knives.

In the types selected for illustration of present practice the bed is made of two sides, which are joined together by cross-girts. These sides may each have two or three legs. The cross-braces are bolted to the sides by bolts in reamed holes, and the true fit of the contact surfaces is secured by facing their bearing areas. The rude practice of bolting them together as they came from the sand is very generally condemned. The joints jarred loose, and the bed was not true. One builder, beside facing and bolting the braces, uses steel dowels for further stiffness and security. The most advanced practice tends toward consolidation of parts and casting in one piece as much as possible. Fig. 434 illustrates a departure in this direction. The four cylinders are attached to one central trough-casting, which bolts in place in a hollow of the bed. The lower surfacer acts first. By the system of expansion-gears in two planes the advantages are gained of the use of gears larger than the rolls. The weighting of the rolls is effected by a very neat mechanical device, by which no adjustment of the linkage and levers is required as the rolls are lifted to take in thicker stock. The adjustment also by hand does not need to overcome the feeding-weights, but the latter act immediately when any one roll rises separately. The rolls are lifted by worm and wheel combinations driven by hand-wheel or power. The worms are splined to their shaft, and their motion in one direction is resisted by a collar, while the bent levers connected to the weights press against their other ends. These bent levers hold each other in equilibrium when no pressure is on the rolls, or when they are lifted or lowered together. Should one roll be forced to rise by thicker lumber below it, its rise tends to turn its worm-wheel and to move the worm along like a rack. This rack-like motion is resisted by the weight and bent lever of that roll. The upper and lower cylinders are separately driven by a shaft at each end of the bed. The lower head can slide out upon ways, and the matcher heads have ample adjustment in all directions.

The chief feature of Fig. 435 consists in the use of cutter-heads with nine knives, instead of the usual three or four. The knives are of thin steel, with a cap. This divides the duty of cutting, and enables a high feeding-speed to be used. The standard speed for this machine is 150 feet per minute. The older practice approved from 20 to 50 feet, which is still all that some machines admit of. The feeding-rolls on this machine are large, of 9 inches in

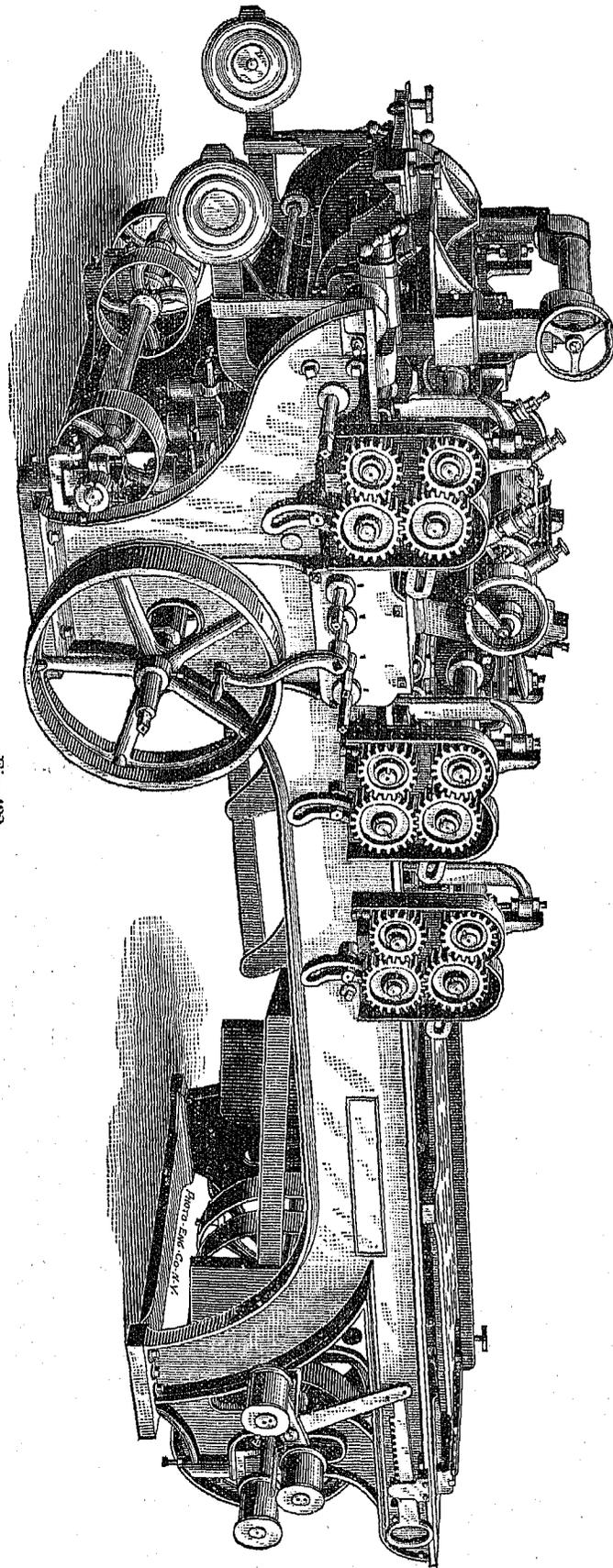


FIG. 432.

Morris, E. & Co., N.Y.

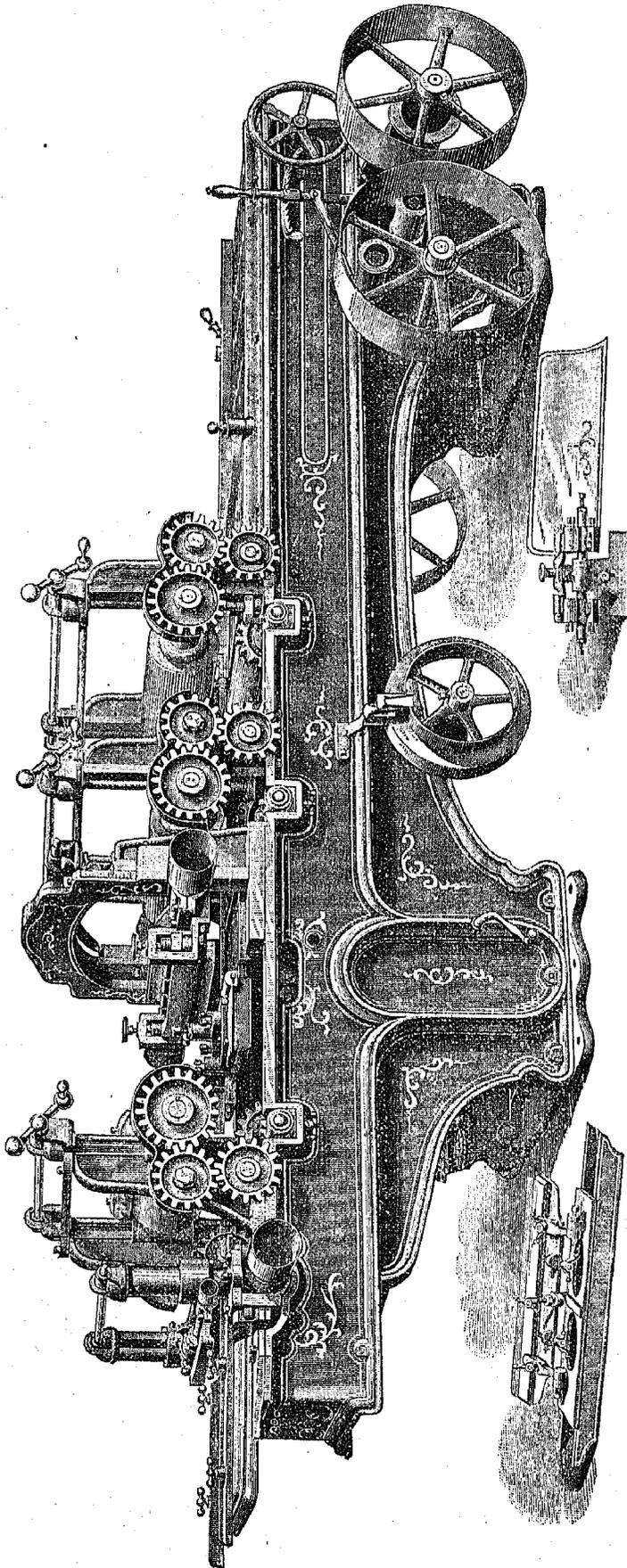


Fig. 433.

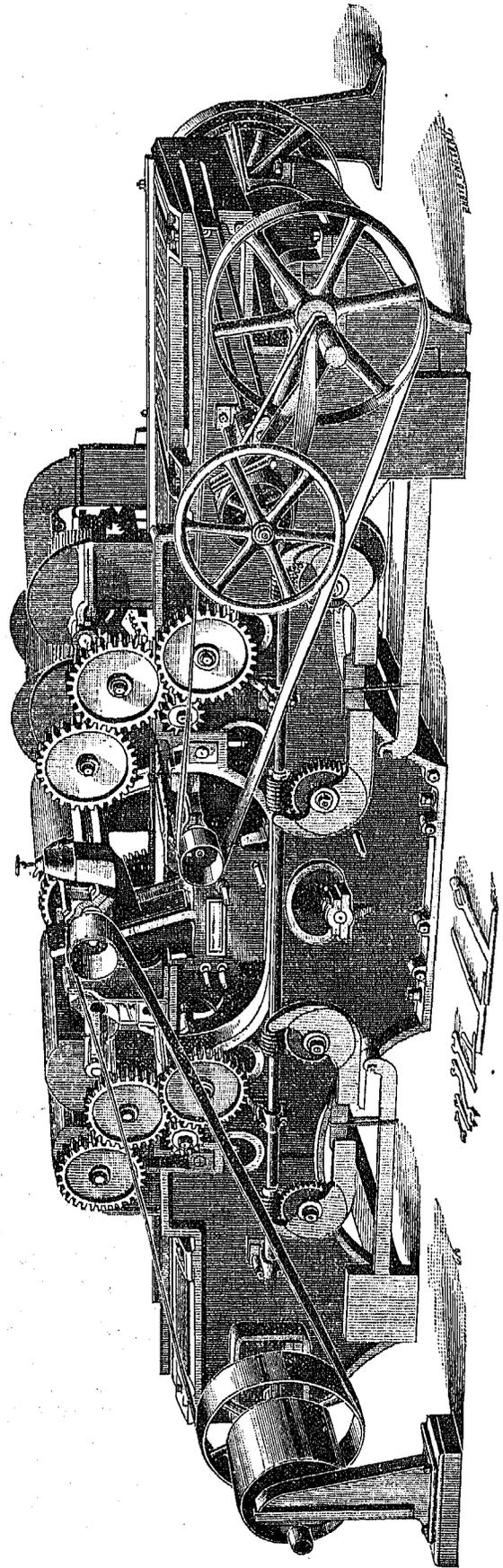


Fig. 434.

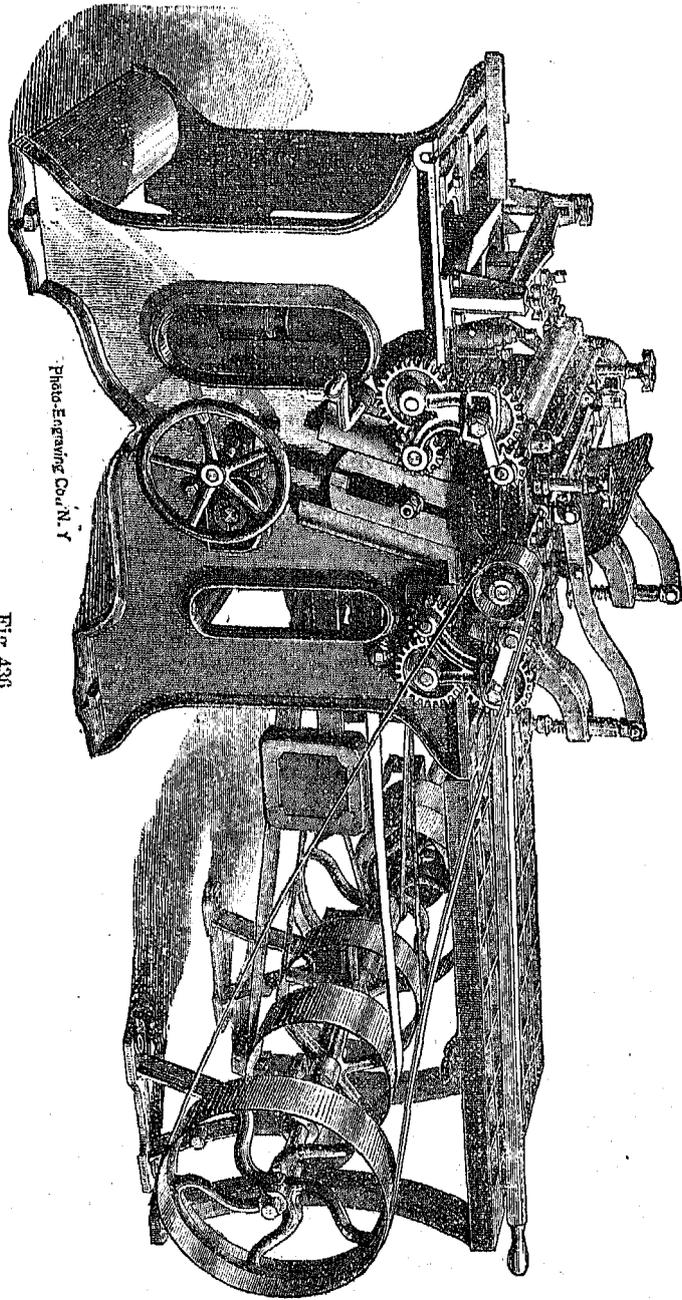


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Fig. 436.

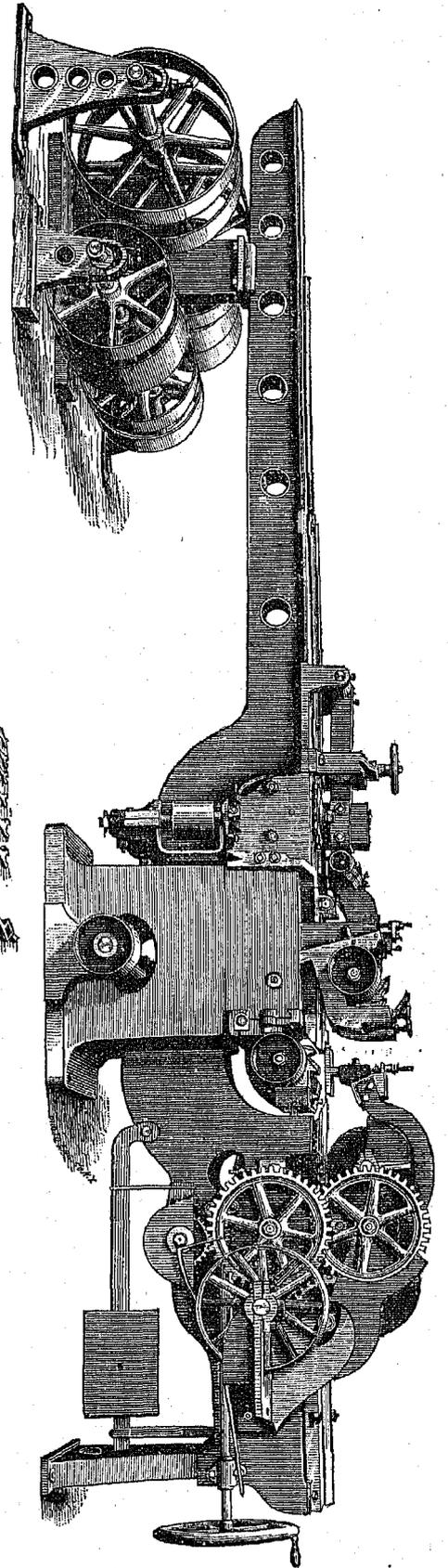


Fig. 435.

diameter, and the upper one is fluted, while the lower is plain. Fluted rolls are usually of small diameter, of 2 or  $2\frac{1}{2}$  inches, in other designs, while a great many use all smooth rolls. One designer, driving the rolls from both ends, divides the rolls in the middle. This permits boards to be fed side by side, even though they may vary in thickness, and thus nearly doubles the output of a surfacing-machine. With solid rolls the thinner board will cease to be fed, because the thicker board has taken off the pressure from it. The rolls driven from one end, from difference in the leverages of the weights, will feed a board obliquely sometimes, which gives trouble at the matcher-heads.

The suppression of many parts of the larger machines selected as types is very usual. This gives rise to a series of simpler and cheaper machines, adapted for special classes of work and special financial conditions. Figs. 436 and 437 show two types of such machines. Fig. 436 is the older form, and shows an especial arrangement of expansion-links. In Fig. 437 the principle of one casting is illustrated. The feed-rolls are driven by worm-gear.

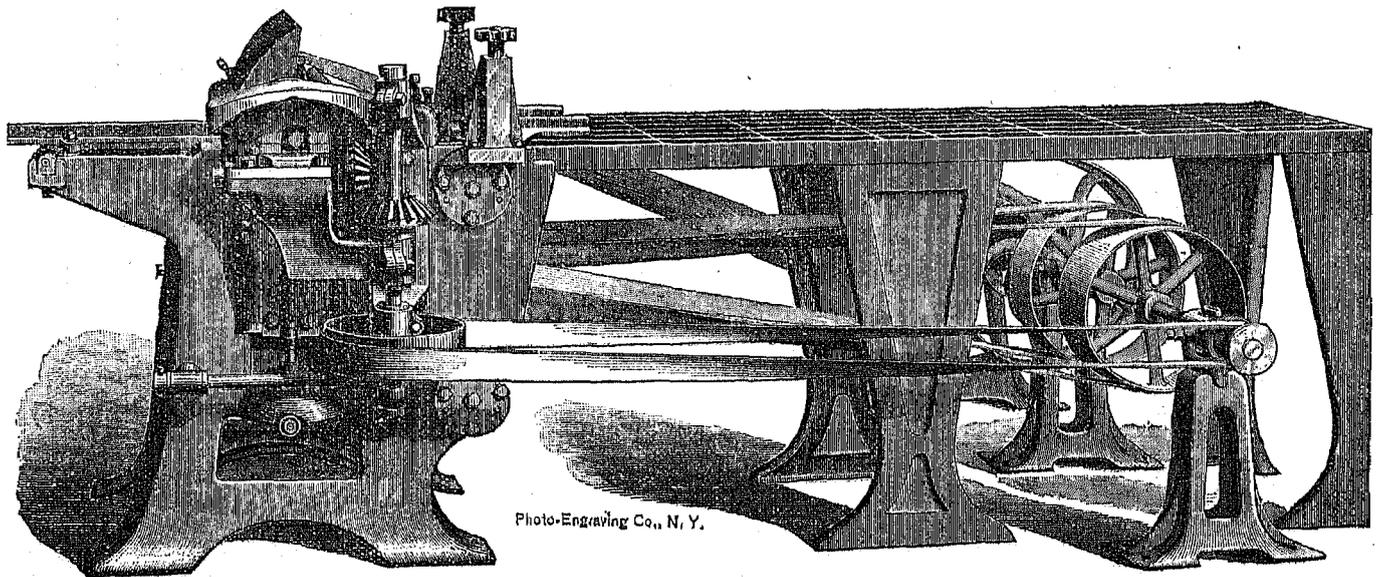


Photo-Engraving Co., N. Y.

Fig. 437.

The knives in both are set with a retreat at one end of 1 inch in 24 inches, so as to give a dragging or shearing cut. This increases the smoothness of the surface in some woods. They require no further detailed allusion. The machines discussed are the successors of those made under the original Woodworth patents, which ran from 1828 to 1856. These patents were for the combination of rotary cutters and holding-down rolls which are required in all designs. The first machines were built with wood frames. Iron frames were introduced about 1850. The decision with regard to the Woodbury pressure-bar claims as further released this type of machinery. The improvements in the later designs over the earlier have been in the direction of greater strength and stiffness of bed and frame, more ample bearing and wearing surfaces being provided, and steel is more largely applied. The capacities of the machine have been enlarged. The feed-rolls will expand for lumber from one-fourth of an inch to 10 inches. Timber, 8 by 8 inches, can be faced on all four sides in new machines for such work as that for which the elevated railways are calling in the cities. The output of the machine has been enormously increased. Records are accessible of 55,000 feet of  $1\frac{1}{4}$ -inch lumber planed on two sides in eight and a half hours. The lumber was from 8 to 11 inches wide. Ten thousand feet of lumber of similar width and 1 inch thick has been planed on one side in one and a half hours. It is claimed for the machine of Fig. 435 that it will surface 40,000 feet on four sides in ten hours, if not more, on a trial. These are great advances on the performance of earlier days, and may be taken as indicative of the rapid progress which has made possible such an increase in productiveness.

#### § 43.

#### ROLL-FEED SURFACERS.

To meet a want for a machine which should be rapidly adjustable in miscellaneous shops the roll-feed planers, with lowering bed, have been introduced. The bearings of the upper cutters are fixed, and the rolls have only rubber adjustment, if any at all. The variation for thickness is obtained by lifting and lowering the whole bed or table by a crank or hand-wheel. The separate adjustment of the series of rolls is entirely avoided, the machine becomes much shorter and more compact, and a stiffness and solidity is obtained for the upper cutters which has commended the system very widely.

Fig. 438 illustrates a double surfacer and matcher of this kind. The whole bed is guided by long ways in the center, and is raised and lowered by screws geared from the hand-wheel. The lower rolls drive the upper through expansion-gear, and a tightener takes up slack from the under cutter. The matcher-heads adjust themselves with the table.

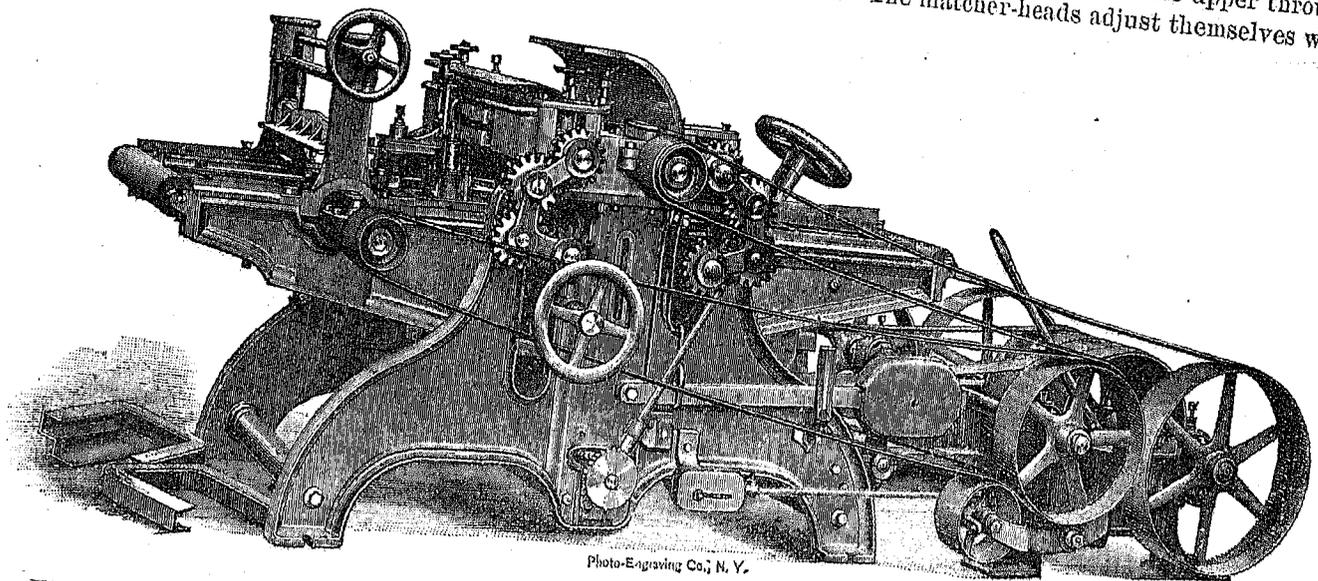


Photo-Engraving Co., N. Y.

Fig. 438.

Fig. 439 illustrates a machine with both cutter-cylinders belted from one belt with tightener. The bed and all the feed-works give an adjustment for thicknesses between one-sixteenth of an inch and 3 inches. There are six rolls geared together expansively, the feeding-out roll carrying the stuff completely through. It swings out of the way to permit access to lower head. There are three changes on the cone-pulley of the feed-shaft.

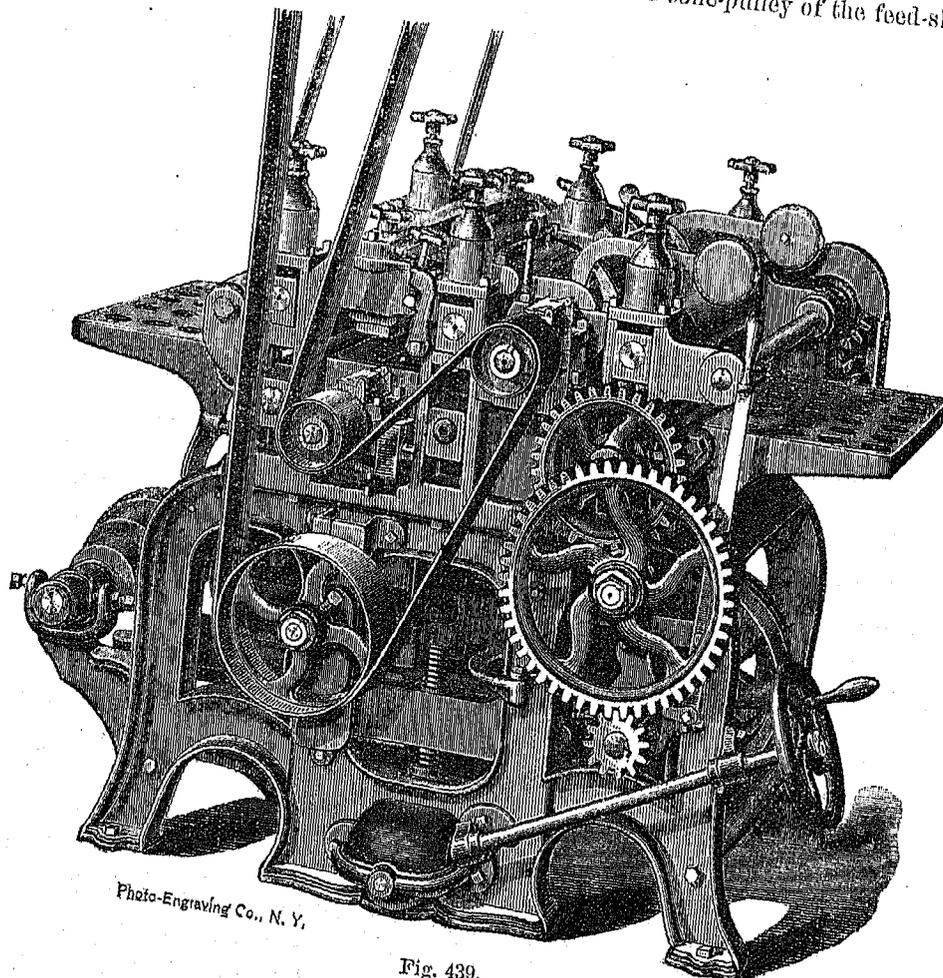


Photo-Engraving Co., N. Y.

Fig. 439.

Fig. 440 shows a type of machine for upper surfacing and matching. After the long table has been set, the farther end may be clamped from swaying. It is raised with the central part by having its screw geared to the others by bevel-gears. There are four feed-rolls, and the counter-shaft is held on the lower extension of the machine. The feed-gear is engaged by tightening the loose belt.

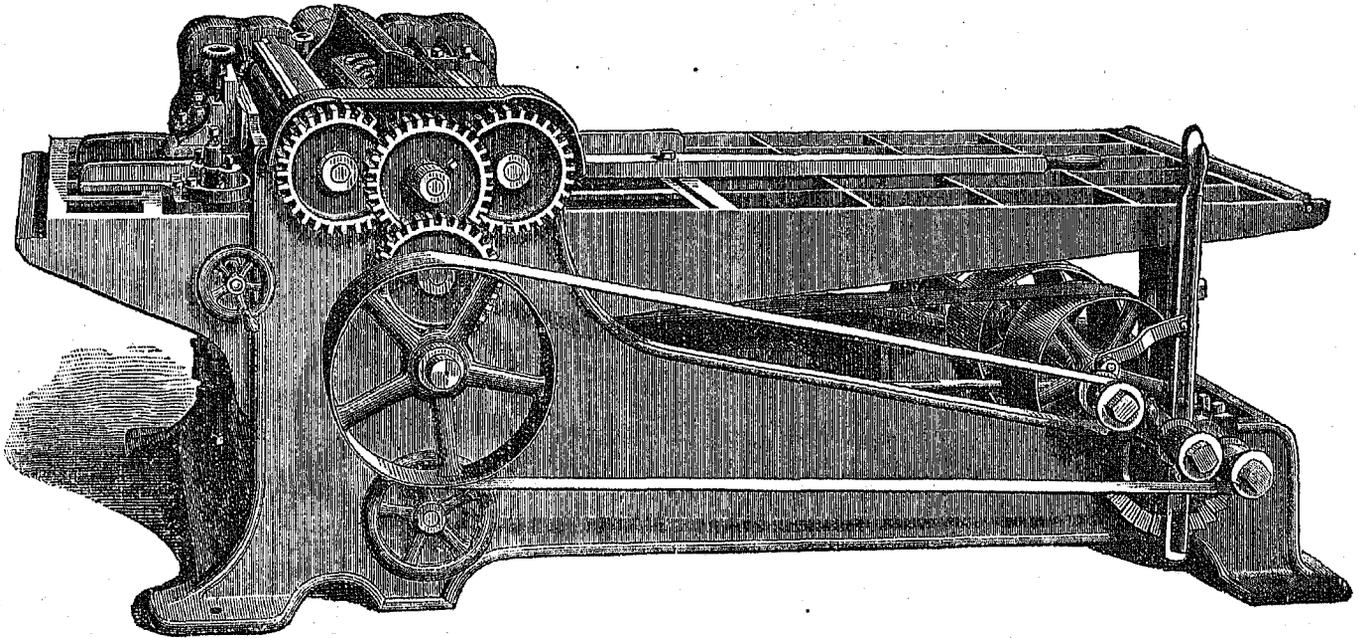


Fig. 440.

Fig. 441 shows a machine of excellent construction. The bed rises and falls by inclined planes, worked by a screw from the hand-wheel. One revolution of the wheel lifts the table one-eighth of an inch. The machine has capacity from one-sixteenth of an inch to  $6\frac{1}{2}$  inches. The feed-rolls are driven by heavy gearing, which may be arrested instantly, and which permit two changes of speed. So powerful is the feed that half an inch may be taken off at one cut. The pressure-bars move in grooves concentric with the cutter-head, so that pieces of 3 inches in length may be planed without clipping the ends. The journal-boxes are self-oiling by a strip of felt put in a groove in the babbitt. The journals are long ( $7\frac{3}{4}$  inches), and are belted at each end. Such machines will take in lumber up to 48 inches wide.

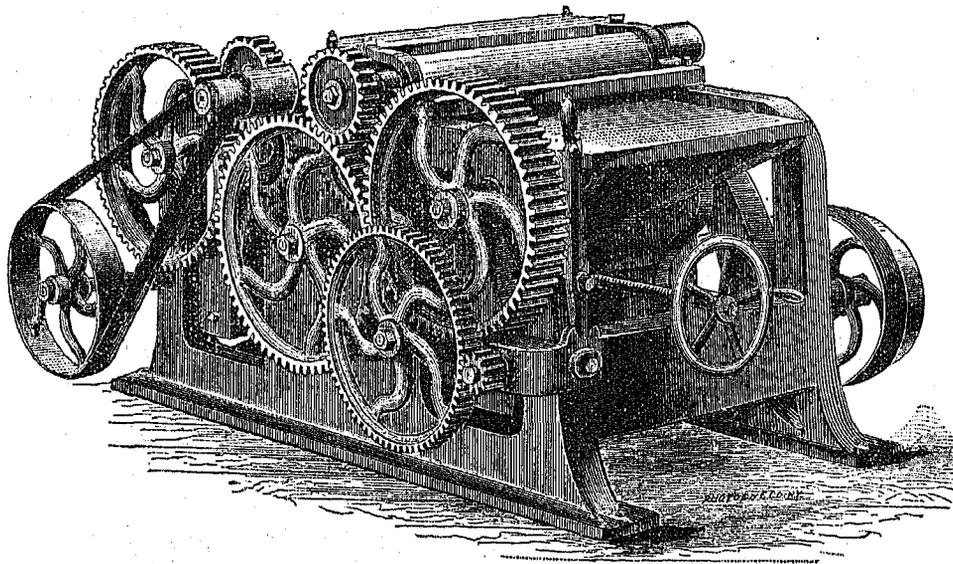


Fig. 441.

Figs. 442 and 443 show a very prevalent type of single surfacer, which is often called a "pony" planer. One shows rubber springs for both upper rolls, and the other has weights for the front one. The feed is controlled by tightening the belt. The adjustment for thickness is made by geared screws.

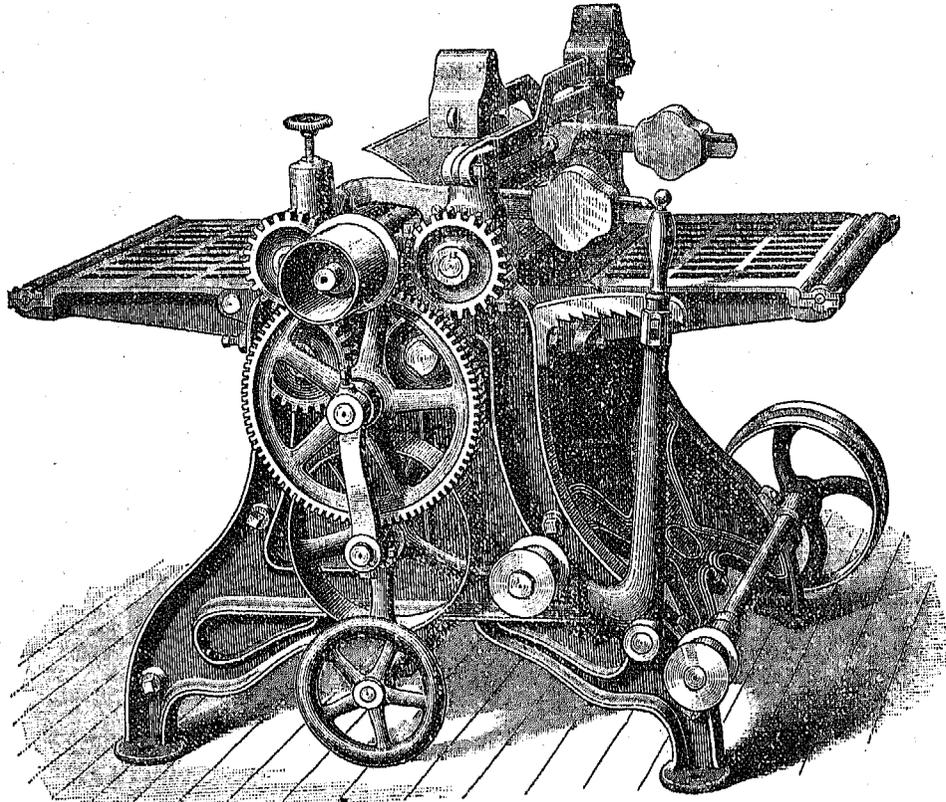


Photo-Engraving Co., N. Y.

Fig. 442.

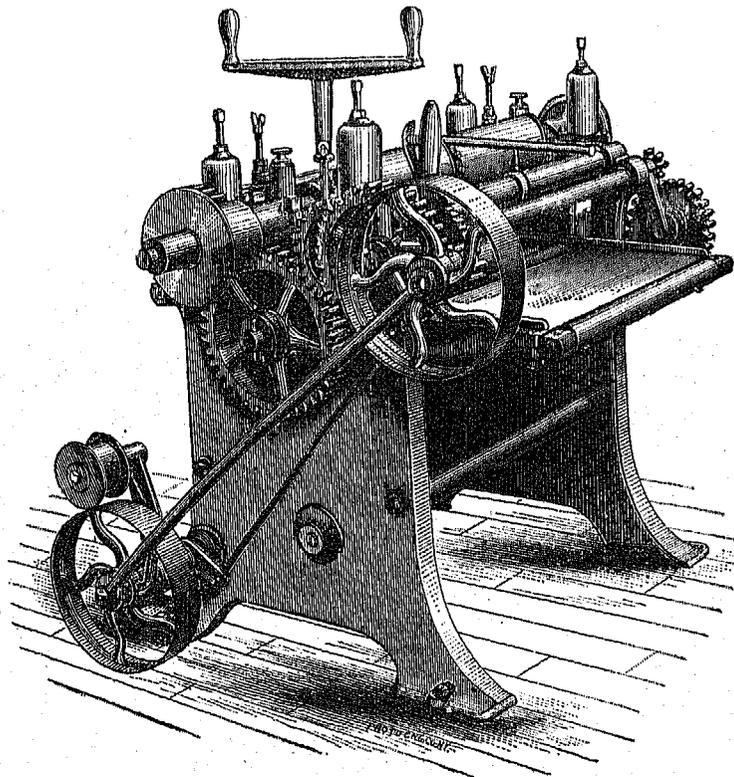


Fig. 443.

Fig. 444 illustrates a very compact pony planer, or panel-planer for finer and more exact work of short length. The bed adjusts for lumber up to 4 inches thickness by the hand-wheel. The rolls are driven by a neat application of the brush-wheel friction. The position of the driver is controlled by a lever, with a latch locking into a sector.

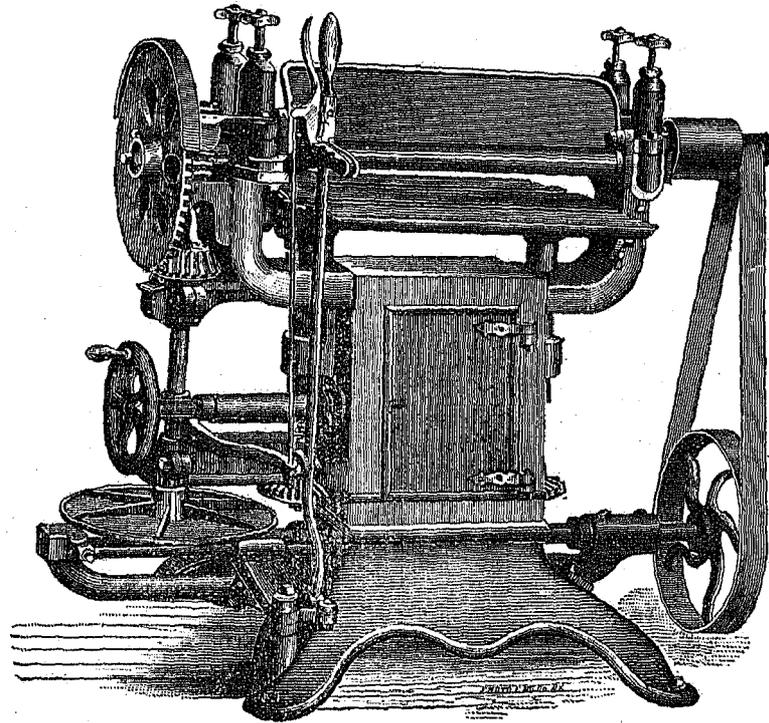


Fig. 444.

An ingenious release of the friction when the feed is to be shifted or reversed adds further to the excellence of the device. The opening of the latch lifts the face-wheel, and the weight of the latter acts as a latch-spring. A variation of feed between 20 and 40 feet is thus possible. For certain purposes, it is desirable that the cutter should act

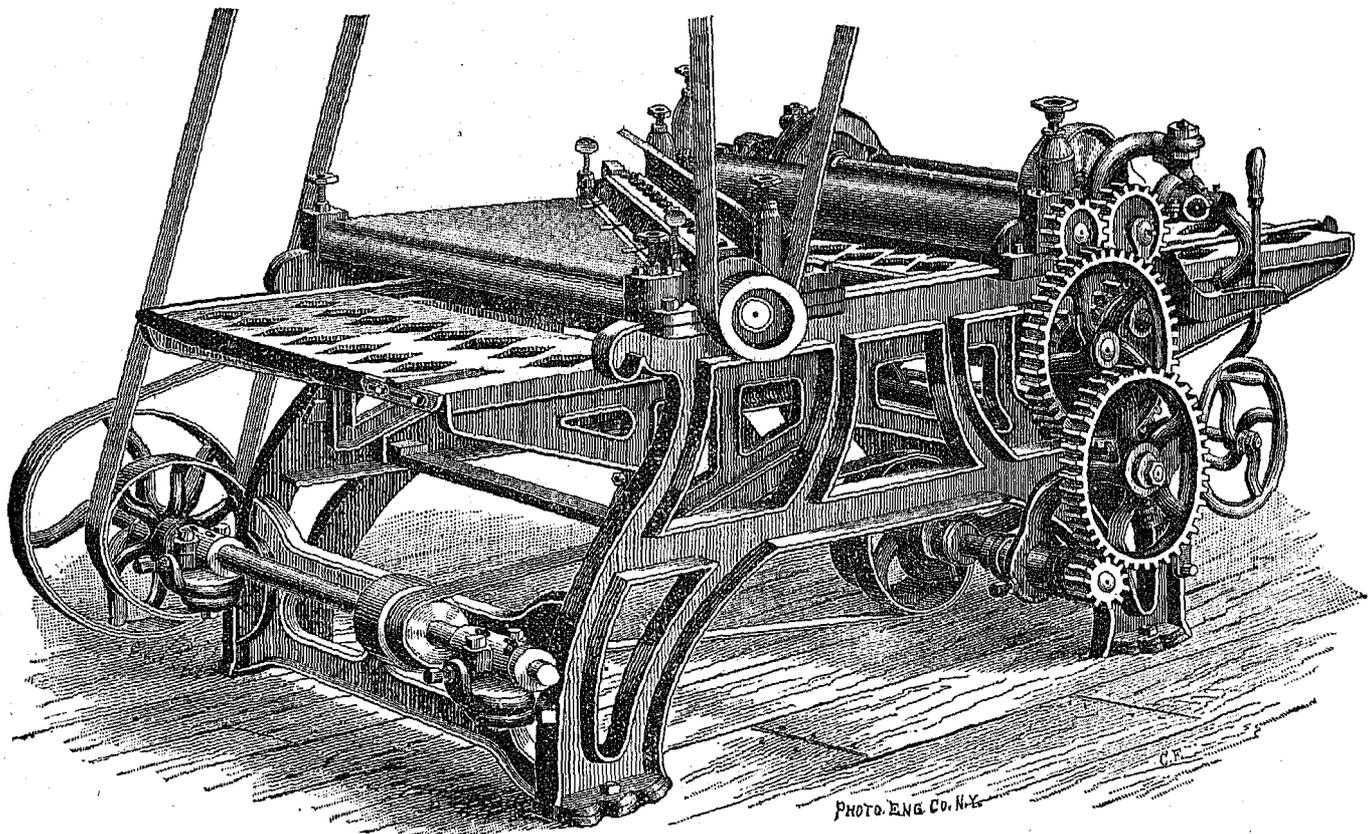


Fig. 445.

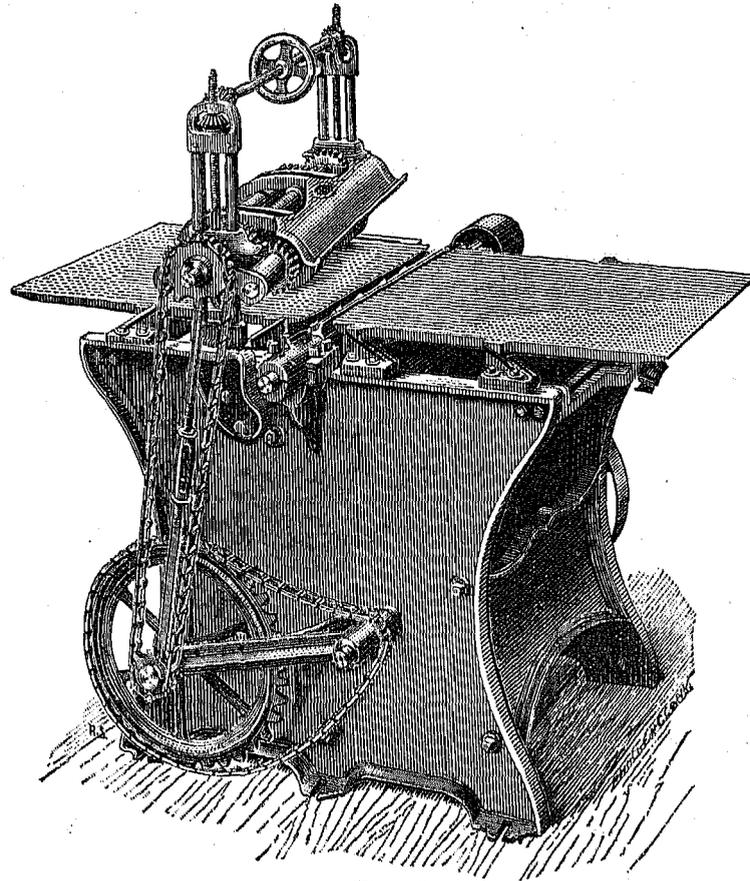


Fig. 446.

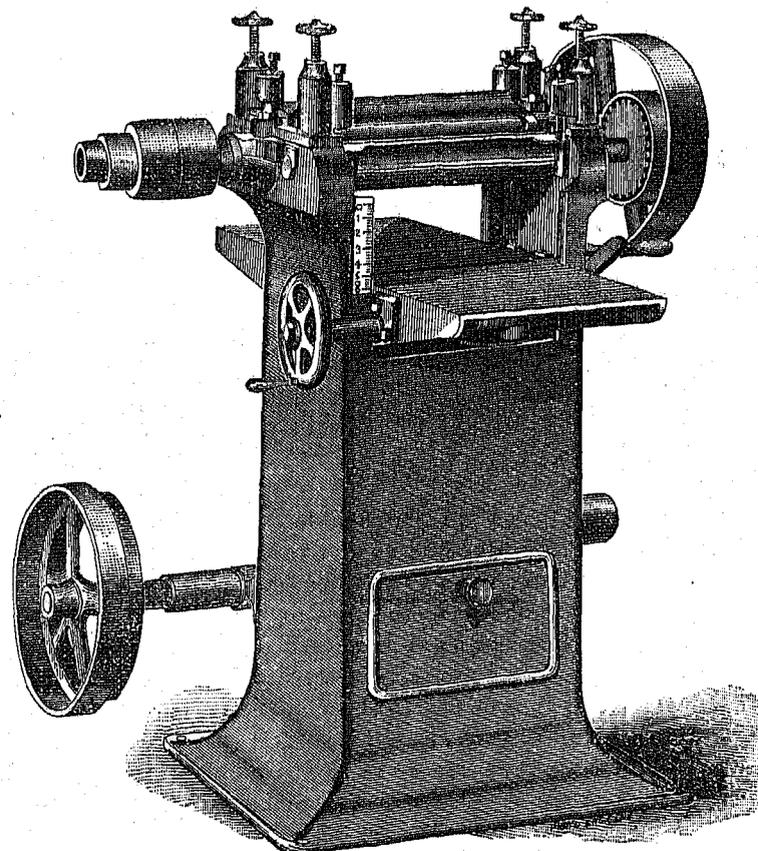


Fig. 447.

diagonally upon the stock presented to it. This is especially desirable for work made up of lumber with the grains running both ways, as in doors, shutters, and paneled work. Fig. 445 illustrates such a machine, with a capacity for 500 doors per day, working one door of 7 feet in length on both sides per minute. Tenons, wedges, etc., are cut off by adjustable saws at the work end, and the table adjusts for thickness by inclined planes. To counteract the variation in thickness of rails and muntins the pressure-bars have independent adjustments, that they may bear equally with requisite pressure on all parts of the surface. There are two changes of feed, disengaged at will.

Fig. 446 shows a diagonal planer, with feed by gearing-chain, using rubber bands on the rolls. It may also be used as a straight buzz planer. The great simplicity of Fig. 447 results from the arrangement for moving the table. The table is borne by a large round pillar, which fits inside the standard. A screw of gentle pitch is cut on the pillar, and a nut which fits it is revolved by a worm on the hand-wheel shaft. The screw on the pillar lifts and lowers, and the tangent gearing acts as a clamp. Pony planers or surfacers of this class are very useful and popular for small, short work, and for sized pieces. Long work would overhang too far to permit accuracy.

#### § 44.

#### ENDLESS-BED OR TRAVELING-BED PLANERS—FARRAR OR LAG-BED PLANERS.

By the above names is known a large class of machines adapted for heavy and rapid surfacing. They appear in two general forms.

Fig. 448 shows the type in which the cutter-head and bars rise and fall, while the bed has no vertical adjustment.

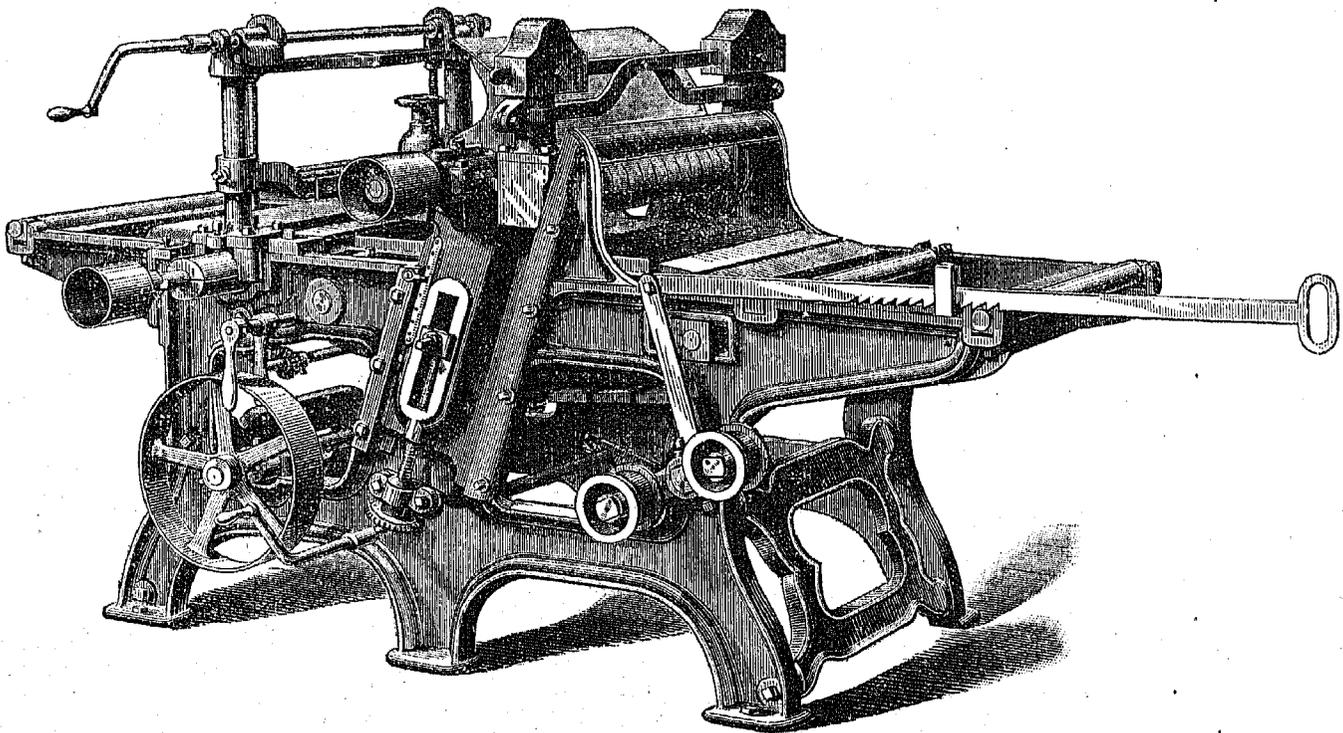


Fig. 448.

Fig. 449 illustrates the type with fixed head and adjustable bed. The latter type is the prevalent one, on account of the rigidity and stiffness which the fixed boxes give to the upper cylinder. The other system offers advantages when double surfacing is to be done. The stock is fed to the cutters by the motion of the bed on which it rests. This bed is made of slats or lags, linked together into an endless belt sidewise and driven by sprocket or polygonal wheels within the bight. These lags are supported upon longitudinal ways beneath the cutters. There are either two, three, or four of these ways. Against the three-way system the objection is urged of excessive wear on the middle one. There are two at the ends of the lags and one midway between them. The bulk of the pressure on the lumber is borne by this third way, since the stuff is instinctively presented centrally. On wide lumber the flexure of the thin lags will cause the surface to taper to one side after the machine has been in service for some time, or produce uneven thickness when the machine is changed from narrow to wide stock. To prevent this objection the two-way system is preferred by some excellent builders.

Fig. 449 shows a detail of the lags. They are cast with a deep web, to prevent flexure between the ways, and the latter are brought nearer together by linking the lags outside of them. Against the two-way system is the objection that it is possible for the lags to be lifted against the cutters by a pressure at their ends. This cannot happen, however, when the two ways are at the extreme ends.

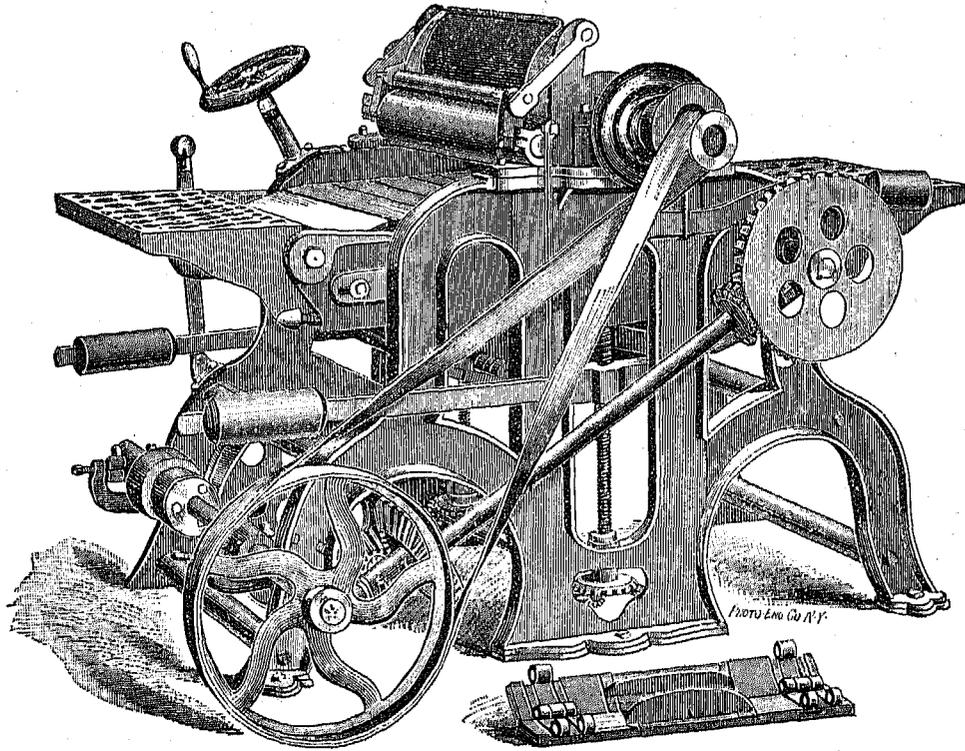
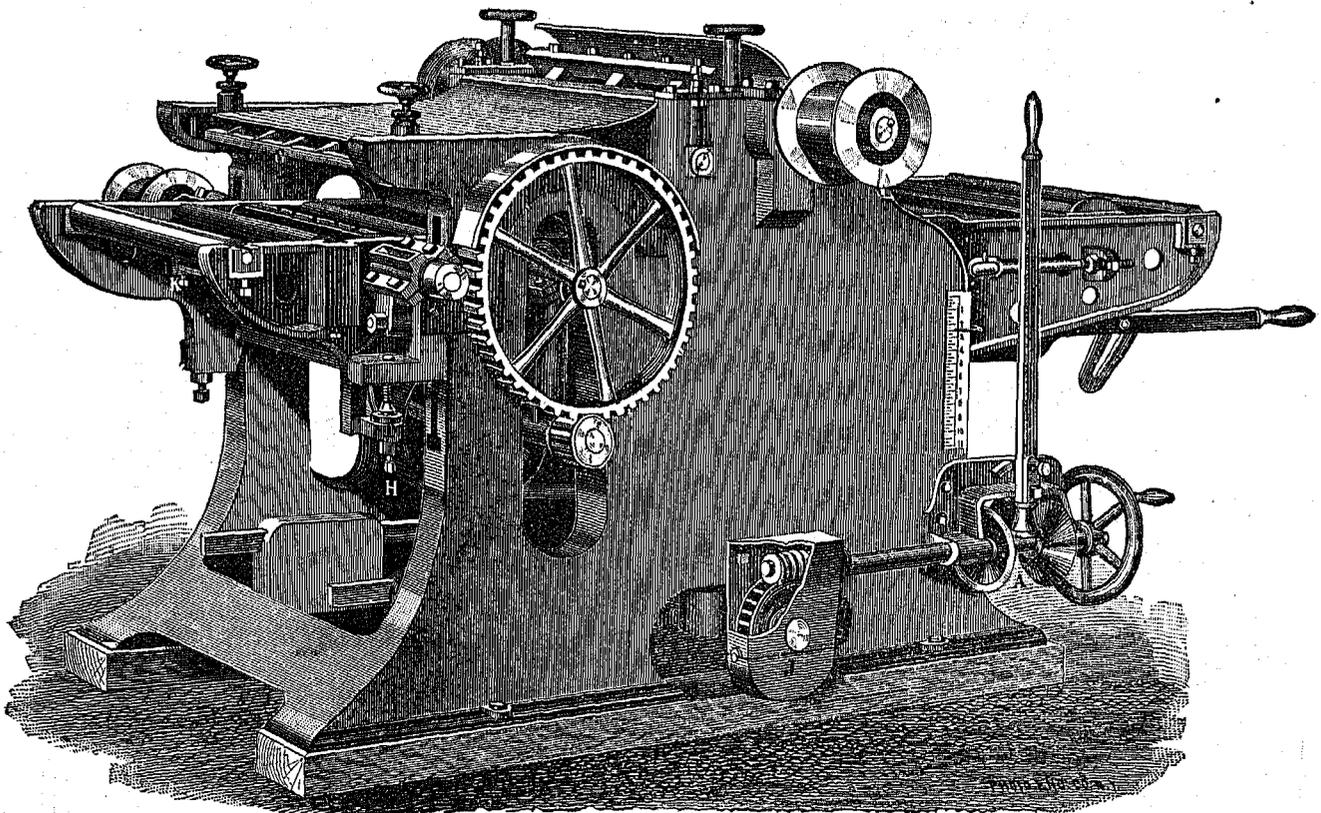


Fig. 449.

Fig. 450 illustrates a machine with four ways to counteract this latter danger and distribute the wear. The ways are provided with oil-cellars, which lubricate the lags as they pass over saturated fibrous material. The lower



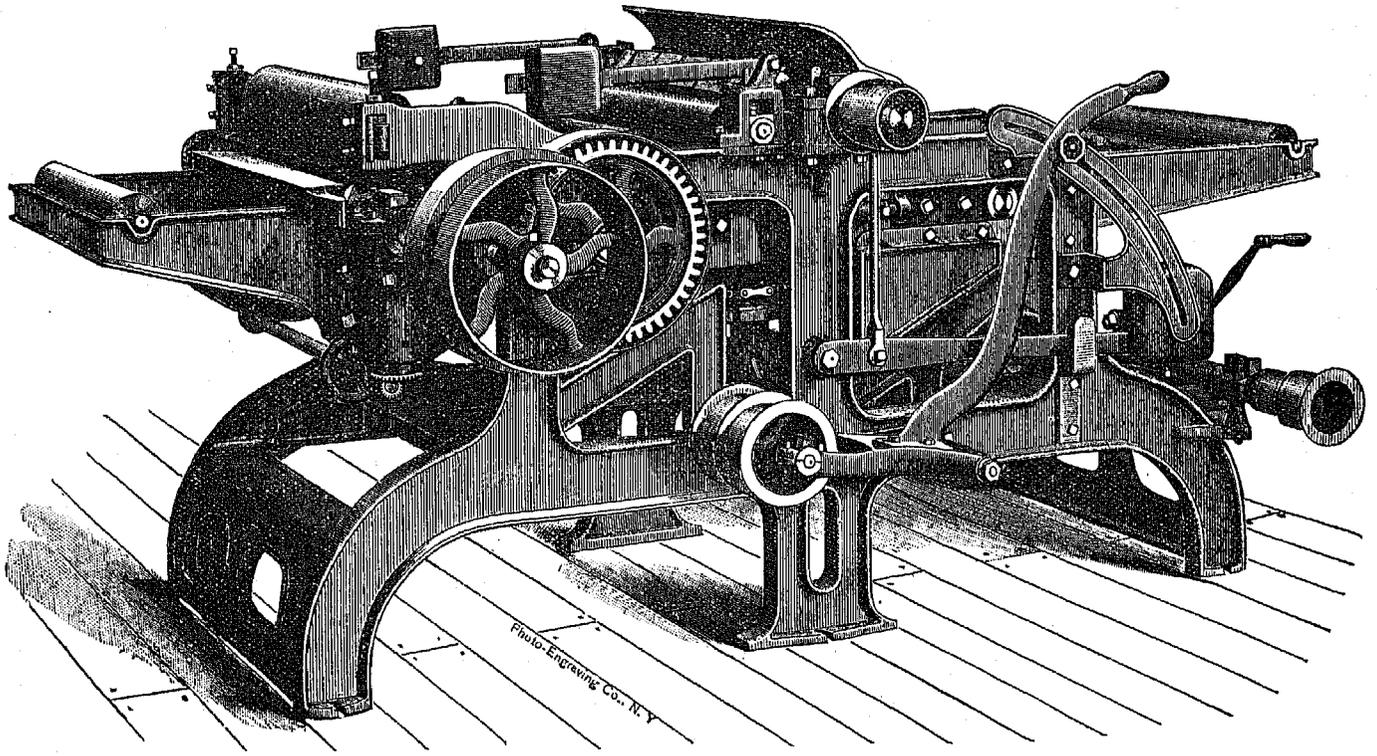


Fig. 451.

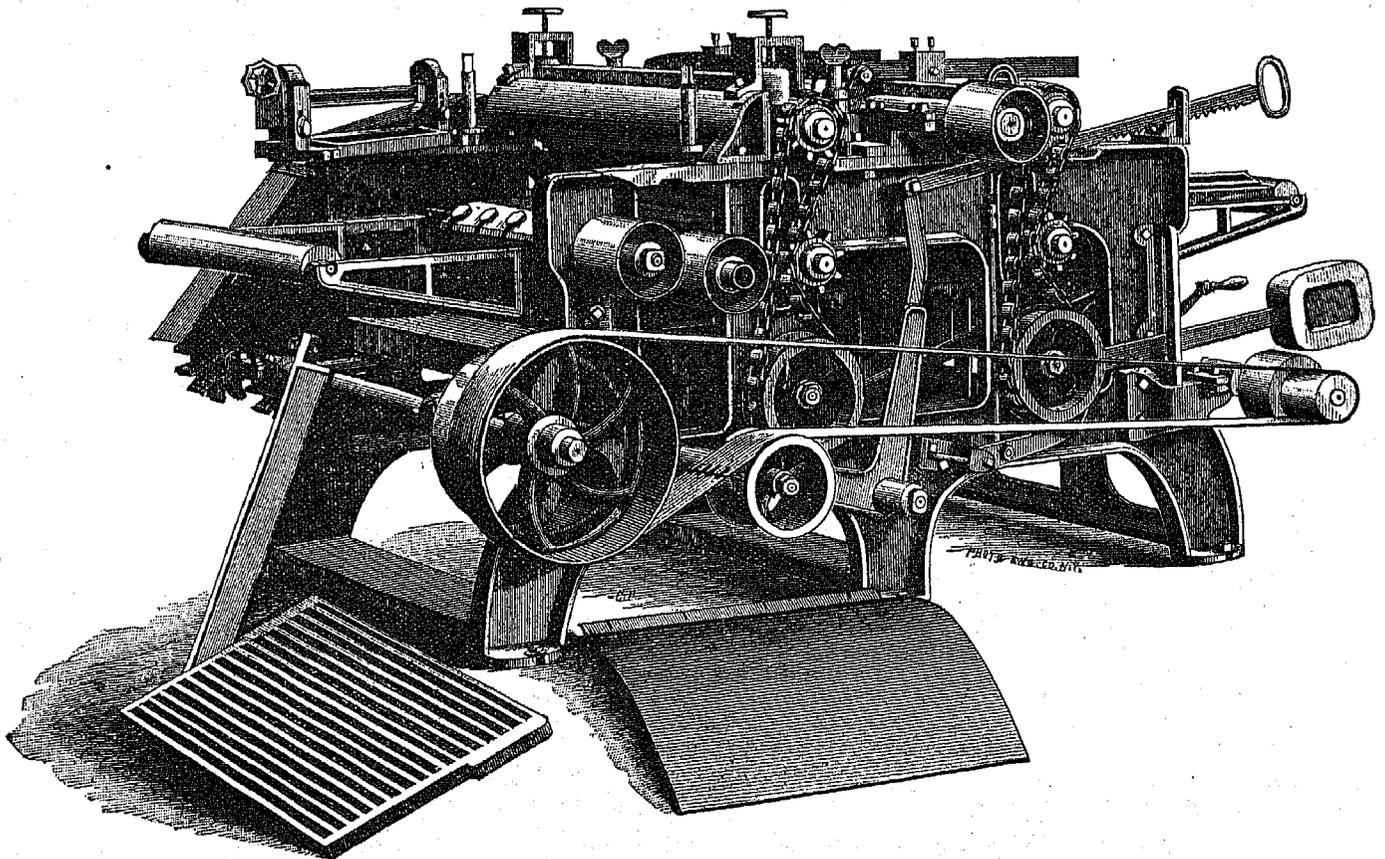


Fig. 452.

bight hangs slack and the sag can be controlled by a lateral adjustment of the bearings of the idle drum. The lags are linked together by flat links in commoner practice like a gearing-chain. The alternate single links are on the lags.

Fig. 449 in the detail shows the lags hinged together by  $\frac{1}{2}$ -inch wrought-iron pintles, instead of riveted links. Special profiles have to be given to the lag-corners to prevent them from kicking up or chipping the lumber as they

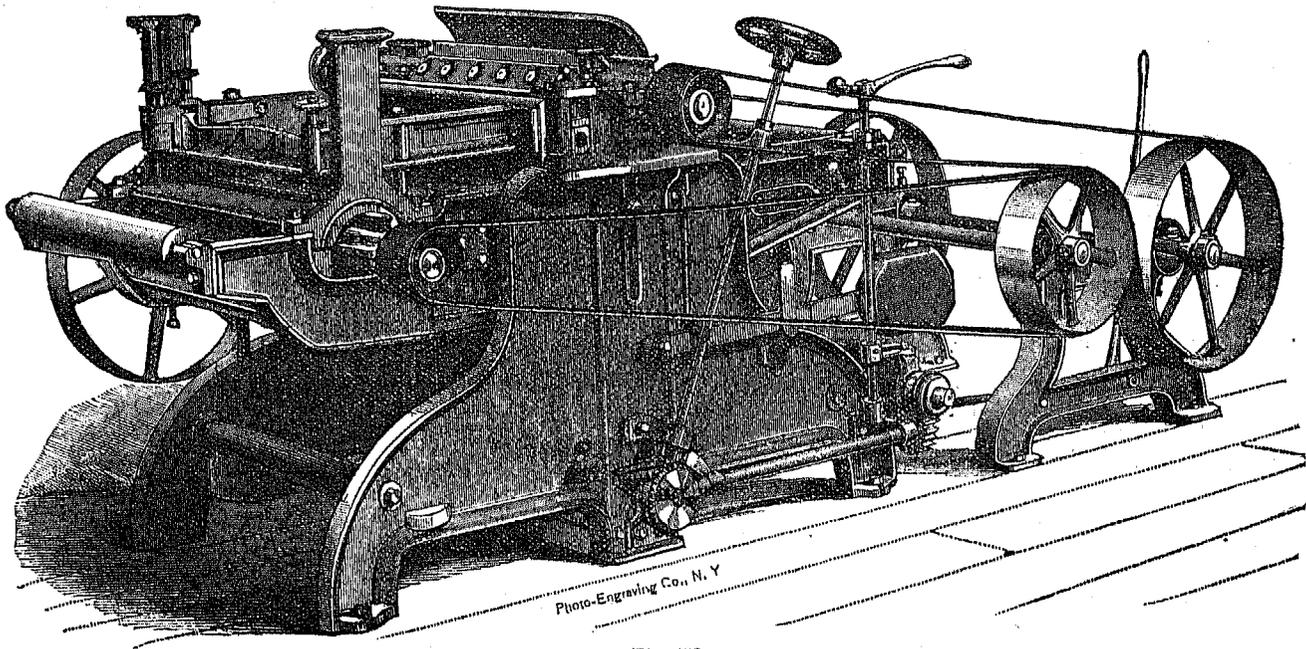


Fig. 453.

pass from the circular drum to the tangent ways. The driving-drum is always at the back of the machine. Fig. 449 shows it driven by bevel-wheels from a friction-shaft with two speeds. Fig. 451 shows the more usual system by belt-tightener, clamped to a sector. The upper pressure is found to increase the resistance to the feed if left plain. In best practice it becomes a roll, and the chip-breaker is separate. The latter comes close enough to the cut to be effective, but does not press so heavily upon the stock. These pressure-rolls are not usually driven, but are turned by friction of the stock.

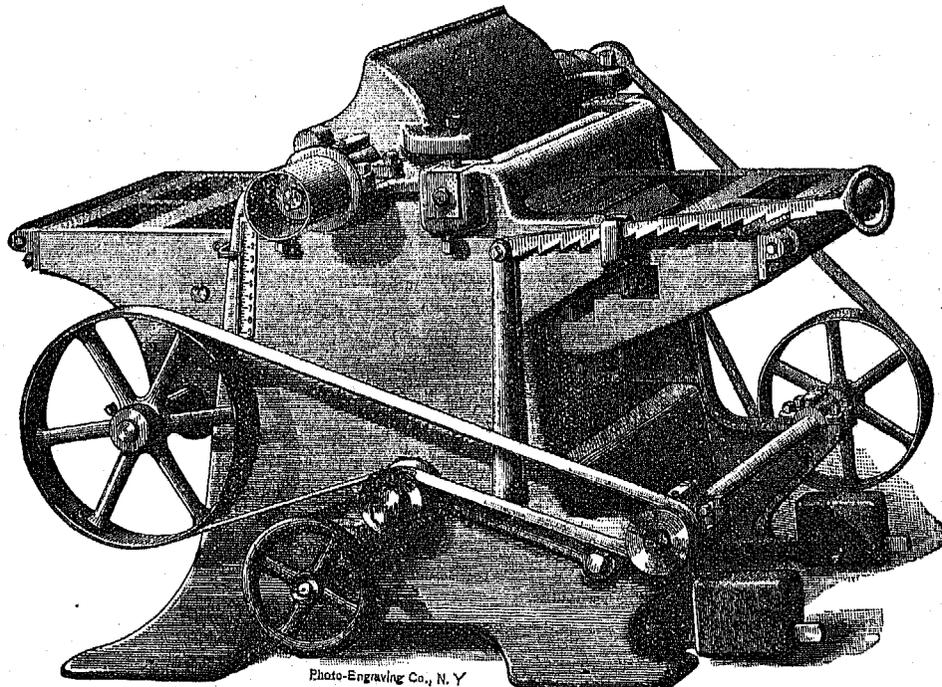


Fig. 454.

Fig. 452 shows the upper rolls driven by slack-gearing chain. The same builder uses this same device for his expansion gear on fixed-bed Woodworth planers instead of the usual links. The cut illustrates a double surfacer,

and shows the convenient method for freeing the lower head for inspection and sharpening. The grating of the part beyond the cutter-cylinder lifts away and the pressure-table swings out of the way. An objection to the double surfacers with adjusting bed is the difficulty of unsteadiness in the under head. This must rise and fall with the table, and the loose fit of the latter to permit motion magnifies the vibrations. In the design of Fig. 450 the boxes of the lower head may be clamped to the sides of the frame, making the lower head as firm as the upper. There are adjusting-screws to bring the two cylinders parallel, and hand-screws adjust the platen over the lower. The table is raised or lowered by screws geared together or else by inclines. It is guided and kept horizontal by

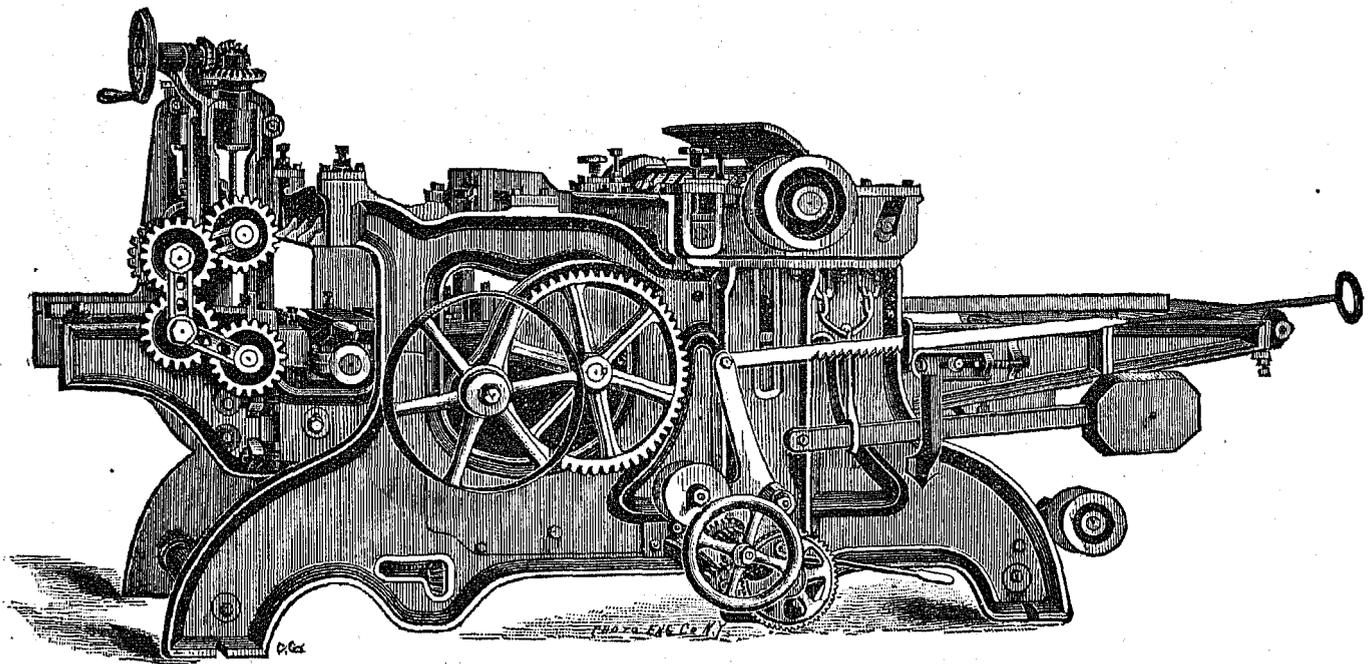


Fig. 455.

dovetail slides. Fig. 453 shows the screws geared from the power-shaft by short right-and-left worms. These can be engaged at will with the worm-wheel by the vertical shaft. Fig. 450 has the worm-shaft driven by friction from the central bevel-cone. There is also a hand-wheel adjustment in all cases. The types illustrated show the diversities of practice with respect to the resistance of the pressure-bars or rolls. Fig. 448 has the weighted levers cross each other, with a special integrating device at the center. Fig. 451 has the standard weighted levers, and some of the others show the adjustable rubber spring.

Fig. 454 shows the use of the shaving-guard as supplemental to the roll. An extension of the bonnet comes down close to the cutter-head and acts as a chip-breaker. The front roll lifts the bar and prevents the stock from catching on its corner. The other features of the designs will be visible from the cuts.

The endless-bed planers are not very extensively built as matchers also.

Figs. 455 and 456 illustrate very large machines of this type for dressing car- or bridge-sills, and similar 10-inch lumber. The system of Fig. 456 is not without its advantages in these heavy machines, since the weight of table and attachments does not have to be overcome. Extra feeding-out rolls are made necessary, in order to free the matcher-heads, which have to be beyond the end of the traveling bed. The cheaper and smaller type of Fig. 457 and the surfacers of a little larger size are by far in the majority. The endless-bed planer, as a type, is especially adapted for fast work, which may be permitted to be rough. It can do very smooth work when properly built and slowly handled. It has done splendid service for lumber which was wet or icy, upon which the Woodworth rolls might slip or fail to catch. The weight of the work favors the feed, instead of resisting it. It has a speed of feed of about 60 feet per minute, and in its "pony" form is very popular, even to the displacement of the other forms in certain classes of work.

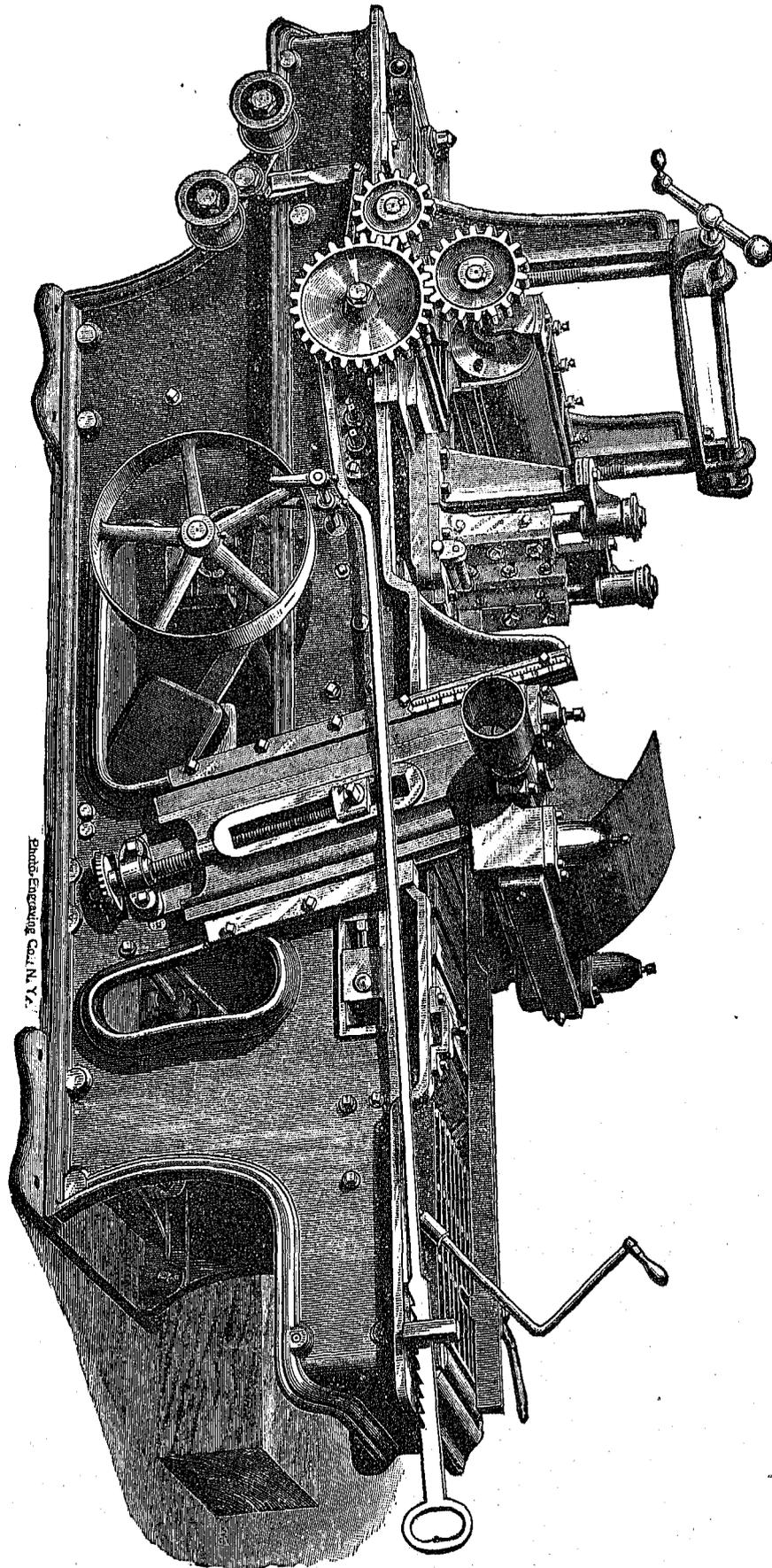


Fig. 456.

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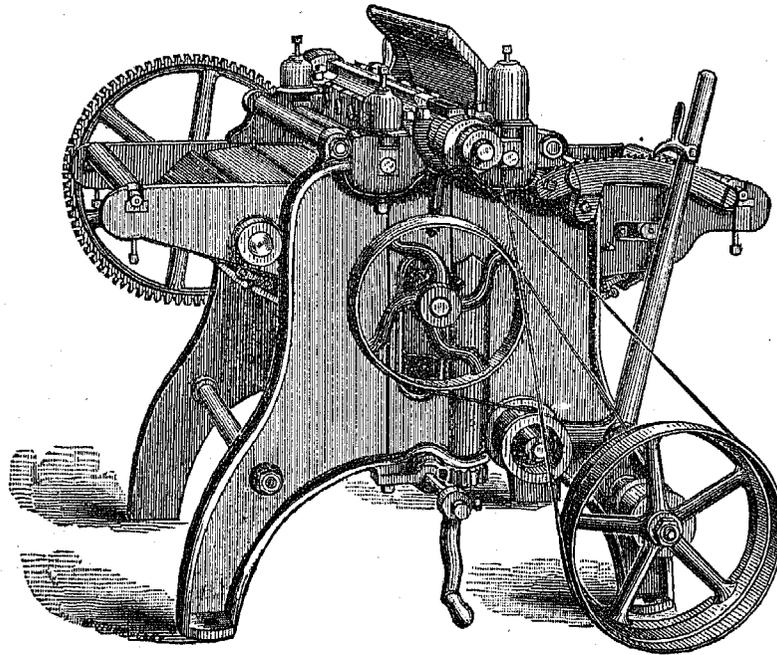


Fig. 457.

## § 45.

## BUZZ-PLANERS—HAND-PLANERS—HAND-JOINTERS.

In the tools of this class the wood is held by hand and presented to the cutting-edges. They are adapted for surfacing and for jointing all kinds of small and joinery work, and effect a notable saving of time in comparison with hand-labor. One of the chief special problems they present is to permit an increase of depth of cut, without unduly increasing the opening at the cutter-head.

Fig. 458 (see next page) illustrates the general appearance of these tools and a special device for securing a close fit around the cutter-head. The table is made in two halves, with the edge of the cutters just protruding between them. The work is pressed upon the tables by hand, and is guided by the fence. This will incline for chamfers and bevels. The two tables are swung above the pairs of short links, and the screws at each end lift and lower the tables as the links are made perpendicular or inclined. The edges nearest the cutter describe a curve which is nearly an arc round the center of its axis.

Fig. 459 shows a hollow-base jointer, where a parallel link device secures close approach to the arcs of the knives. Two hand-wheels are necessary, because the back table should always be in line with the top of the

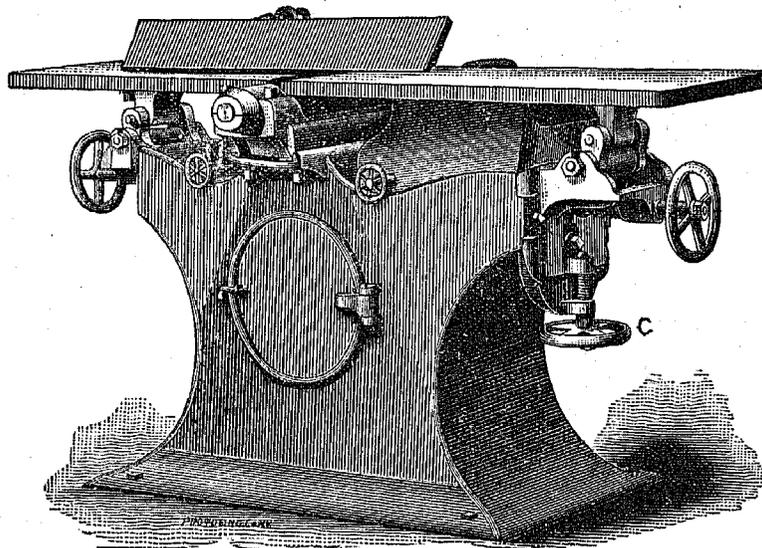


Fig. 459.

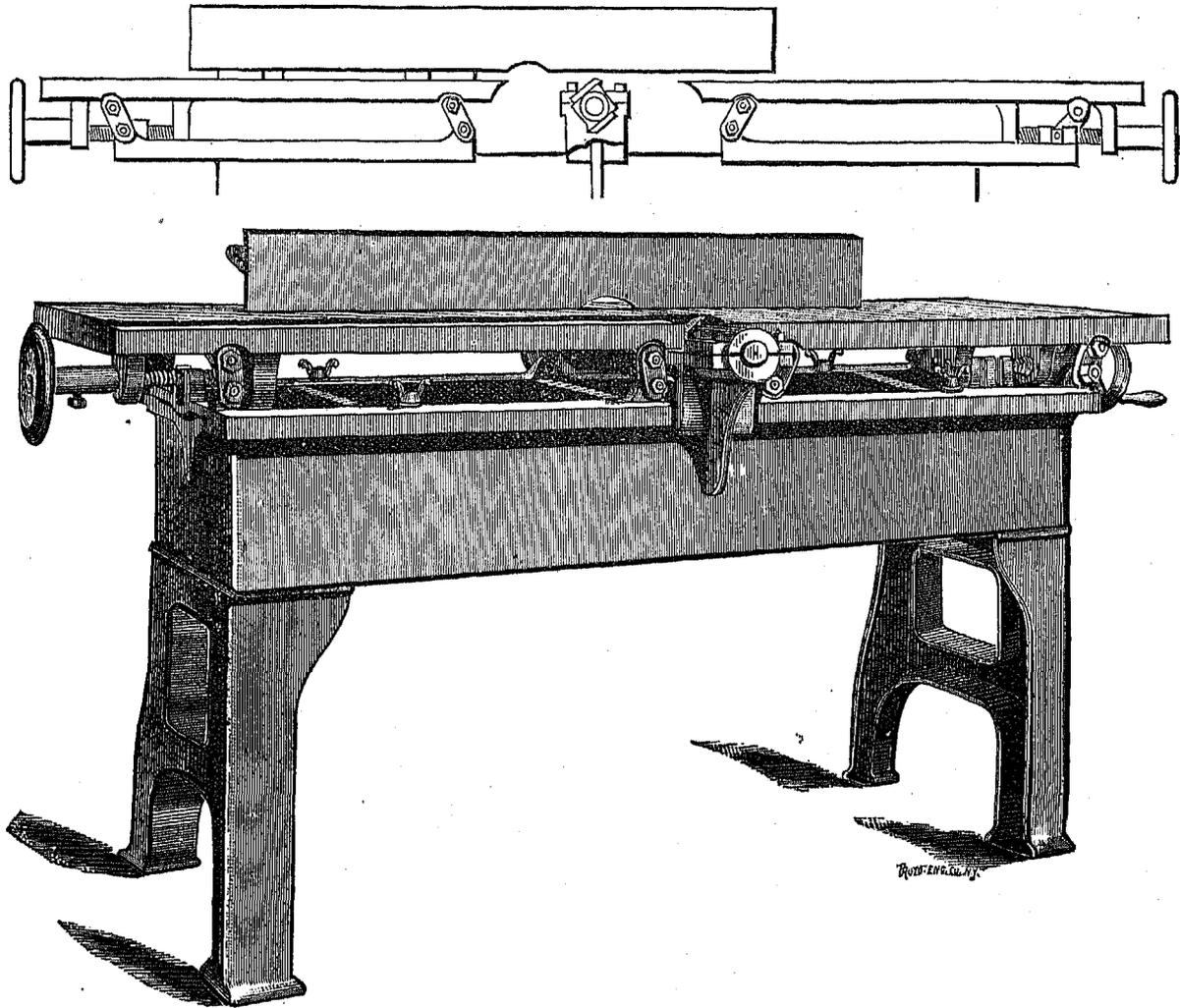


Fig. 458.

cutters. The depth of cut is gauged by the front table only. In order to make hollow or spring joints for gluing the front table is lowered by the hand-wheel C. When joints are planed hollow, the clamping of the glue-joint need be in the middle only.

Fig. 460 shows a similar design by the same builders, where the cutter-head stands at an angle with the direction of the feed of the stock. It is called a diagonal jointer. The shearing cut adapts the machine for cross-

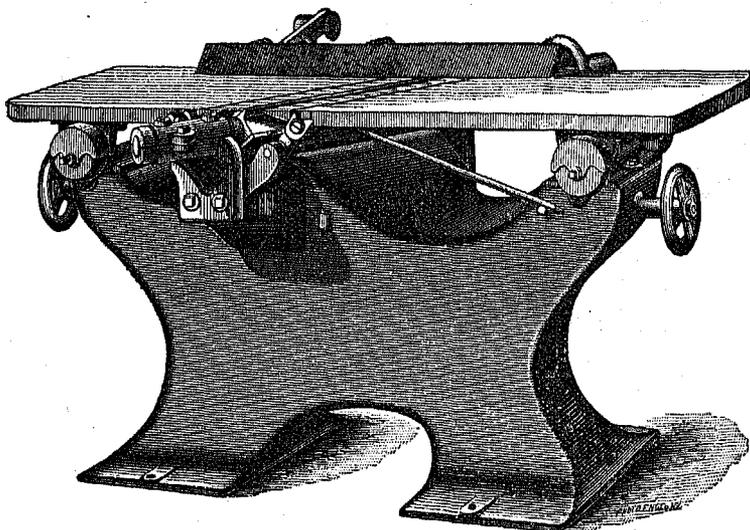


Fig. 460.

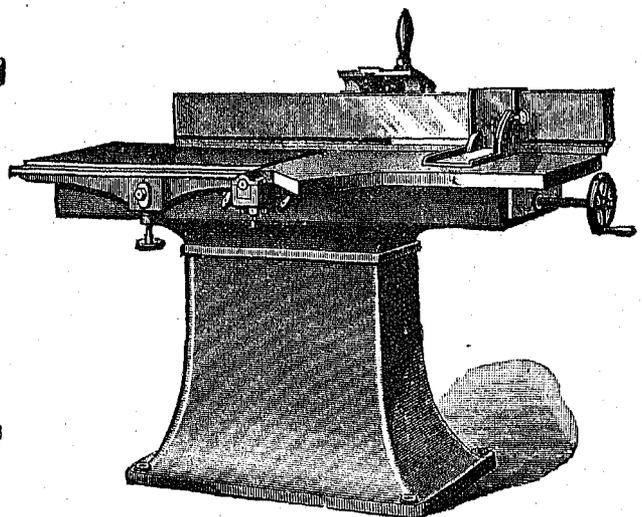


Fig. 461.

grained and curly lumber, and gives a smooth surface. In the planer of Fig. 461 the fence may be set at  $45^\circ$  to the vertical plane through the cutter-cylinder, and thus transform the straight jointer into a diagonal one. In this tool the danger to the hands of the operator when working on short pieces is overcome by the use of a finger guard. The tables rest on inclined planes, and their lips are faced with steel. The cutter-cylinder has three bearings, to secure freedom from spring. Some of the other forms of buzz-planer permit a horizontal tilt to the tables.

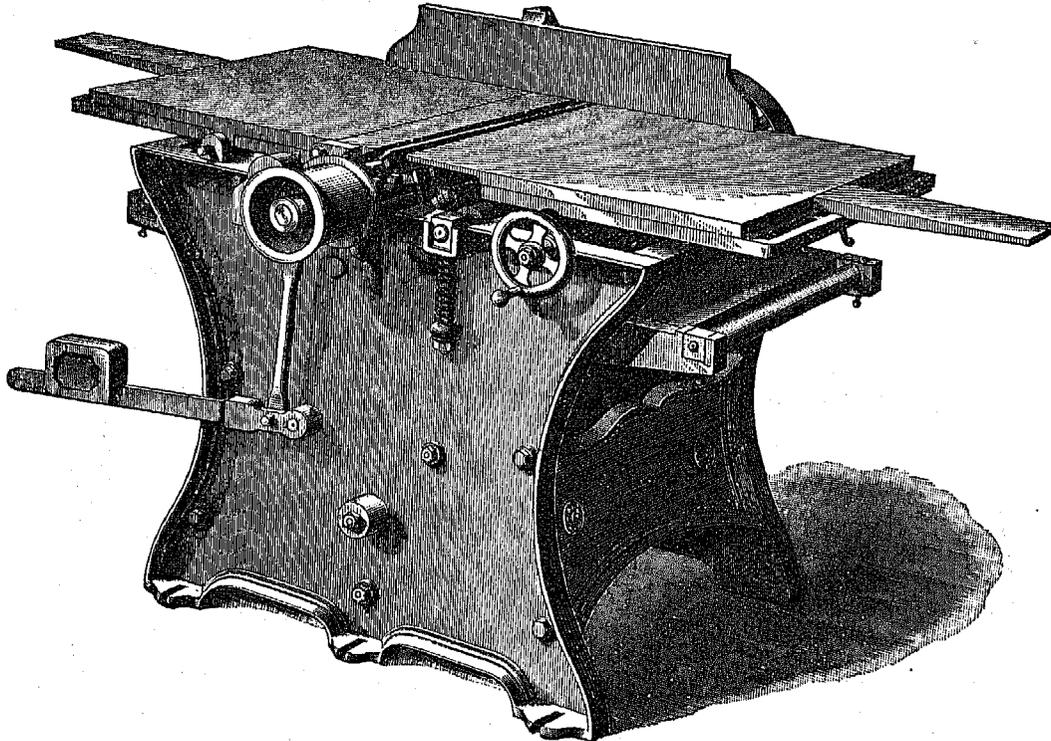


Fig. 462.

Fig. 462 shows a machine arranged to use the upper side of the cutter-head as a buzz-planer, and also the lower side as a pony surfer. There are feeding-rolls driven by gearing-chain for the roll-feed over the lower table. The lower table rises and falls by screws, and Fig. 463 shows the expansion-gear for lower rolls. The front

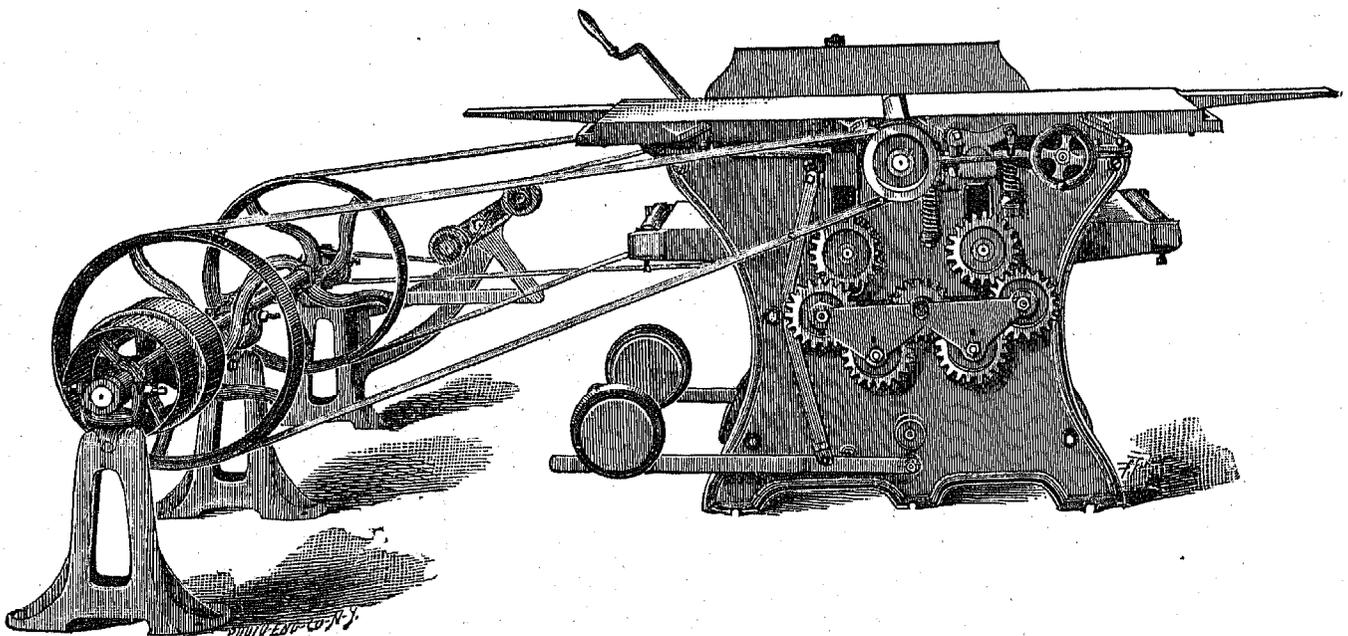


Fig. 463.

table for the hand-planer service is adjusted by hand-wheel. It makes a compact combination where both machines could not be kept full, or where both may not be required at once. As a principle, however, combination machines

are to be designed with great caution. The jointers previously discussed have been horizontal. For jointing small work, where finish is of moment rather than fit, a vertical machine such as Fig. 464 is approved. It is especially adapted for shingle-jointing and the like, and may be fed by two persons. The plane-knives make a drawing cut

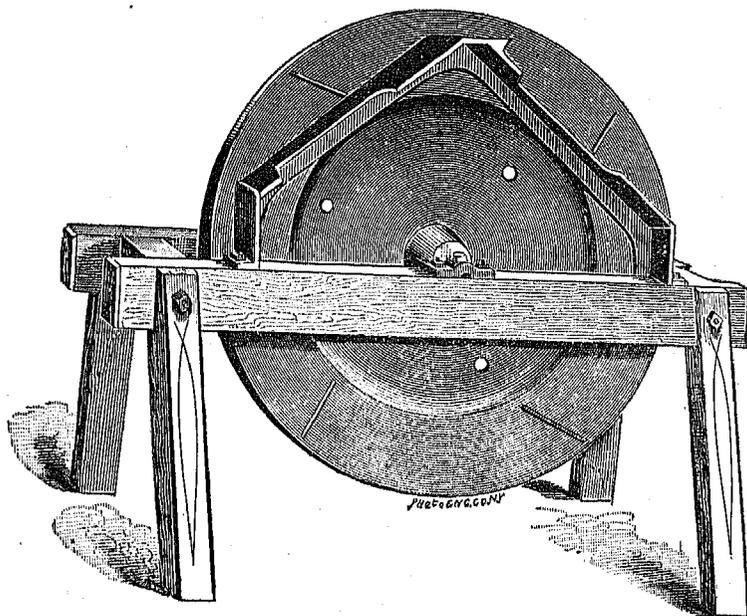


Fig. 464.

as they pass over and along the work. The stroke-jointer (Fig. 465) acts like a hand-plane, traversing back and forth over the work presented to it. It is, of course, adapted for edge work or more especially for jointing, and the stroke may be varied to economize time. The reciprocating knife gives a true and even surface. A knife on the

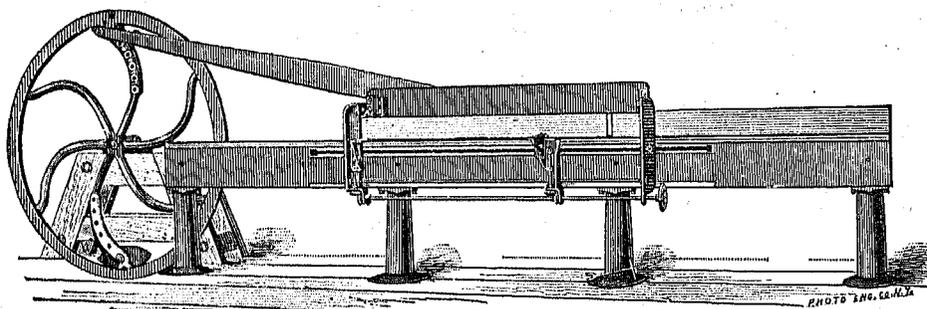


Fig. 465.

top of the plane-slide may be used for jack-planing. In jointing, the work rests upon the adjustable brackets shown. The tools of this class are finding an increasing application. Pattern-shops find them very useful for a great deal of their work. Better work is done on them when the pieces are heavy enough to help to resist the pressure of the cut.

#### § 46.

#### SCRAPING- OR SMOOTHING-MACHINES.

To produce a smooth finished surface on hard-wood lumber which should show the grain it has been necessary to employ hand-labor. The surface has been scraped with a steel edge, slightly turned over into a shape not unlike the hook-scraper for metals. After this scraping process, the wood was ready to be filed and varnished. The scraping-machines of Figs. 466 and 467 *a* and *b* are designed to do by power that which has hitherto been done by hand. Fig. 466 is a small size in perspective, and Figs. 467 *a* and *b* show a larger size in end and side view. The scraper-knife is held stationary by a square holder in the lower table. The stock is fed over it by driven feed-rolls with expansion gear. The knife-holder is kept up by springs against bearing-screws, and the pressure of the lower rolls upward is also by springs. The upper platen and rolls are adjusted by screws together, worked by worms which are geared together in the larger size. The gearing is direct in the smaller. The lower hand-wheel, by compressing the lower spring, releases the stock or holder when necessary. The great obstacle in the way of these

machines hitherto has been the difficulty in securing the proper edge for the scraper. Although the machine has been on the market since 1857, the extended application of it has only begun since the introduction of the accessory machine of Fig. 468, for grinding and turning over the edge of the cutter. The cutter is securely clamped on a

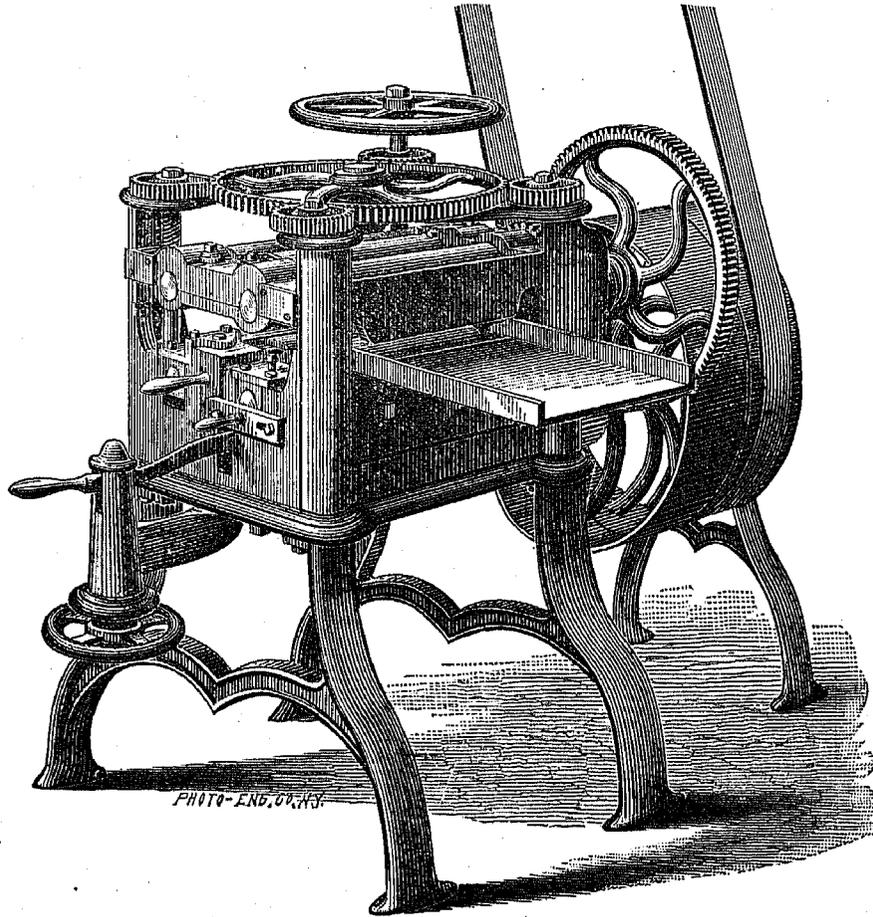


Fig. 466.

carriage, which slides back and forth upon ways under a pair of emery-wheels. The carriage is driven by a screw of steep pitch by open and crossed belts. There are two small emery-wheels, one acting on the face of the cutter,

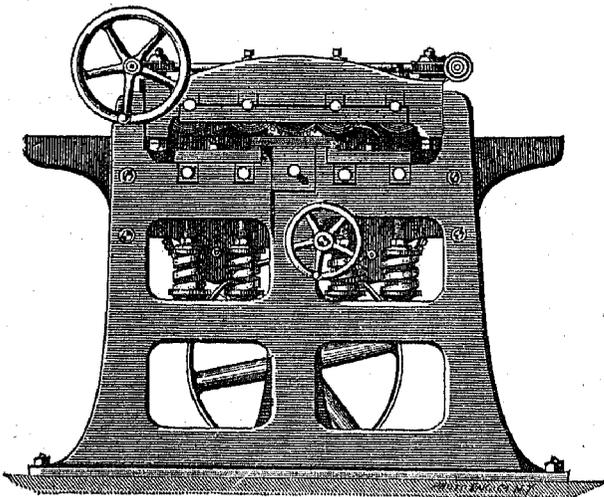


Fig. 467 a.

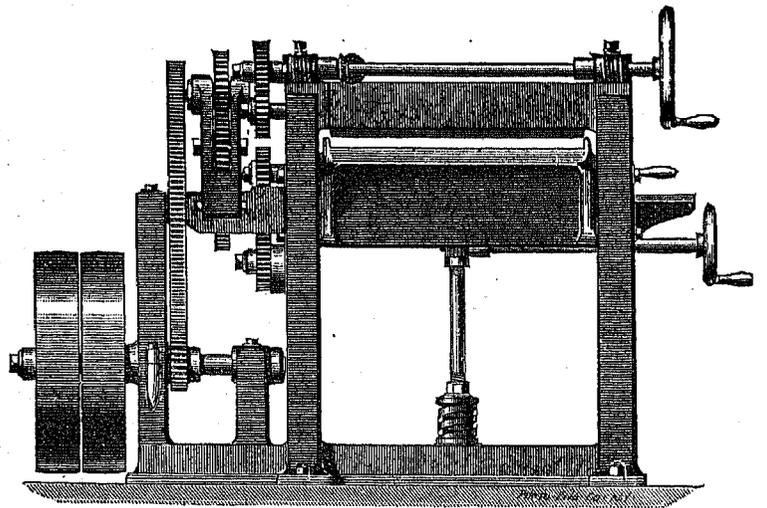


Fig. 467 b.

and the other in a different plane on the back. The rear wheel grinds a bevel of about  $35^\circ$ . After the edge is produced the emery-wheels are raised, and the burnishing-tool to the left of the emery-wheels is brought down to turn over the edge. The traverse is made by hand, and only once, while the the contact is lubricated by sperm- or lard-oil of heavy body. Great care should be taken to keep a perfect surface upon the burnisher. An exhaust-fan carries off the emery-dust from the bearing-surfaces.

The smoothing-machines are more especially adapted for the hard woods and for manufactured articles. They possess great interest as an instance of the direct replacement of hand-labor by that of a machine, with manifest gain in quantity and quality of work performed.

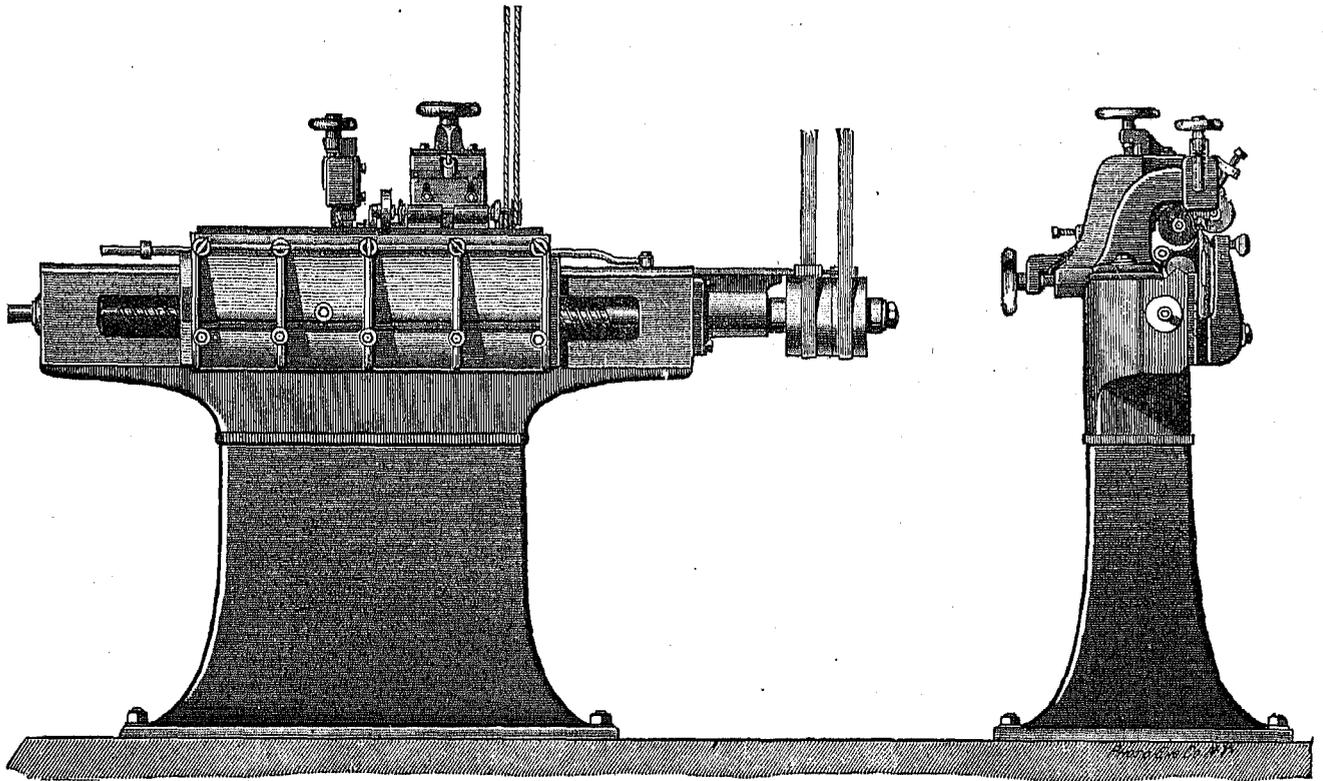


Fig. 468.

§ 47.

## DIMENSION- OR CARRIAGE-PLANING MACHINES—DANIELS PLANERS.

The Woodworth planers, the roll-feed and lag-bed planers, belong to a class which might be called *parallel* planers. The upper and lower heads are not opposite each other, and each will act to produce a surface parallel to

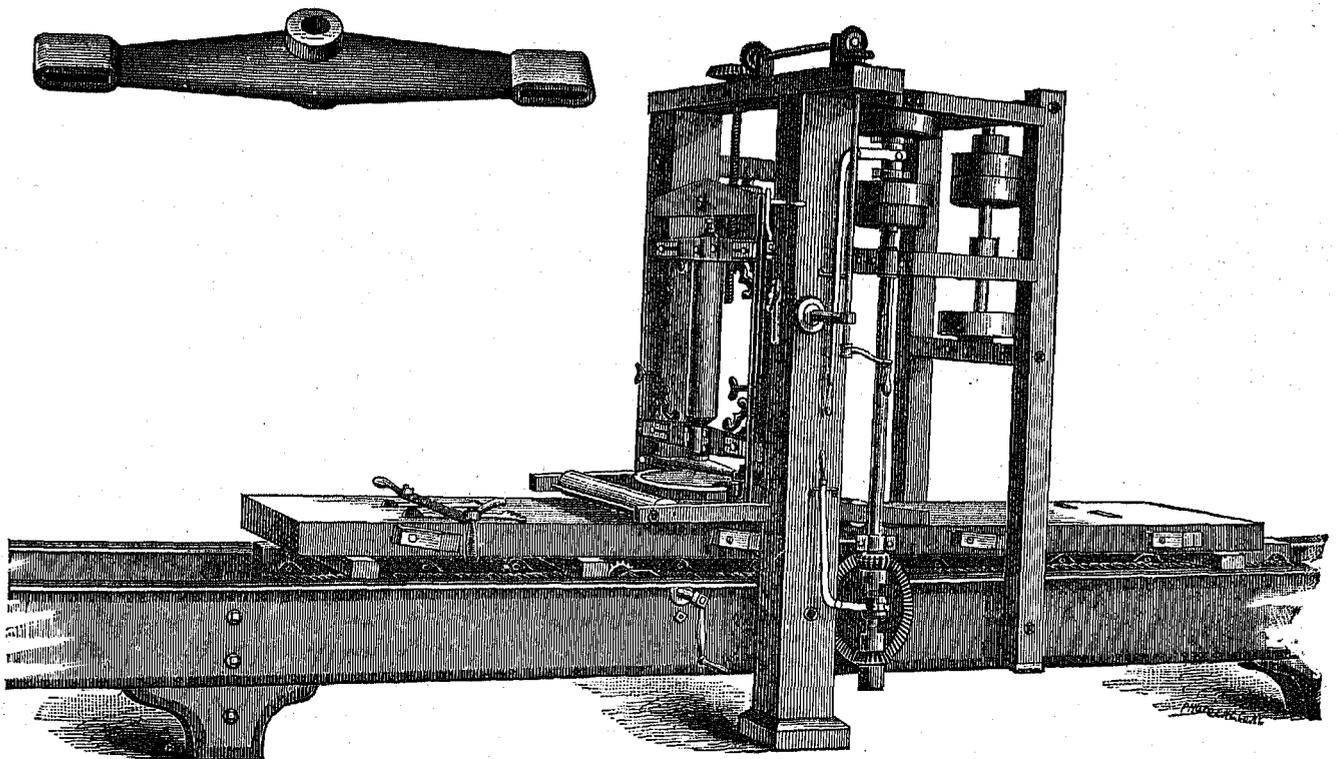


Fig. 469.

that which resists the pressure of the cut. This will be especially the case where the lumber is flexible, or where it is stiff enough to be in contact with the bed at a few points only. The resulting surface need not be a plane, nor need the finished stock be of the same thickness at all points of its length. Where the stock is to be true when planed, or of standard dimensions, it is necessary that it be dogged to a carriage which runs upon true ways. The passage of the stock under the cutters must generate a true plane surface on the top parallel to that of the ways. This one surface can be used as a base plane for working out the other three in rectangular work.

Fig. 469 shows the Daniels planer for this class of work, with wood frame. The two cutters are held in the ends of the arm shown in detail in the cut, and revolve transversely to the motion of the stock. This rotation is

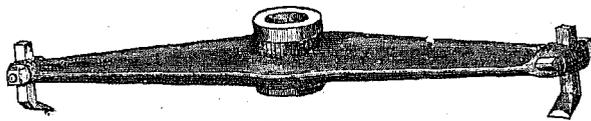


Fig. 470.

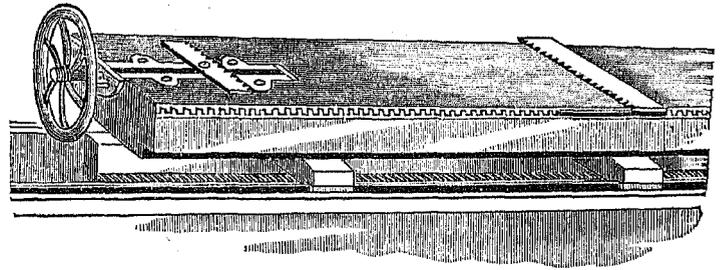


Fig. 471.

given to the long axis of the arm by a belt from a wheel behind, on a vertical shaft with fast and loose pulleys. Some designs use a drum at the back, arranged horizontally, and give the short belt a quarter twist. The cutters are borne in a sash-frame which is adjustable vertically by a screw for varying thicknesses of work. A cast-iron disk, known as the "dead-weight", hangs concentric with the cutters and serves to keep the stock to a plane when

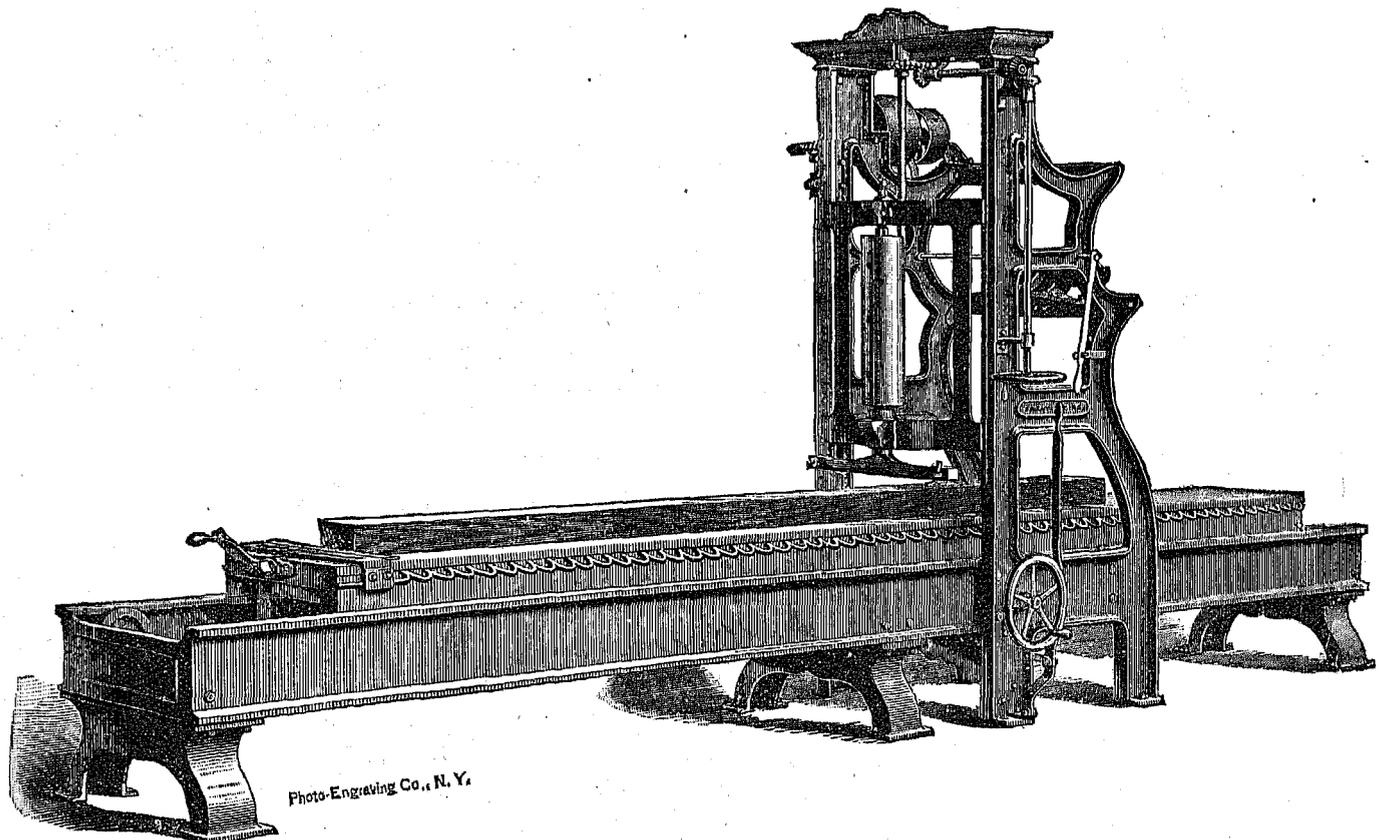


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Fig. 472.

thin, and acts as a sort of chip-breaker also. A pressure-roll turns in a frame in front of the cutters. The carriage is fed forward by a rack in its under side. The rack is put below the driving-pinion, in order that there may be no tendency to lift the table. Motion is given to the driving-pinion by horizontal belts to a vertical shaft through a combination of two bevel-wheels and clutch. This makes it very easy by a motion of the hand-lever to arrest or reverse the feed instantaneously. A quick-return combination is secured by the upper clutch on the vertical shaft. For feeding forward the driving-shaft turns an idle shaft from which a further reduction is made to the gear-shaft, with choice of two speeds. For returning, the gear-shaft is belted directly to the driving-shaft, and with less reduction. The clutch engages the one belt or the other at will, independent of the reversing-gear below. A loose crank permits easy adjustment by hand.

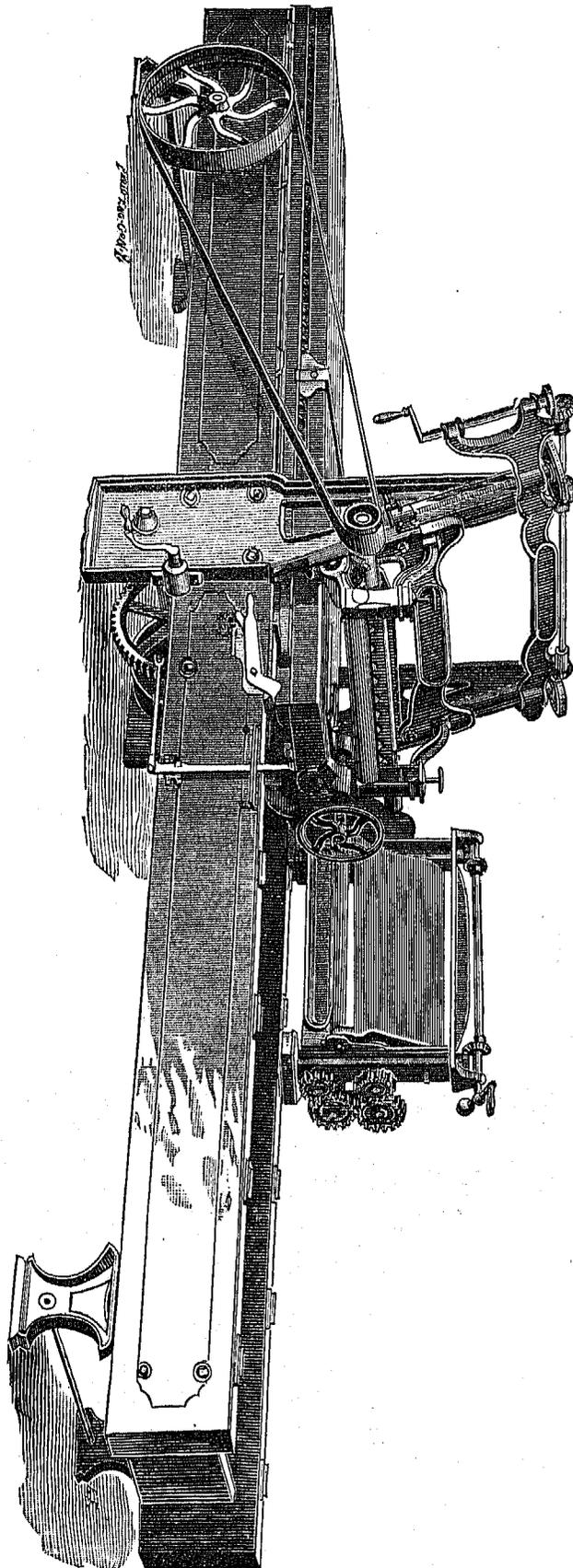


Fig. 473.

Fig. 470 shows a different form of cutter-arm with the usual cutters. The bolts have a hook-head, and the cutters come nearer to the ends of the arm. They also come central to the arm instead of in front of it, diminishing the leverage of torsion. For securing the work to the table, the cheaper device is by means of the toothed flats which are held in place by a clamped cross-bar. The toothed ends are driven into the end of the stuff.

Fig. 471 shows a screw-dog, where the serrated edge moves forward by the hand-wheel and the abutment only is adjusted for different lengths. It will be seen at once that the bed of the Daniels planer must be more than twice the length of the table, and the latter must be longer than the longest piece the machine is ever expected to accommodate. The great length of bed makes the machine a very bulky one, and has made many builders continue

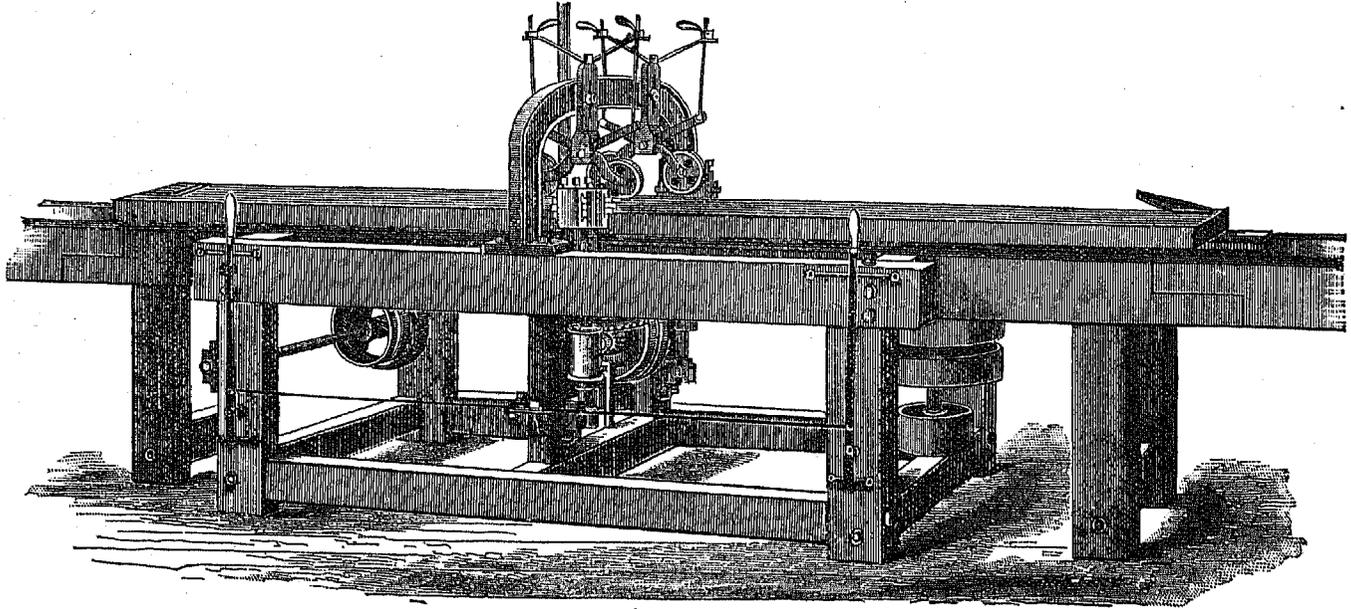


Fig. 474.

to make the framing all of wood. One or two are using iron uprights on the frame bolted to a wooden bed. There are objections to this, inasmuch as the wooden parts yield to atmospheric influences which do not affect the iron, and the excellence of their work is thereby vitiated. The high-grade machine is the one with metal framing, although its relative expense stands in the way of its extensive use.

Fig. 472 illustrates one type of the iron-frame planer, with the feed mechanism on the farther side. There are the same capabilities as in the other. While the transverse action of the cutters does not tend to distress or

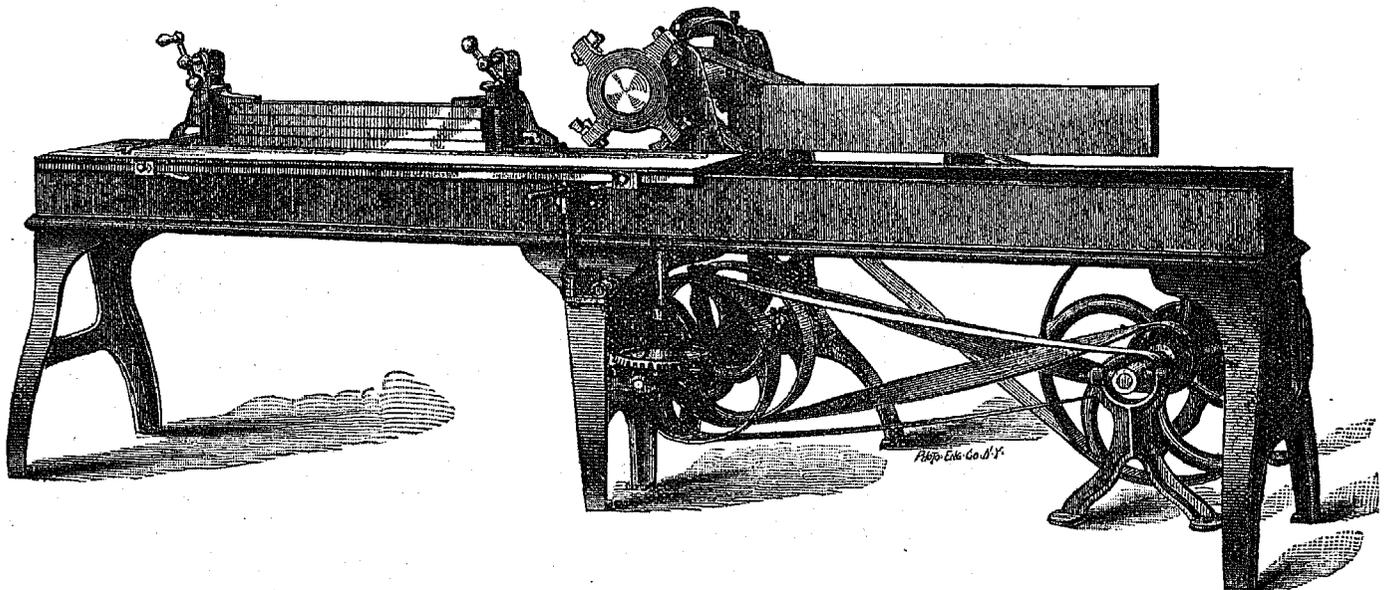


Fig. 475.

displace the lumber which is being trued, their action is slow. To remedy this difficulty, the rotary cylinder of the Woodworth planer has been fitted parallel to the traversing bed. It is made adjustable by screws for varying thicknesses and carries its own spring-pressure bars or rolls.

Fig. 473 illustrates a machine of this design. The adjusting-screws are outside of the uprights, and are geared to the convenient hand-crank. The machine will plane true and out of wind as well as the old, and has great advantages in the long life of the cutting-edges relatively to those of the transverse planer, and in the rapid feed. The same figure illustrates an attachment of feeding-rolls for the use of the machine on the pure Woodworth principle. The carriage being locked stationary, the stock is fed over it as in the typical machine. An iron plate which hinges up against the upper roll turns down upon the carriage to protect the wood from the wear of the friction of the stock. The roll-gear is hung upon a long hinge at the back, so that the operator does not have to lift its weight, and the rolls are geared to the feed-train by a special device. The passage, therefore, from a planer of one system to a planer of the other is made very simple and easy.

The principle of carriage-planing has not been extensively applied for double surfacing. There are but two or three such machines in service. Fig. 474 illustrates one of these for double surfacing or matching. The rotary cutters are opposite each other, and adjustable spring-pressure rolls keep the stock down while the dogs hold it from endwise motion. The feed-motion is very simple. A machine of iron frame, with a third cutter-cylinder lying horizontally across the bed, can surface three sides at once with corresponding gain in time. The principle of Fig. 475, which has a Daniels head with four knives on its side, may be doubled for double surfacing. The machine shown is designed for jointing, but can be applied otherwise. The thrust of the work is borne by a thrust bearing in the grooved surface of the babbitt. The reversal of the feed is effected by stops at the side of the carriage. It is no doubt the comparatively slow feed of the Daniels planer which has caused its slower development than the parallel classes of planers. While the earlier speeds of less than 20 feet to the minute are much exceeded to-day, the limited capacity of the machine has restricted its use to the shops which handle larger and heavier sizes of lumber for car, bridge, or other engineering purposes.

#### § 48.

#### MOLDING-MACHINES—STICKING-MACHINES.

The paring-machines of the previous discussion have been intended to produce plane surfaces. The next class includes those which act to produce profiles or ornamental cross-sections at right-angles to the length of straight stock. These diversified cross-sections will be produced by rotating cutters or knives whose action is identical with that of the surfacing- or matching-heads of the planing-machines. In fact, many kinds of molding with flat top and bottom, and profiled only on the edges, may be made on any matcher by the exchange of the matching-cutters for those of suitable profile.

Fig. 476 illustrates a standard type of internal molding-machine for working molding-stuff upon four sides. It differs in width from the planers of the same builders, but has the same mechanical excellences. The stock must be guided laterally to secure a straight and uniform profile, and these are provided to be set at any part of the table. The lower head surfaces the base of the shape, and is a plain straight knife. The upper and side heads carry knives ground to the desired profiles.

Fig. 477 shows a number of types of head which are in use for a variety of purposes, with the knives in place. The side heads have lateral adjustment by screws for widths, and the boxes of the upper head have an endwise adjustment to bring the knife-profile exactly where it is wanted relatively to the other two. This may also be done if required for the lower head. The adjustment is by screws.

Fig. 428, of the planers of the same make, shows how the side heads are clamped to a round bar to prevent back-lash or tremble. The cylinders of molders usually are fitted with balance-wheels to equalize the motion when the knives are not symmetrical with the cylinder. The cylinders have two or four sides, for better equilibrium. A special form of pressure-bar is required to hold down the moldings after their tops have been shaped. Adjustable hinged cross-bars are fitted with a foot, which ends usually in a wooden sole, complementary in shape to that of the molding. These feet can be adjusted laterally and vertically upon the cross-bars, and thus steady the work beyond the cutters. Where the moldings are worked from rectangular stock the first rolls and bar may be straight and of the planer type. A notable economy in chips and lumber may be effected by previously sawing the stock into an approximation to the required cross-section, the saw-kerf perhaps entering the two sides of the squared stock at different angles.

The heavy black line of Fig. 478 represents the one kerf by which two molding-blanks are separated and the work of the molding-cutters is lightened and lumber is saved. For blanks of this sort a sectional pressure-bar is a feature of this manufacture.

Fig. 479 shows a sectional view of the cutter-head, with a number of separate feet resting upon the various parts of the profile. Such pressure comes near the cut, and each, being weighted, acts to help to cause smooth work. By the use of a number of heads with separate or sectional cutters on each (Fig. 480) it is possible to work out quite varied patterns. Each knife finishes a part of the profile in succession. By having the side heads adjustable laterally below, the crowns of moldings may be cut with a knife of durable shape. Projecting fine points in a profile are apt to burn off. Such a picture-molding as Fig. 480 in older practice would have been

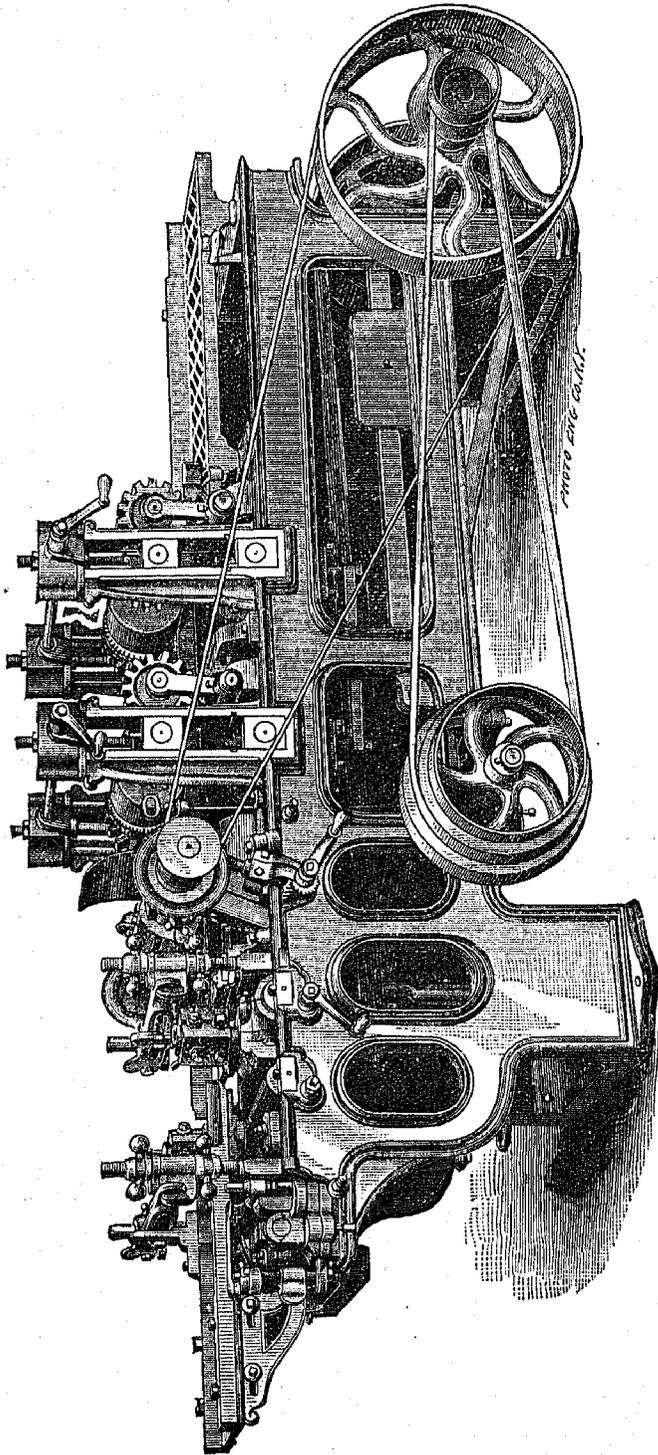


Fig. 476.

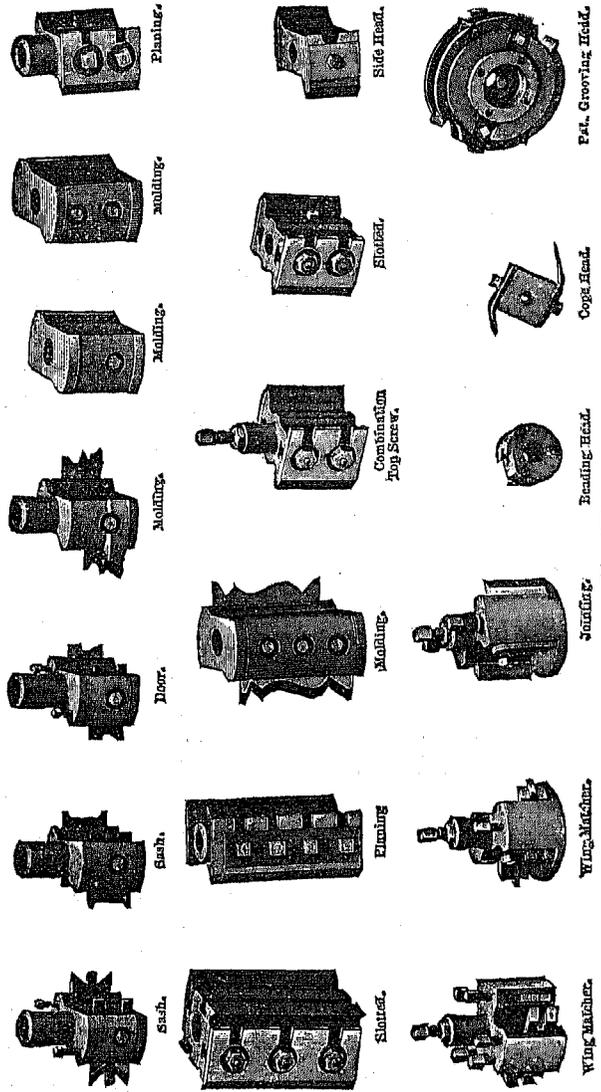


Fig. 477.

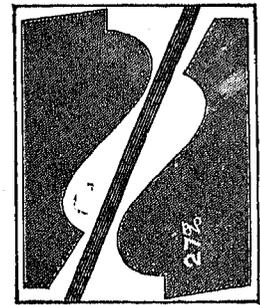


Fig. 478.

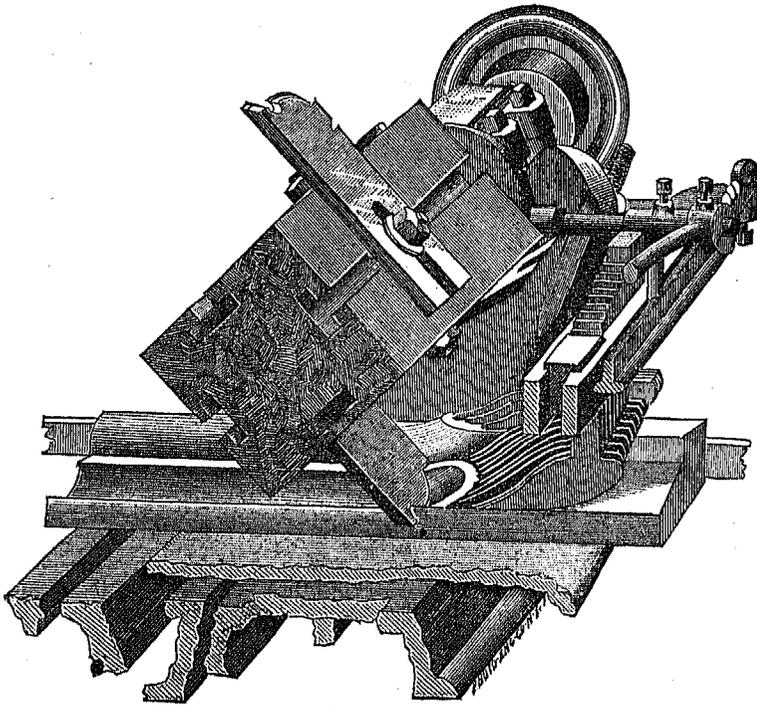


Fig. 479.

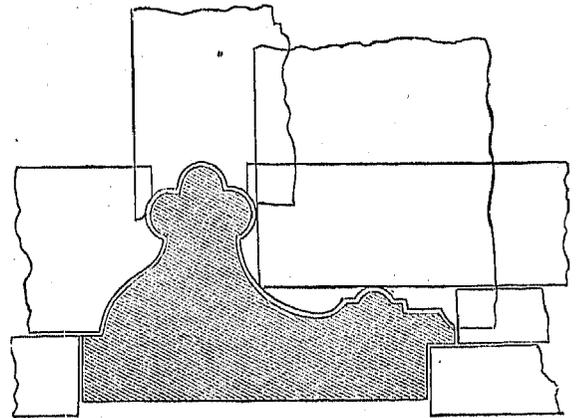


Fig. 480.

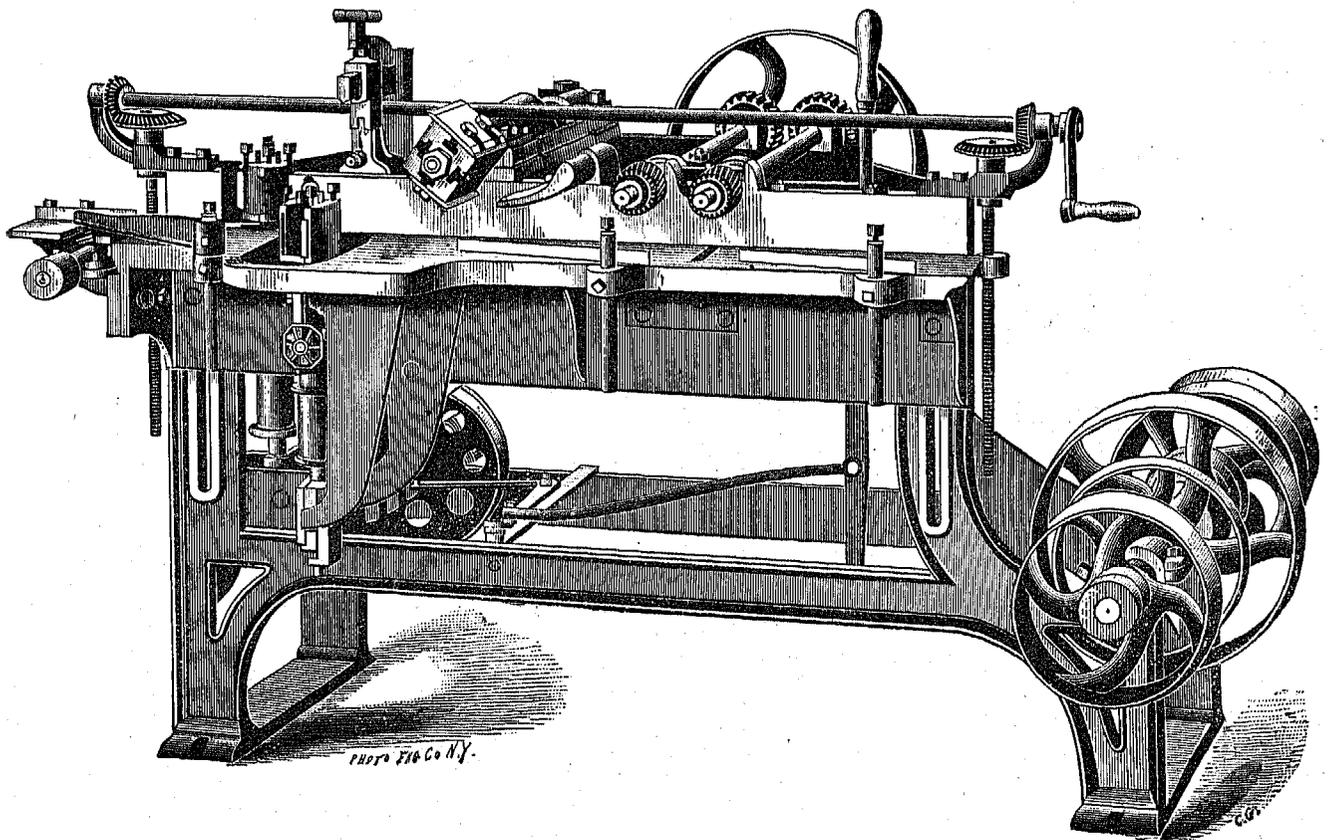


Fig. 481.

made in two pieces and glued together with a tongue. There are many classes of shops for which this type of inside molder has advantages. They will surface and match, if required, usually up to 10 or 12 inches wide, and may be used for ceiling- or flooring-stuff as well as for moldings. But on account of the greater accessibility of the heads for adjustment and for sharpening, what is known as the outside molding-machine or "sticker" is preferred, where the surfacing duty will be for narrow work only.

Fig. 481 shows one type of such a machine especially designed for sash and blind or similar work. As in all machines of this external class, the upper cylinder is stationary and the other three are attached to the table, which rises and falls by geared screws. The side heads adjust vertically and laterally, and there are take-up devices at

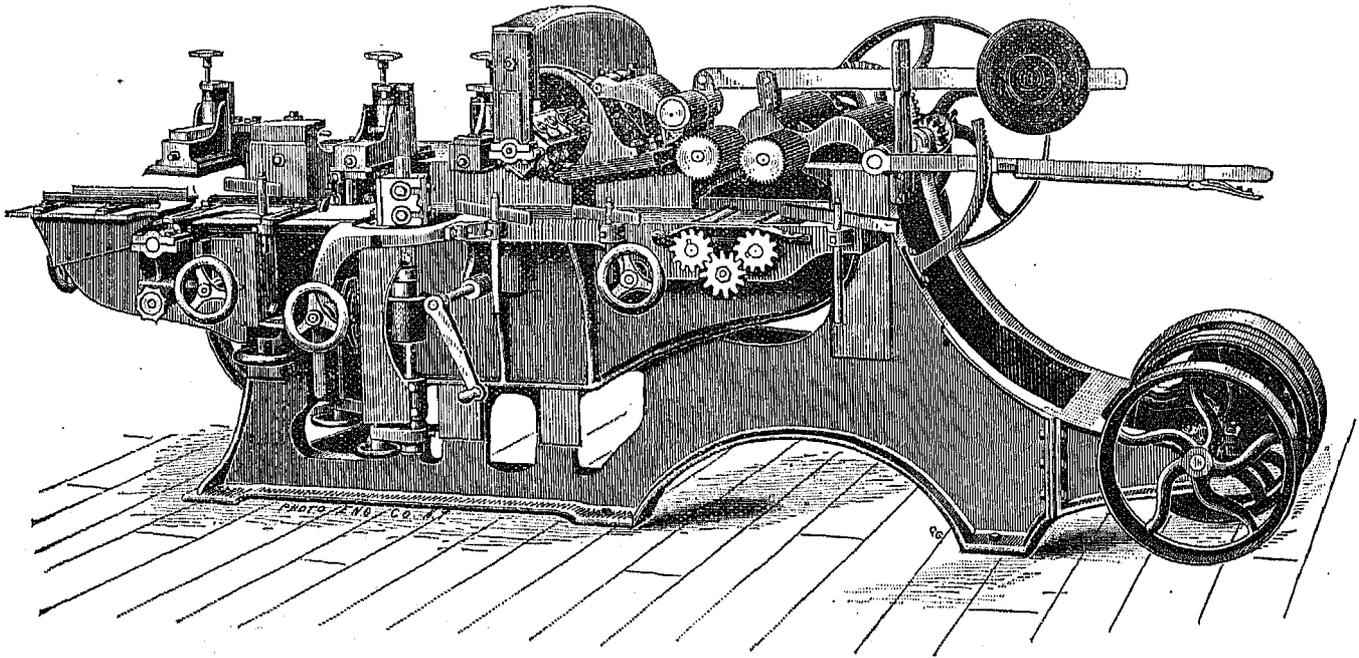


Fig. 482.

the foot for angular motion and to prevent chatter from wear. There are two pair of rolls driven by power engaged by friction-clutch below the table. These give a strong feed, and the upper rolls are fluted with spiral grooves, which tend always to feed the stock against the side of the frame which acts as a guide. There are springs adjustable in lugs in the table to keep the stock firmly in line and in contact with the frame. A solid pressure-bar and chip-breaker lies in front of the upper head, and an adjustable one with a foot holds the profiled stuff for the

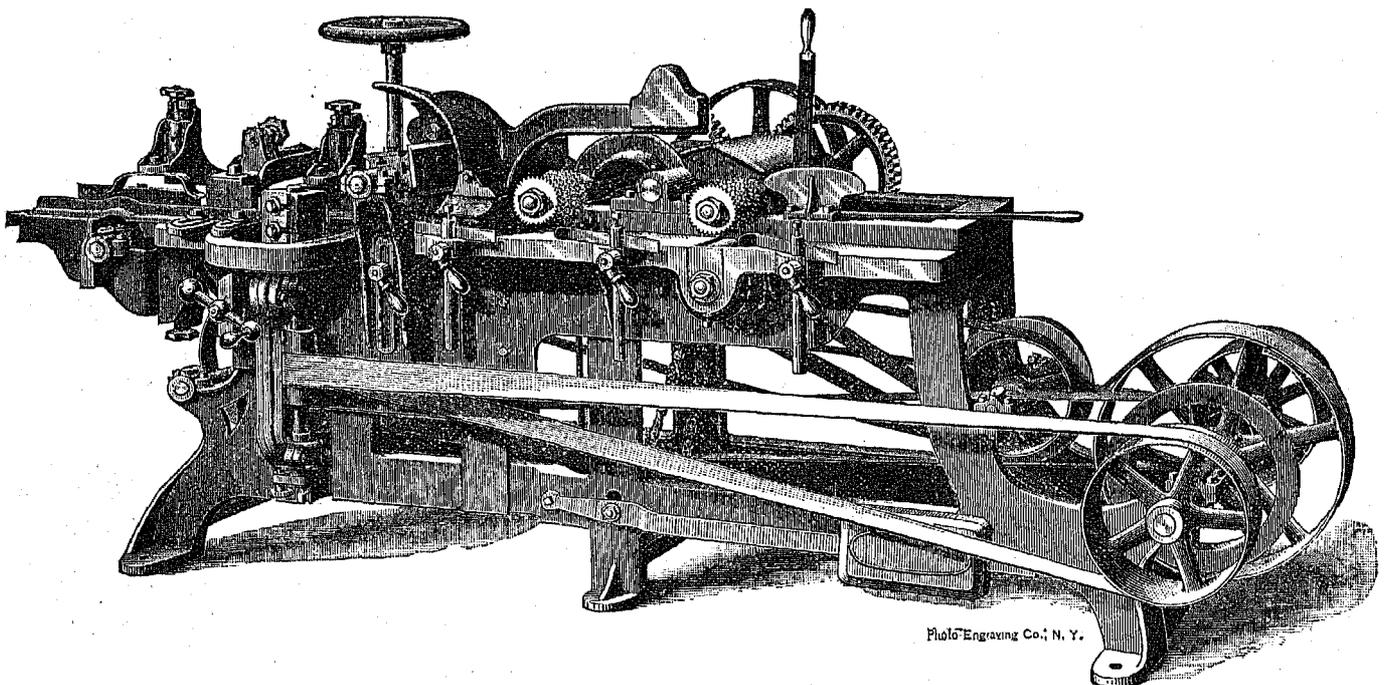


Photo-Engraving Co., N. Y.

Fig. 483.

side heads. These latter are not put opposite each other, in order that there may be no danger if it is desirable that the cuts of the two sets of knives should overlap. The machine shown has the upper head overhanging. This is wise and possible for narrow machines. Where the work is to be heavier and wider the outer end of the spindle should be supported.

Fig. 482 shows a machine for molding 10 by 4 inches, with the spindle supported by an arm overhead. This system leaves the table free at the side. The feed-rolls are heavily weighted and fluted, all the rolls being driven. There are three pressure-bars, arranged with holders for sections of wood to fit the profile. A chip-breaker is in place in front of the upper head. The side heads have all the usual adjustments, lateral, vertical, and angular. At the further end of the table, beyond the under cutter, a section of the table is made adjustable, and is arranged so that a diagonal smoothing-knife may be mounted at that point. Beside the heavy gibbed slides for steadying the table, the ends may be bolted to the frame by a screw-bolt in a slot. The lifting-screw is geared to a horizontal shaft coming out in front. The counter-shaft is bolted to an extension of the bed-plate.

Fig. 483 shows the type where the outer bearing of the head is attached to the table, which must rise and fall behind it. The upper rolls are of a spur-tooth or serrated profile, arranged to lift perpendicularly. The lower

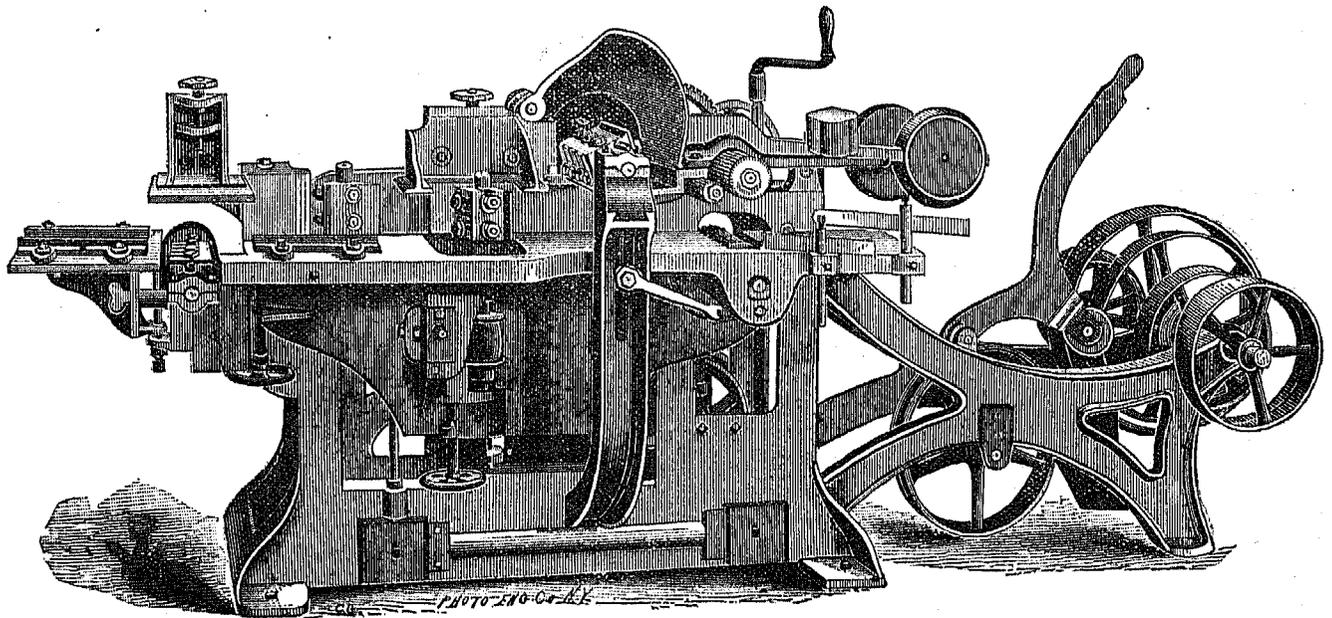


Fig. 484.

rolls are smooth, and are also driven. The upper rolls are so hung upon a crane-like frame that they may be lifted from the stuff by a lever at the rear if desired to arrest the feed. The use of gearing-chain is to be noticed. The shaving-bonnet and pressure-shoe are pivoted in front of the cutter-cylinder so as to follow the knives closely, and can be swung entirely clear for access to the cutters. The lower cylinder has a separate vertical adjustment independent of the bed, so that its cut may be varied without shifting the knives. The upper cylinder-boxes are held in a gateway, which is gibbed to the frame for easy lateral adjustment. In Fig. 484 the outer bearing is supported from below the table, and independent of it. The bolt in the slot gives additional security. Its other features are sufficiently obvious. The molding-machines of this class are specially adapted for shops which make a specialty of builders' moldings, and require to turn them out in large quantities. This work they perform very rapidly and very well.

#### § 49.

#### UNIVERSAL WOOD-WORKERS—VARIETY WOOD-WORKERS.

The growth of small wood-shops at distances from the large centers has made a demand for a machine which shall have many other functions beside that of turning out linear moldings. To these the name of universal or variety wood-workers is given, on account of their large capacity for different kinds of service. One side is made entirely independent of the other, so that there are really two machines. One side is known as the molding-side, and the other half is called the wood-worker side. Fig. 485 shows a perspective view of such a machine, and Fig. 486 illustrates the molding-side. There are *five* heads in use at once, of which two act upon the upper side. These may divide the cut if it is heavy, or one can be used to take out dirt and make a rough cut, while the second finishes the upper surface. The lower head acts first at the front to plane the lower side of the material smooth

and out of wind before it reaches the molding-heads. The side heads rise and fall with the table, and have separate adjustments horizontally, vertically, and at an angle. A pressure-bar with wood foot lies between the two upper heads, and the shaving-bonnet may swing out of the way of the knives. Four of the cutter-heads have helical cutters, giving a dragging or shearing cut. The fifth is parallel and slotted. The feed-rolls are serrated,

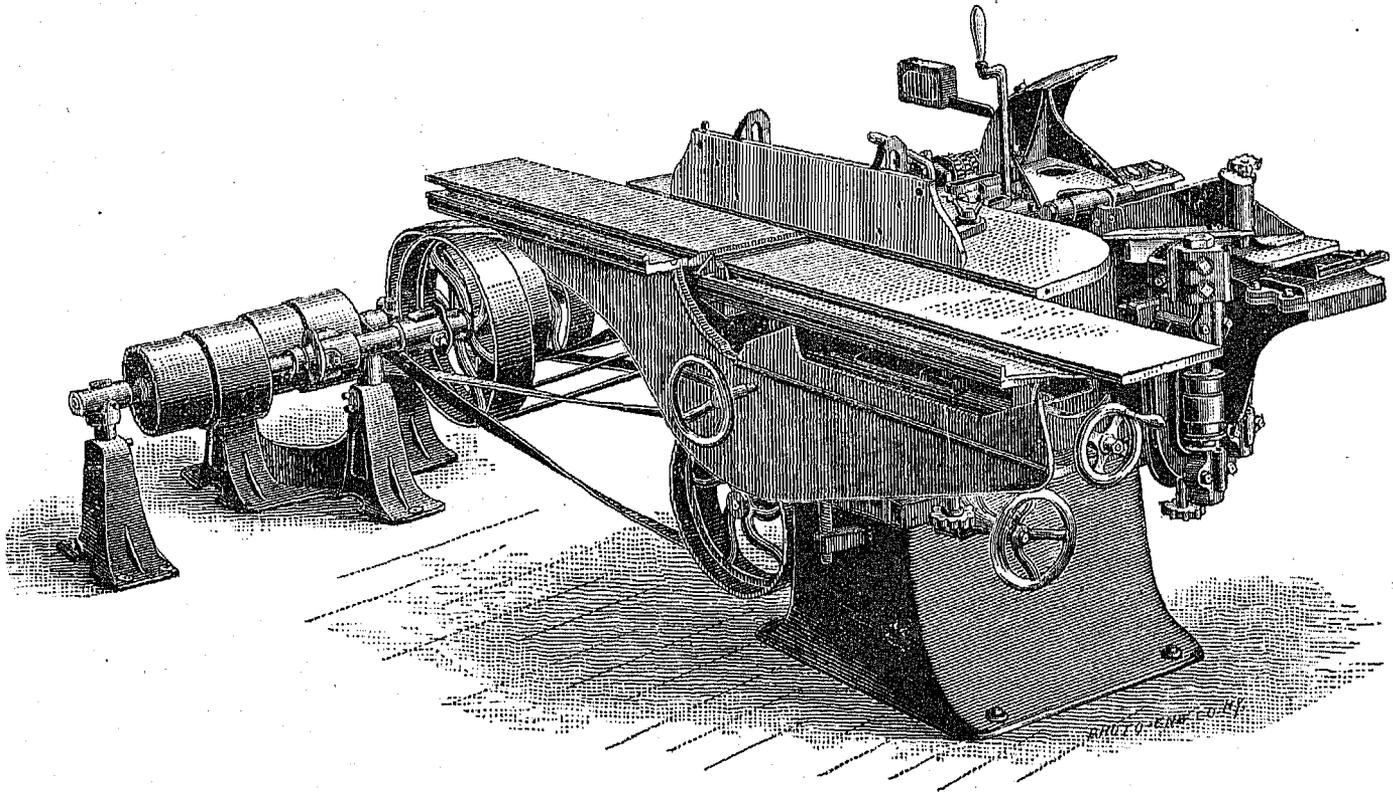


Fig. 485.

and are kept to their work by weighted levers. The form of platen for the outgoing end is more plain in the previous cut. The construction of the wood-worker side is essentially like that of a buzz-planer. The whole table

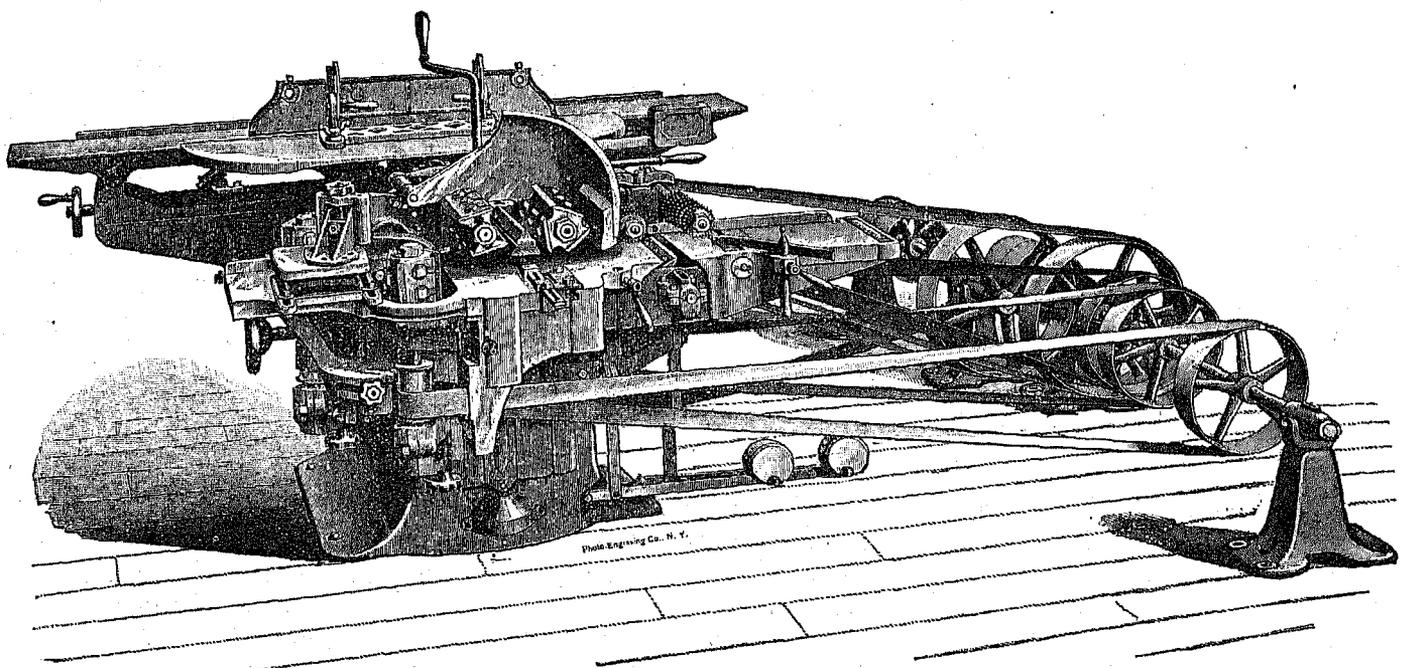


Fig. 486.

lifts and lowers by screw and hand-wheel; each top has a horizontal motion to and from the cutter-head, and both tables have a vertical adjustment on inclined planes by screw and hand-wheels. The two tables may be brought

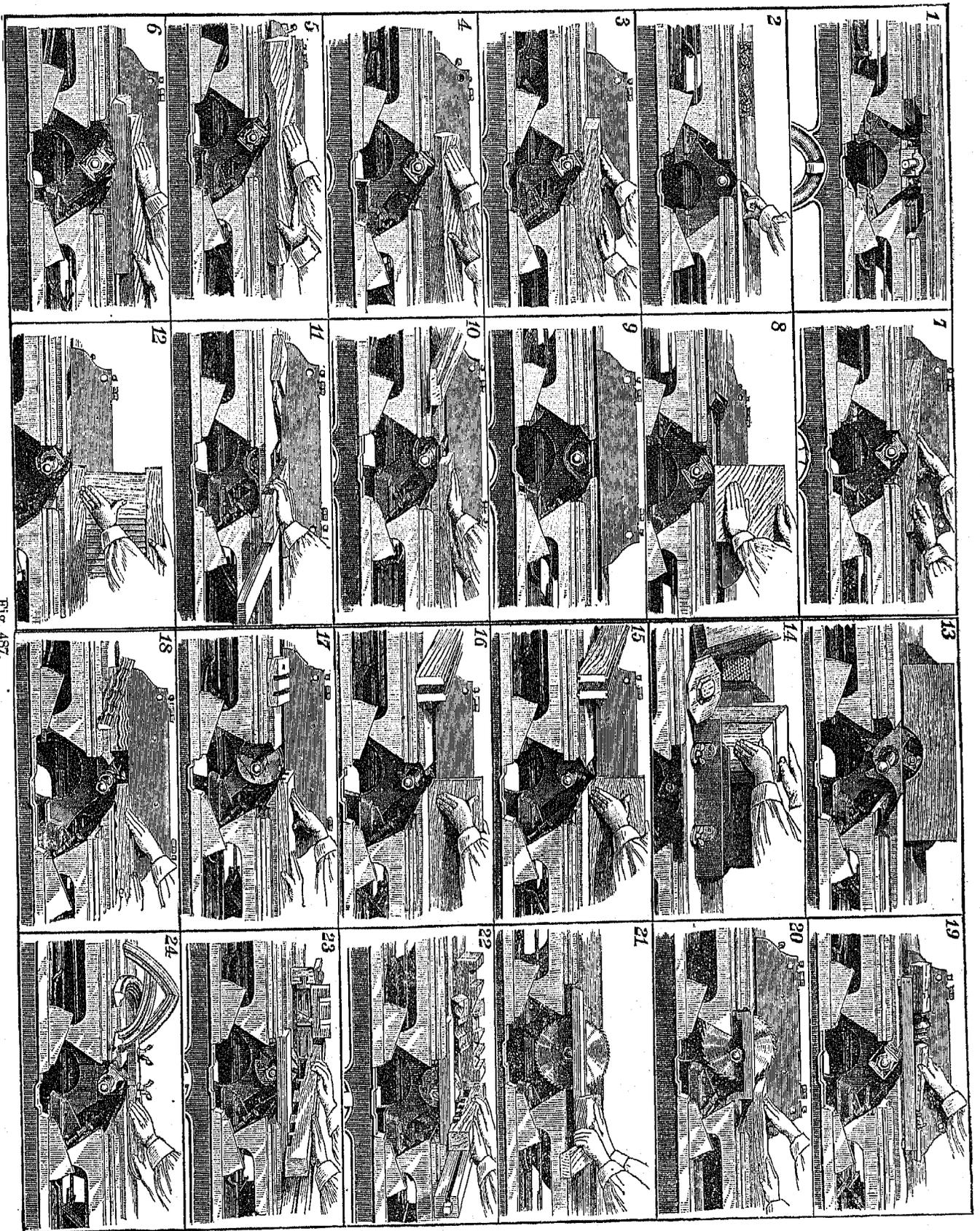


Fig. 487.

together over the cutter-spindle to guard against accident, and their accidental motion is prevented by thumb-screws and a rack with special pawl. The fence gives wide capacity for chamfering and bevels. The plate (Fig. 487) shows twenty-four different positions or applications of the machine. The numbers indicate respectively:

- 1, 2. Tables slide laterally, raise and lower, recede and advance toward the cutters.
3. Planing out of wind, jointing, squaring and smoothing.
4. Beveling, cornering, and chamfering.
5. Chamfering between the ends.
6. Cornering with chamfering form.
7. Tapering.
8. Mitering.
9. Rabbeting head and iron.
10. Rabbeting.
11. Tenoning.
12. Rabbeting and jointing blinds at one operation.
13. Panel fence, iron and head.
14. Panel-raising, both sides at one operation.
15. Tonguing, grooving, hand-matching.
16. Rolling-joints.
17. Making two plows at one operation.
18. Serpentine and waved molding.
19. Planing and fluting banisters.
20. Ripping and splitting.
21. Cross-cut sawing.
22. Gaining at right angle.
23. Gaining at any angle.
24. Circular, oval, and elliptical moldings.

These operations are permissible without adding special machinery to a fundamental machine. It is only necessary to mount the proper cutter-head and to adjust the fence and tables. Their universality has made them very popular, especially where the amount to be done of certain classes of work is too small to pay the interest on a special machine. This is likely to be the case in small shops and in small settlements. There is considerable variety in the forms of the universal wood-workers, although certain features must be retained in them all. An older design has a boring and routing table opposite the wood-worker side, and the latter can be rapidly changed from a wood-worker to a molding-machine for two sides by dropping the table. By fitting a proper head on the vertical spindle the machine may be used as a single-spindle shaper or friezer. It is made reversible by two friction-cones, engaged at will with a third between them by a foot-treadle. In one class of designs the cutter-head has an adjustable and removable outer bearing, as in the sticker of the same builders. A design of solid-frame variety of wood-worker, without the molding facilities which make it a universal machine, is shown by Fig. 488. The cutters

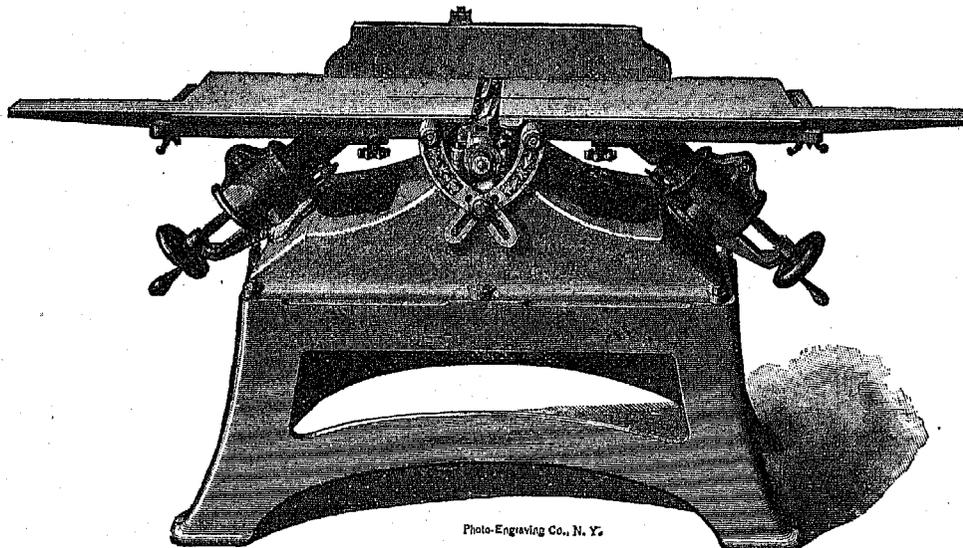


Photo-Engraving Co., N. Y.

Fig. 488.

are helically arranged, and the two tables have separate adjustment by the plunger-bearings and screws. The head has outside bearings on the frame. Other designs have a columnar bed, with an arrangement by which the fence requires no separate adjustment. It retains its proper position relatively to the cutters by virtue of its

attachment to the forward table. It has lateral and angular adjustment, and may receive springs for holding down the stuff. When such machines are used for sawing, the usual tables are separated and a special one fits between them. Sawing is, however, not a legitimate use to which to put such machines. The broad scope of these universal and variety wood-workers adapts them to meet diversified needs; but where certain alternations would have to be frequently made, or where a certain class of work would keep a machine full and its operator busy, it is policy to have a special machine. Where, for instance, a quantity of tonguing and grooving is to be done to match small boards or tapering, such a machine as shown in Fig. 489 would be used. Taper or small work cannot

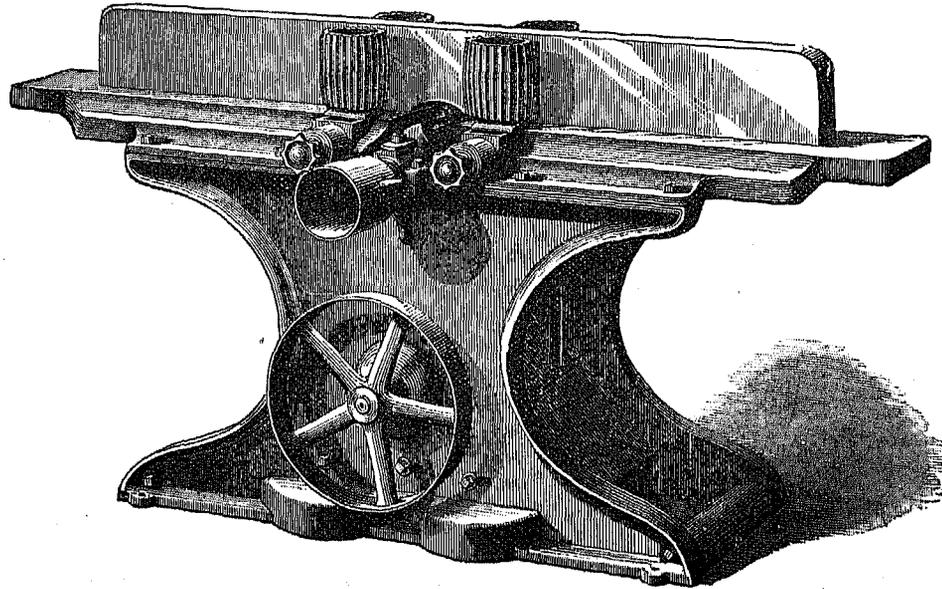


Fig. 489.

conveniently be matched in a large machine, and to do it on the wood-worker demands an entire change of head from that suitable for its usual functions. The same is true for panel-raising and edge-molding, to be discussed in the sequel. The machine of Fig. 489 has the central fence stationary, and the rolls and cutter-heads are adjustable horizontally for differing thicknesses of lumber. The rolls are heavily driven by gearing below, which is protected by the guards shown. Changes of feed can only be made by changing the large pulley below the cutter-axis. The fence carries friction-rollers, and the stock is fed in one direction to be grooved. It is returned in the reverse way on the other side of the fence, to be tongued by the other head. The feed may be by hand, if preferred. Such a machine may be found very valuable, either supplementary to the wood-worker or as a machine by itself.

## § 50.

## EDGE-MOLDING OR SHAPING-MACHINES—FRIBZING- OR CARVING-MACHINES—PANEL-RAISING AND DOVETAILING-MACHINES.

Under this head is included a large class of machines which carry vertical spindles, fitted with rotary cutters at or near the top, which latter act upon their ends or sides. The machines are designed to produce profiles upon the edges of surfaces which could not be reached in the typical molding-machine. The edges to be profiled are often internal, and very often are curved, both of which conditions are prohibitory to the other type. Usually the feed is by hand, guided by formers or templates to which is secured the material to be operated upon. The template bears against a collar on the spindle. These tools are very nearly on the line between the paring-tools and those which act across the grain also. Most frequently they act by paring.

Inasmuch as in a curved molding the grain runs in opposite directions on its opposite sides it becomes necessary to have either two spindles revolving in opposite directions or else to have the one spindle reversible. The latter is perhaps the newer practice. Fig. 490 illustrates the type which has long been standard. The two spindles are driven by quarter-twist belts from the counter-shaft at the rear. The pulleys on the spindles are very wide and crowning, and a flange at the bottom acts also as a balance-wheel. Instead of one upright, many builders make a framed bed, the spindles being supported on cross-girts between the two sides. The top may be of alternate strips of wood, glued together to prevent warping, or it may be of iron. In the design shown the lower box is also a foot-step. A steel foot-screw supports the weight and thrust of the bearing. The back of the box is of babbitt-metal. The front is of brass composition, which is slipped in place, and is held by a set-screw through the cap of the box. The spindles always have a vertical adjustment to bring the cutter-knives to the proper level.

The upper end of the spindle ends in a species of chuck (Fig. 491), by which two flat knives of the required shape may be held firmly by the central screws and the set-screws. Many firms are using solid cutters, which can be milled to the required profile, and are not as liable to the dangers which attend the flat knives. If a knife works loose in a spindle revolving at 5,000 revolutions, as these small ones may, the centrifugal force transforms it into a dangerous missile.

Fig. 492 shows a form of one of these solid cutters for edge-molding, and Fig. 493 shows how the cutter is freed between the edges to diminish friction and to give clearance to the cut. The dotted line shows the full

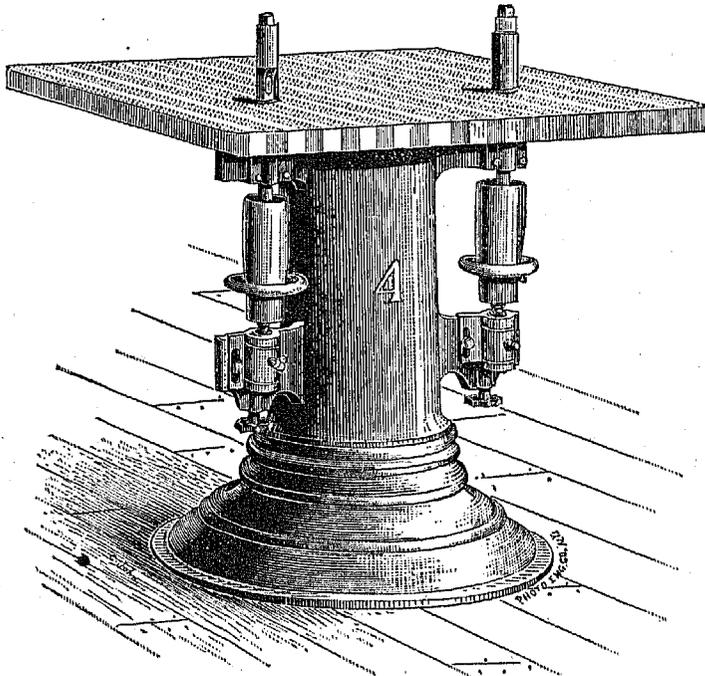


Fig. 490.

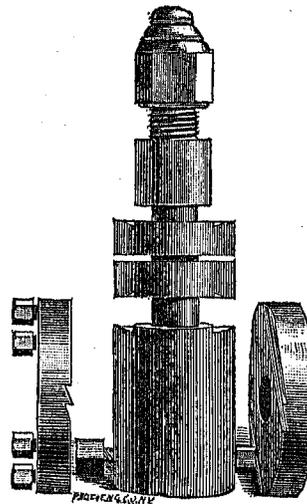


Fig. 491.

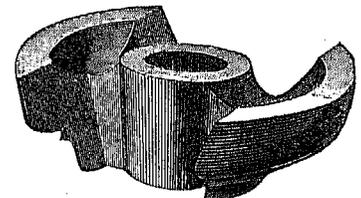


Fig. 492.

circular profile. Cutters of this type cut at all four edges, so that they may be reversed. They are a specialty of one of the carving-machine builders, and are milled from Pittsburgh steel. For the protection of the fingers in the use of the machine a cage or shield may be put over the spindles supported on an adjustable upright.

There are objections to the use of the quarter-twist belt. The spindles must run very rapidly, and since the pulley is small a wide belt is needed to prevent slipping. The counter-shaft, too, must be at some distance from the

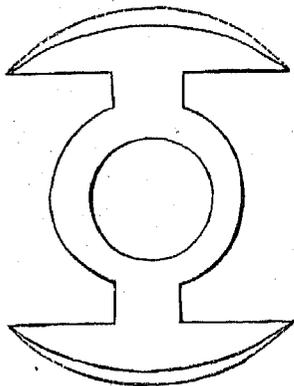


Fig. 493.

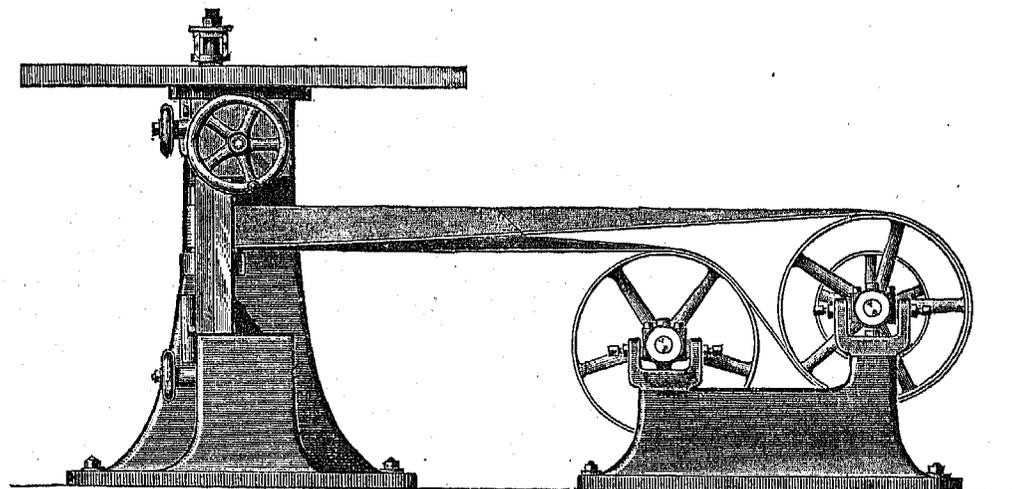


Fig. 494.

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machine, to avoid a very great strain and wear due to the twist in a short interval. The design shown in Fig. 494 in side view and in Fig. 495 in front view exhibits the use of large guide pulleys to cause the belts to approach the spindle-pulleys more nearly at right angles to their axis. The shaft-boxes are adjustable and swivel. The two spindles turn in conical brass journal-boxes, which are borne in a frame gibbed to the base-casting. These frames are adjusted vertically by inclined planes worked by the hand-wheels. The cutter-knives are held by compression from the nut above them.

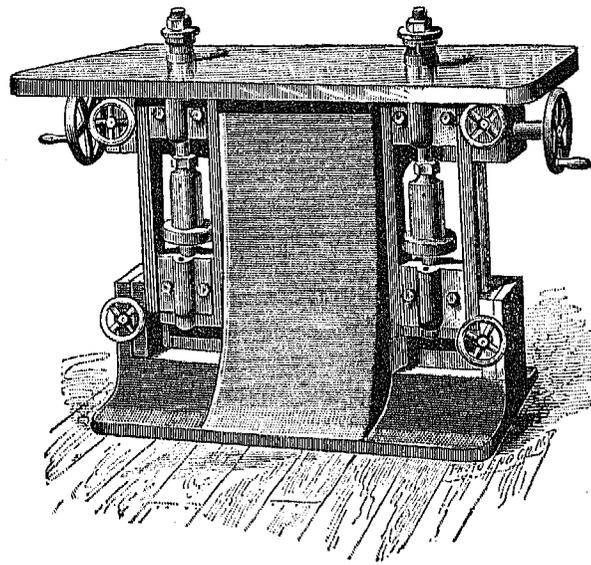


Fig. 495.

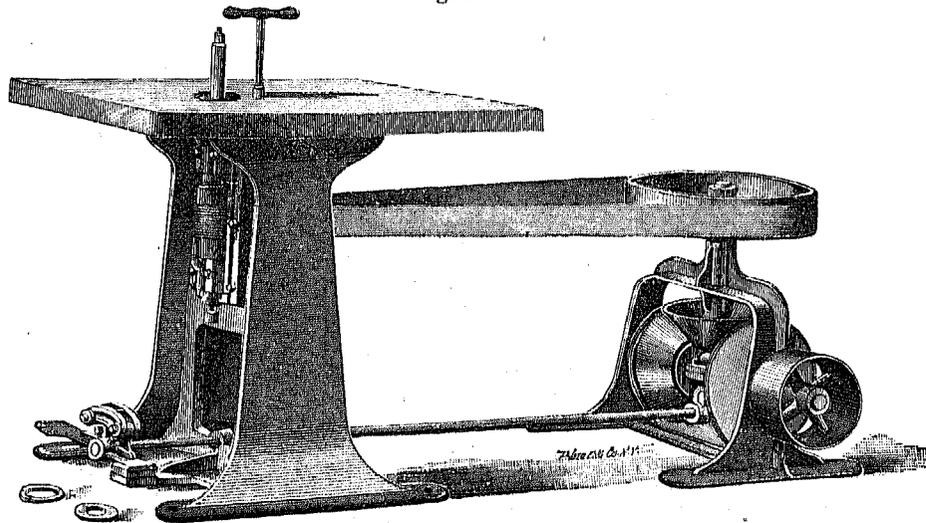


Fig. 496.

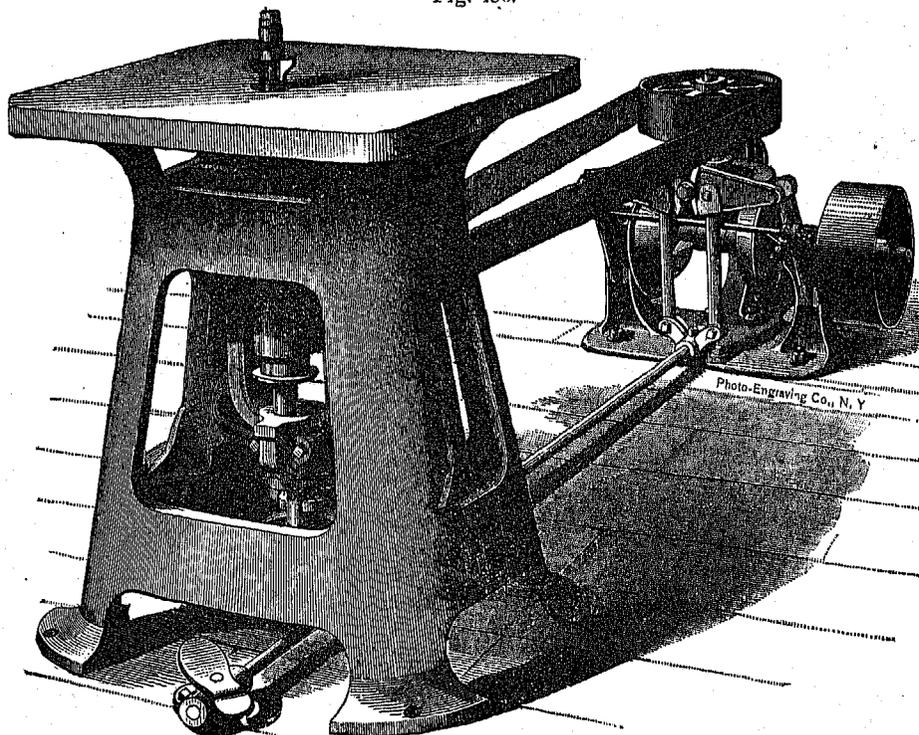


Fig. 497.

The western builders have sought by the use of a simple reversing device to secure the advantages of a straight belt and of a single spindle. Fig. 496 shows one of these designs. The loose pulley is dispensed with, and the vertical shaft may be driven by frictional contact with one or the other of the cones on the shaft. The foot-treadle turns the rocking-shaft and shifts the driving-cones into contact with the follower. The latter is an iron wheel; the surfaces of the other two are of paper or of glued tar-board. The spindle-gate is raised and lowered by the socket-wrench. The slides are of dovetail form. The lower bearing consists of a conical box inside of a cylindrical case, with step-screw at the bottom. The friction device of Fig. 497 consists of paper drivers and iron follower, the shifting mechanism having some original features. The cones are shifted by the foot through the torsional shaft, which throws the spiral sectors. They bear upon the roller upon the stud between them, and thus lock the levers. In another design by the same builders the two cones are on the upright shaft, and the reversal and arrest is effected by a rock-shaft, controlled from a handle at the left of the table. The spindle frame is double, of a ribbed section, and the bottom step is made adjustable and self-oiling. The frame has vertical and angular adjustment, for flat and deep moldings.

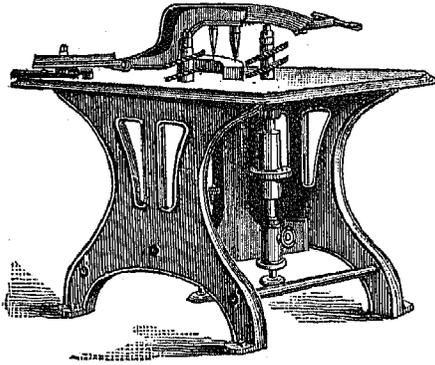


Fig. 496.

Fig. 498 shows a machine for shaping which uses saws set obliquely on the vertical spindles. The fine teeth do not cut or tear, but give a shearing or oblique action, which fits them for working against the grain. The illustration shows how arcs may be produced by the use of a machine of this class. The pointed holders are pivoted around an adjustable center.

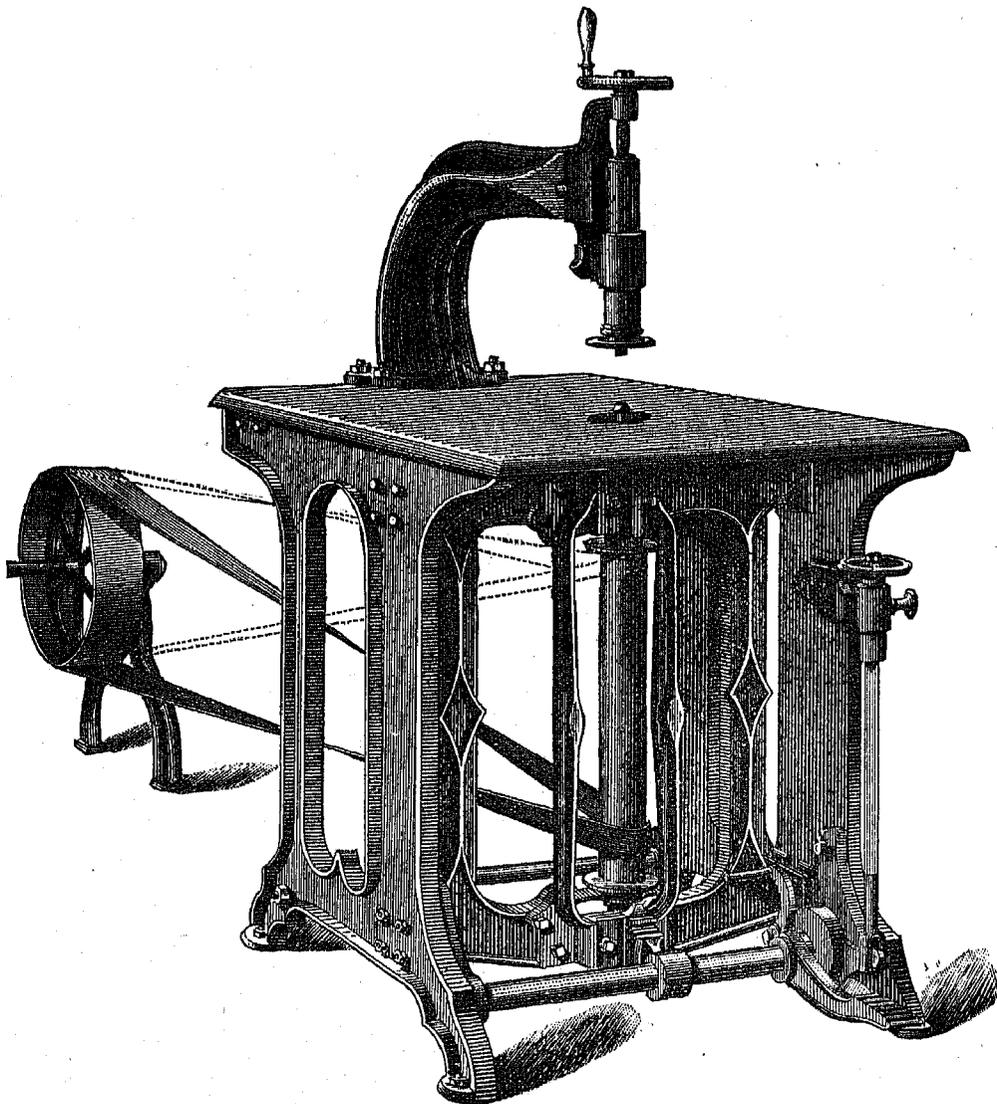


Fig. 499.

The machine of Fig. 499, while applicable as a friezer, is especially fitted for carving or for raising panels. The counter-shaft has open and crossed belts, and the spindle-pulley has to have a length greater than the diameter of

its driver to permit the quarter-twist belt to follow its tendencies when the counter-shaft is reversed. The newer machines have three cones, and avoid the twist. The work to be carved or paneled is secured to a former or templet, which is guided by the pin in the bottom of the pressure-plate on the upper spindle. This plate acts as a platen to resist the lifting action of the cutters. It is adjustable for thicknesses. The upper box of the spindle is babbitted; the lower journal has a brass box, with steel washer and step-screw. The feed of the cutter to its work is given by the foot-treadle, adjusted by the screw at the side, with suitable stops when the right depth

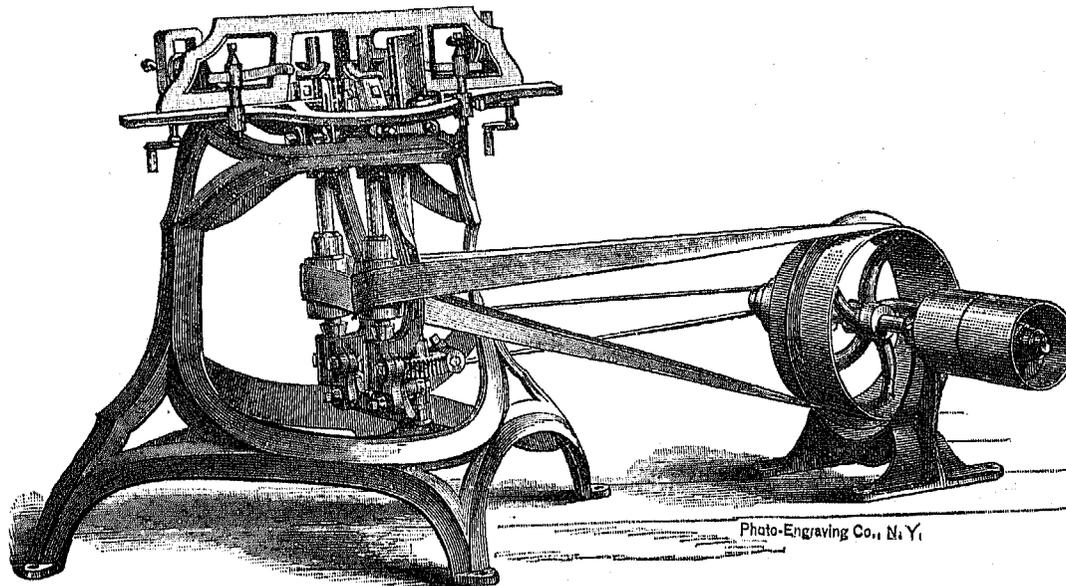


Fig. 500.

is reached. Upon the top of the table special attachments may be bolted for elliptical molding and for bracket-molding. It is in this latter function that this tool finds a field to replace the jig-saw. A rotary mill replaces the platen, and is driven over guide-pulleys on the back from the counter-shaft. A tool of the type just described is the only one which can sink panels. For raising panels in relief the usual type of machine is shown by Figs. 500 and 501. There are two vertical spindles, one on each side of a guiding-fence. By the two spindles both sides

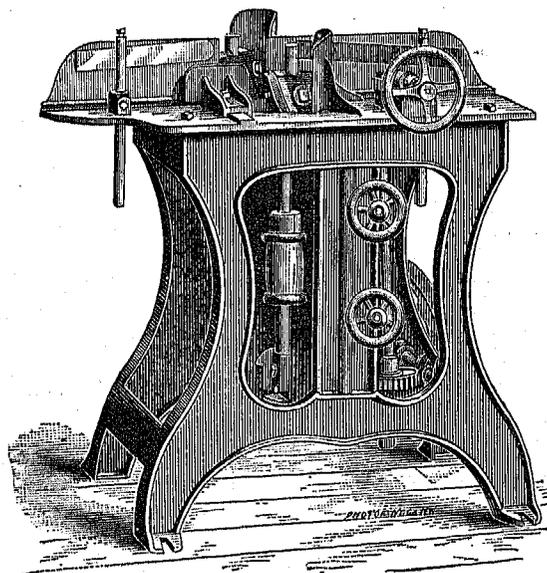


Fig. 501.

of stock may have panels raised on them or intricacies of grain may be provided for. The spindles are fitted with knives to produce a helical or dragging cut, and any profile for the edge of the panel may be secured by properly-shaped knives. The spindles are adjustable laterally for different thicknesses of panel-bed, and also vertically for different widths of panel. There is also an angular adjustment sidewise. Springs in suitable holders confine the stock to the fence. It is usually fed by hand; power feed-motion may be provided, in the shape of a spirally-corrugated roller in front of the cutters.

Panels may be also raised by the universal or variety wood-worker by the mounting of suitable cutter-heads. Where there may be much of it to be done, it is worth while to mount such cutter-heads separately, in order to avoid the temporary stoppage of the wood-worker in its more usual operations. Fig. 502 shows such a machine, built with a wooden frame. The shield for the cutters is shown detached at the foot of the table. The cutters are held in the head, so as to give an oblique cut, and both sides may be worked at once. Lateral adjustment of the cutter-heads and vertical adjustment of the table are required, and are both provided for. The removable knives render unnecessary what would replace the angular adjustment of the vertical spindles, and in respect to simplicity there would seem many advantages in favor of this latter type.

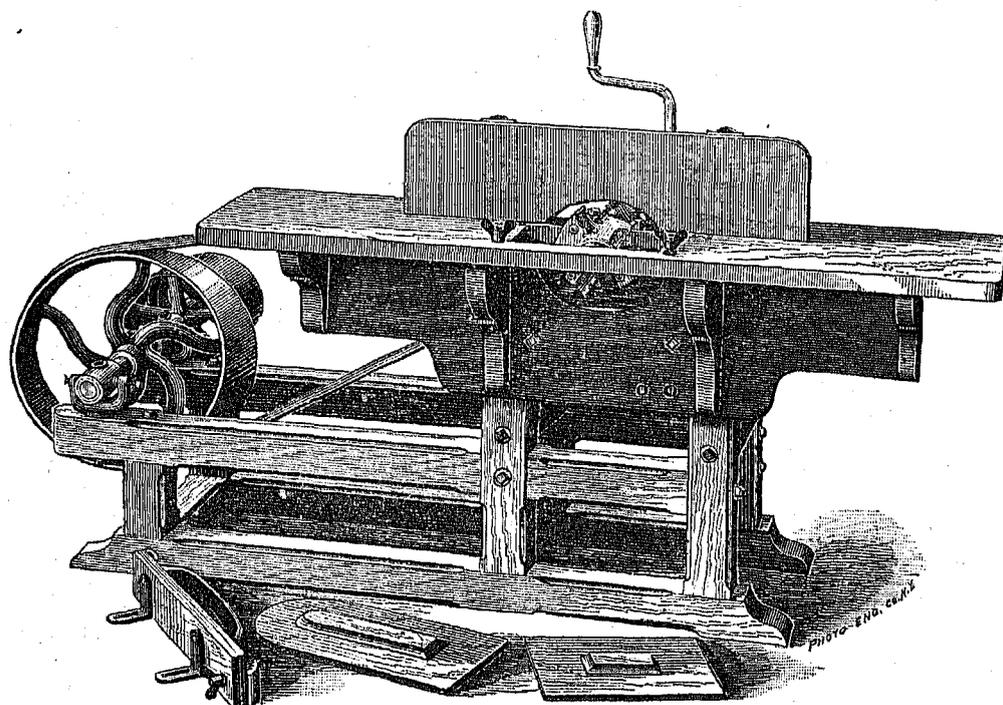


Fig. 502.

The adaptation of the friezer or carver for dovetailing is exceedingly simple. The spindle carries a cutter of the shape shown in Fig. 503, and by varying its size and shape every proportion may be secured for the joints. A simple clamping, feeding, and spacing carriage runs upon ways clamped to the top of the table, and cuts the front and side dovetails at one operation. Fig. 504 shows the attachment for the carver and molder made up into a separate machine, as it is judicious to do where it can be kept full and remunerative. The front and side are clamped in place, and are fed to the cutter by an arm with a sector. The edge of a spring falls into notches to

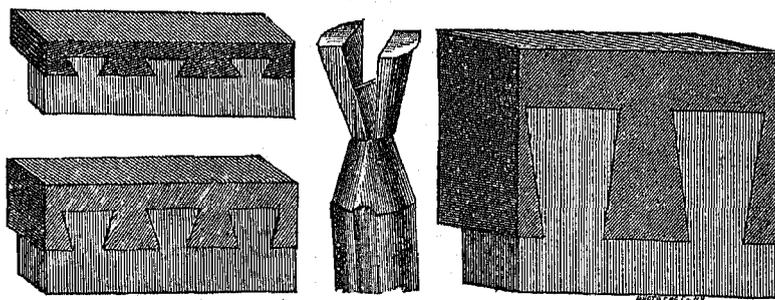


Fig. 503.

give equal spacing. The linear cutter insures the fit of the pins, since the edges of front and side are cut by the same lines. Thicknesses from one-quarter of an inch to  $1\frac{1}{2}$  inches may be dovetailed with equal facility. The mechanical features of its construction are the same as in the carver of the same builders. Fig. 505 shows a different form of a similar machine. This form of dovetail is stronger than the Knapp dovetail, with round pins made by a hollow auger, and superior to the Yankee dovetail, where the ends of the sides are left straight without being scalloped.

The radius-planer of Fig. 506 is an edge-molder with horizontal axis. The material to be planed and shaped is clamped to a pattern and presented by hand to the cutters which have the required profile. Such a machine, beside working crooked and cross-grained stuff, can be used as a machine spoke-shave or smoothing-plane for very narrow work. Forming-guides go with the heads of various profile, for cornering, chamfering, and rounding, and the machine may be made useful in many kinds of manufacture.

## G.—TOOLS ACTING BY PARING.

The tools belonging to this subdivision bear about the same relation to wood-working machinery that milling-tools bear to the metal-working tools. For irregular outlines upon curved shapes they fill a large field, and one of very great importance in wood-conversion by machinery.

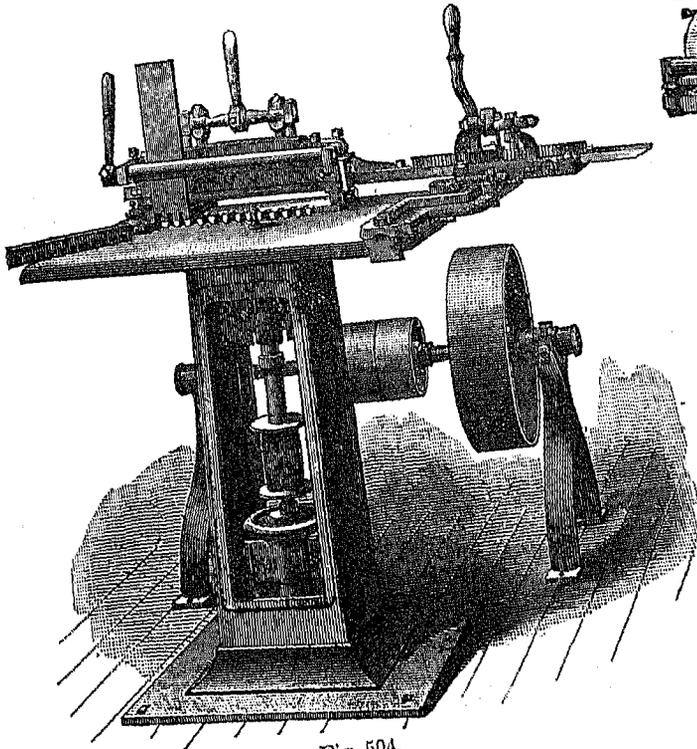


Fig. 504.

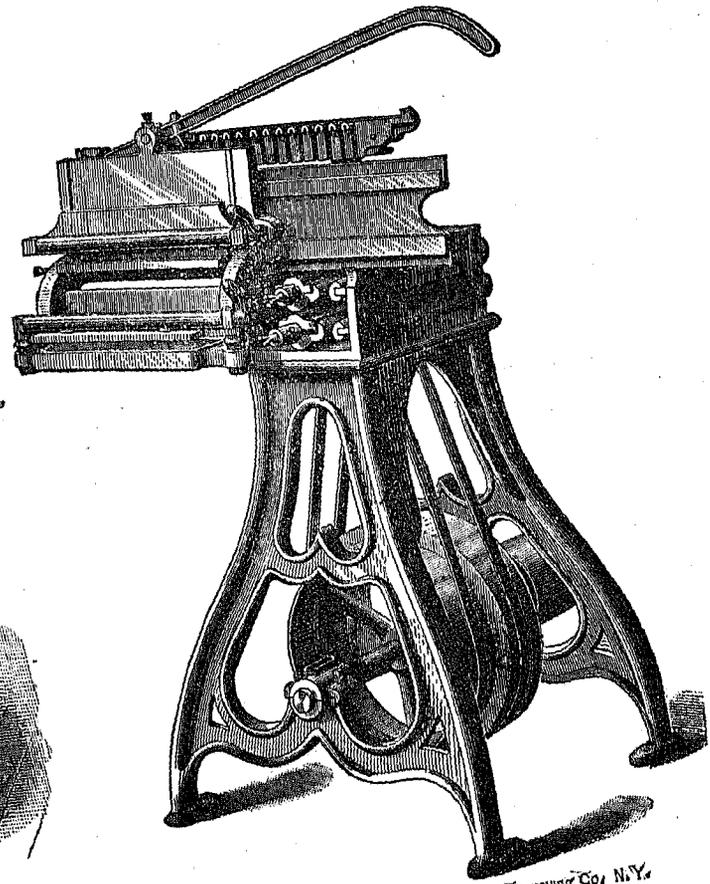
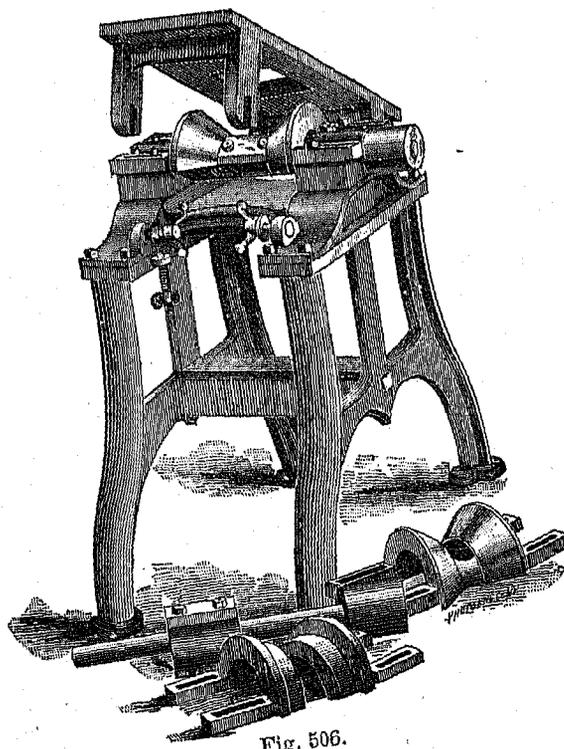
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Fig. 505.

Fig. 506.