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PAPER CUTTING MACHINES

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PAPER-CUTTING MACHINES

A PRIMER OF INFORMATION ABOUT PAPER
AND CARD TRIMMERS, HAND-LEVER
CUTTERS, POWER CUTTERS AND
OTHER AUTOMATIC MACHINES
FOR CUTTING PAPER

BY

NIEL GRAY, JR.



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PREFACE

THE paper-cutting machine is a recent development in the industrial world. Its importance in the graphic arts is only just being recognized. That it has heretofore been considered an apparatus of minor importance is proven by the lack of information on the subject, either historical or technical. No mention is made of a paper-cutting machine in the eleventh edition of the *Encyclopedia Britannica*, either in the index or under the various trade headings. Mention is omitted entirely from *De Vinne's History of Printing*. There are no references to it in many other standard books, nor in the engineering libraries; neither are there any comprehensive articles on the subject in any of the trade journals, either American or foreign. A few scattered references may be found in dictionaries and manuals having to do with bookbinding and presswork.

This manual on the paper-cutting machine has the distinction of being, as far as the author knows, the first book ever written on the subject. It will endeavor to help toward a better understanding of this important mechanism, its use and care, and it may also serve as a starting point from which subsequent treatises may be written.

The difficulty of making a successful machine of this kind to meet the new demands for accuracy, speed, convenience, and safety, has been overcome gradually in recent years and there are now several machines quite efficient and adequate to meet these demands of the modern manufacturer. To coördinate a number of inanimate pieces of steel and iron, to operate at high speed with pre-

cision, requires fine skill. The evolution from the first cutting machine—the old hand-operated wooden plough and press—to the present power-driven steel mechanism is like the advance from the old wooden sailing vessel to the modern steel ship.

The objects of this manual are to acquaint the beginner with the essential features of the machine itself and to provide clear, comprehensive information which will enable him to become a competent operator. It is not possible within so small a book to give complete detailed instructions for all the different conditions which may arise in the many kinds of work done in establishments where paper-cutting machines are used. Each of these places has its own particular requirements; and while the machine can do its part quickly and efficiently it needs the intelligent and skillful operator to get good results. The instructions given herein for a few cases, which have been made as general as possible, indicate the complexity of this operation as carried on in modern workshops. There is necessity for a careful study of the subject in any important industry to insure this part of the work being successful and profitable.

Not all the kinds of cutting machines in use in the printing and bindery industries are considered in the following pages, but simply the typical machines in common use for cutting and trimming printed paper. There are many other styles, such as die-cutting presses, automatic book-trimming machines, punching, stabbing, and eyeletting machines, rotary cutters and revolving-blade cutters attached to presses and other paper machines. These might properly be classed under the title, but as they are chiefly specialized machines the limits of space do not permit a consideration of them here.

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PAPER-CUTTING MACHINES

Importance of the Paper Cutter

A PAPER-CUTTING machine is used for dividing piles of large sized sheets into smaller sized sheets; also for squaring a pile; *i. e.*, making all four corners rectangular; and for trimming off irregular or incorrect edges.

It increases the possible printing output largely because presses of large size can now print many duplicates of a single design on a single sheet, and many of these sheets piled can be separated at a single cut, whereas a fly or rotating cutter cuts but one sheet at a time.

The importance of the paper-cutting machine can hardly be overestimated. The correct position of the printed matter, the widths of head, tail, and fore edge may be destroyed by careless cutting. Friendly coöperation with every department is necessary to produce good work. No matter how fine the printing and color work is, if the margins are uneven and the folds mismatched, then the resulting air of slovenliness discredits the entire work. The final touch that gives the character to a piece of printed matter is the way it is trimmed.

Modern power automatic-clamp cutting machines, in spite of the high speed of their operation, are able to cut with absolute accuracy. Perhaps on no other machine will a little careful study return so large a profit in dollars and cents.

Evolution of the Paper-Cutting Machine

The practice of cutting paper began long before the making of the book of bound leaves, and the necessity of making a number of sheets of the same size called for some mechanical means of cutting and trimming. The earliest cutting machine was no doubt a sharp stone or a stick; then a piece of metal, dragged across the parchment, with a guide to keep the cut in a straight line. The sheet was simply held by the hand, and later the straight-edge formed a clamp also.

About the fifth century the important step of folding the vellum into leaves became the practice. The instrument which we know to-day as scissors or shears probably had a large part to do in these early operations. With the invention of printing and the multiplication of books larger and stronger means were necessary to cut the sheets. Although the book with the untrimmed sheets was the rule of this earlier time, and of a later time, for the smaller books and for divisions of the sheet a cutter was necessary.

For a time the cutting of piles of paper was done by hand with a knife, a small pile being put upon a table and a weight laid upon it. The operator leaned his weight with one hand upon it, while he cut with the other. The earliest attempt to improve this consisted of a table, a framework of wood or metal above it, having a groove in which the knife could be worked, and a screw clamp to hold the pile. The knife was originally short; then longer, until it became long enough to cut through the thickness of the book. The deckle-edge of the earlier and untrimmed books was improved upon and made easier to turn over and refer to rapidly by the improvement of

trimming the leaves. The hand-plough cutter was probably the first successful machine intended to cut a number of sheets at a time.

In the Haupt Halle at the great Graphic Arts Exhibition, Leipzig, 1914, were some illustrations showing the earliest German cutting machines and their evolution to date. The earliest among them is the lightly constructed hand-driven vertical cutter of 1855. This consisted of two side frames, the knife-bar guides in their slots and a large hand wheel at the right. The next stage was a cutter of 1876, a hand-driven wheel at the right turning gears above and outside the table. A crank and a rod connected to the center top of the knife-bar pulled the knife in the direction of the two slots in the knife-bar, giving it a shearing motion. This model is the same as that used by most German manufacturers for both hand and power-driven cutters until within a few years, when the greatly improved, rapid, and more convenient American examples became known.

From simply pressing with the hand to hold the sheets the hand clamp was evolved; then the clamp was attached to a gear by which it could be held down on the sheets with greater and steadier pressure. To quicken this operation the spring clamp was devised, with automatic pressure—fixed at first, then variable to suit varying requirements.

Perhaps the most signal advance in the art of paper-cutting machinery that has been made is the invention of Samuel R. Brown, who devised the fixed "throw" of the knife by means of two cranks at opposite ends of a shaft parallel with the knife. This control of the knife enables a hair to be cut through, or half through, or the knife edge to just touch it, with remarkable precision. The

various other mechanical connections for power-cutting machines between the pulley and the knife, consisting of rolls, slots, guides, cams, chains, levers, etc., all require a great number of parts between the pulley and the knife, with the consequent and necessary "looseness" of the mechanism. This allows, after short wear, a play or "chug" of the knife which quickly tends to destroy its best cutting abilities.

The evolution of the cutting machine has been rapid and distinctly marked in all its essential features, from the oscillating plough to the vertical stroke, to the shear stroke, to the double-shear stroke; from a single-rod pull-down of the knife (by a chain, by a cam, or by a crank) to the two-rod pull-down by cams, rolls, slots, slides, to the cranks which give a fixed dependable stroke; to the cranks which give a fixed dependable stroke, and at the same time pull the knife endwise; from swinging-link shear to a straight-line shear; from man-drive to power-drive; from driving by power fixtures in front and outside the frame to fixtures located back and underneath; from low piles to high piles; from hand clamp to power clamp, to self clamp, to automatic clamp, finally to friction adjustable pressure clamp; from measuring by rule to the use of rapid automatic measuring and spacing devices.

The best paper-cutting machine is designed with a knife motion operated by cranks which give an endwise pull to the knife; with the table of medium height; with quick and accurate adjustments for the knife; with a foot treadle for bringing the clamp down to the pile when desired to see exactly where the knife will strike; with an accurate and dependable device for moving the back gage and the pile and measuring quickly the widths to be cut; with starting handles easily reachable without bending;

with a powerful clamping pressure automatic for all height piles and instantly adjustable for heavy or delicate work; with universal fine adjustments for squaring the back gage with the knife; with a simple change for the cutting stick; with the driving shaft running at a low speed; and with a powerful main driving clutch or friction material that will not cut or damage the parts under the heavy, constant thrusts.

Description of Typical Machines

PLOUGH AND PRESS CUTTER

An early form of cutting machine, made almost entirely of wood. The pile of paper or book was clamped to the table by the upper cross-bar of the clamp, which was brought down by the geared vertical arm. As shown by

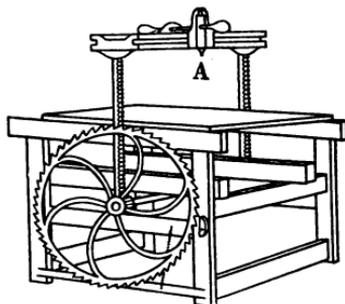


Fig. 1. Plough and Press Cutter

CARD CUTTER OR TRIMMER

picture, these arms were raised and lowered by turning the large toothed wheel. The steel chisel (A) operating in a holder running in a groove, was moved to and fro across the paper, cutting deeper each time as the chisel was gradually lowered by the handle.

Card trimmers are knives hinged at one end to a base upon which the work is laid and held, while the knife is

pulled down by hand to shear it off against a metal edge. Stock cut this way has a slight burr on its lower edge, caused by the "drag" or downward pressure of the knife.

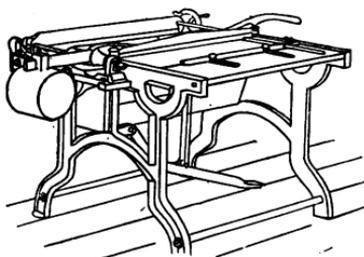


Fig. 2
Binder Shears or Table Cutter

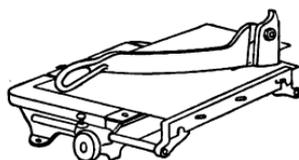


Fig. 3
Card Cutter and Trimmer

To cut cards free from burr a rotary card-cutting machine is used, with a rotating shaft carrying a small wheel cutter. These cutters are used on a workbench.

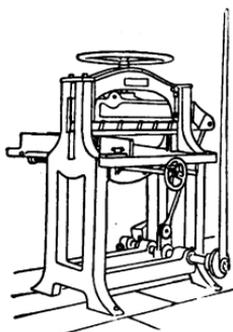


Fig. 4. Hand-Lever Cutter

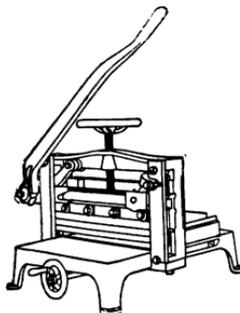


Fig. 5. Bench-Lever Cutter

HAND-LEVER CUTTER

Hand-lever cutters stand on the floor and have a convenient height table to lay the work upon. The cut is made by pulling the knife down through the pile. The knife is hung from two swinging links, and is easily operated

when it has double shear and a toggle crank connection to the hand-lever shaft.

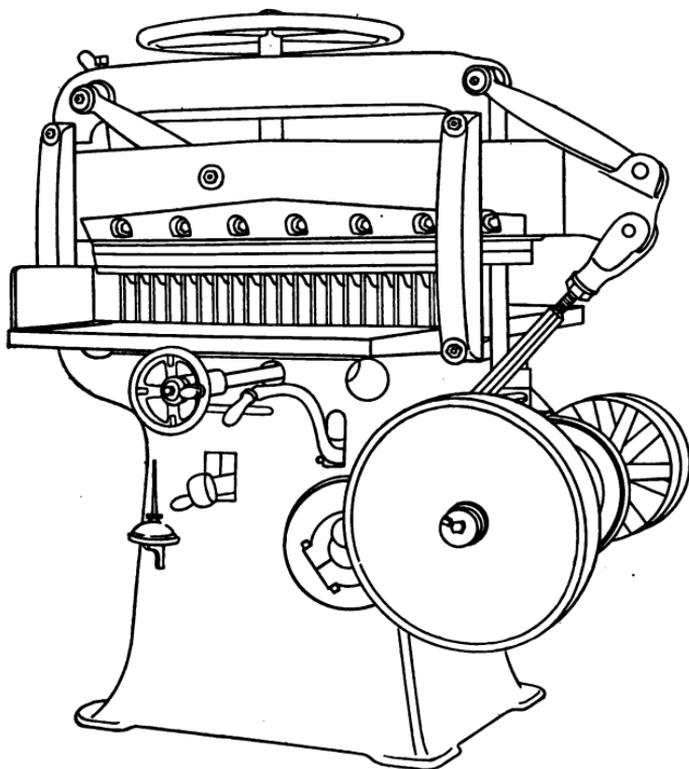


Fig. 6

POWER CUTTING MACHINE (HAND-CLAMP)

Knife Pulled Down at One End

Power cutting machines substitute power fixtures for the hand (sometimes in addition to the hand operating fixtures), and eliminate labor and save time.

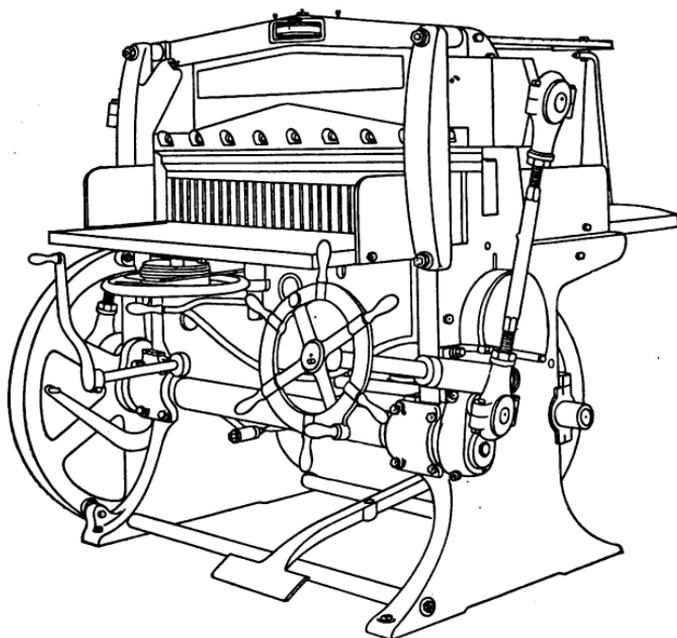


Fig. 7

POWER CUTTING MACHINE (HAND-CLAMP)

Knife Pulled at Both Ends

A hand-clamp power cutter is operated first by screwing the clamp by hand down firmly upon the line where the work is to be cut; then pulling the starting lever, which causes the knife to make the cut, return to the top, and stop.

Semi-automatic means a cutting machine which has a treadle to bring the clamp down quickly upon the work, and a regular hand-clamping wheel instantly acting to produce the clamping pressure when it is turned a part of a revolution. The clamp returns automatically to the

top by touching the treadle lightly with the foot and giving the clamping wheel a slight backward turn. The advantages are the simplicity of construction and operation of the regular hand-clamp machine; and a gain of about one-third greater output with one-third less effort.

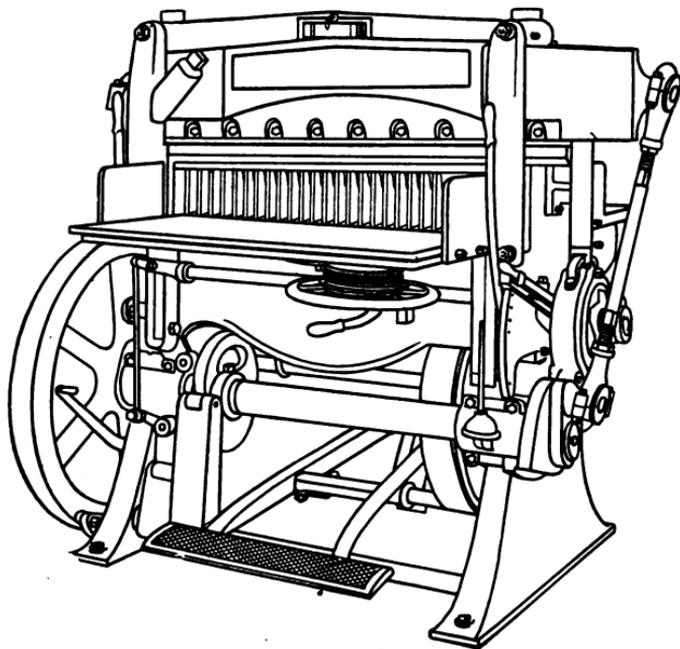


Fig. 8

AUTOMATIC-CLAMP POWER CUTTING MACHINE

With Instantly Variable Automatic Clamping Device

Automatic-clamp power cutting machines save labor by pressing the pile by power, instead of requiring the operator to screw the clamp down and back again by hand. In the larger sizes power attachments save the labor of pulling the back gage and work forward by hand. Automatic

spacing (or measuring) devices for duplicating any desired width, without the customary measuring for each cut, enable larger production.

An automatic power cutter is operated first by determining the line of the cut by the indicator or by pulling the clamp down upon the work; then pulling the starting lever, which automatically forces the clamp down first upon the stock, and then drives the knife through it, and returns both knife and clamp to stop at the top.

Automatic-clamp power cutting machines are also furnished with hand-clamp attachment for special clamping pressures.

Continuous running is effected by devices which permit the quick disengagement of the stop throw-out mechanism. This is desirable with duplicate work in quantities carefully arranged for fast production. Automatic cutting machines are also furnished with spacing devices for the rapid duplication of exact widths of any size.

Vertical stroke (and vertical changeable to shear stroke) cutting machines (see Fig. 9, page 17), both hand power and also power, are used with special shaped knives for cutting fancy edges, and pinking cloth samples, etc., some having back tables of great length, moved on rollers or slides by spacing devices. Considerable ingenuity has been shown in the variable method and mechanism used for moving the knife up and down.

The Knife

The knife is most important. It must be kept sharp. It must be of the proper shape and thickness and bevel and temper and free from any burrs or lumps on its back edge. A cutting-machine knife is like a razor that,

stopped correctly, does not pull the beard, but stopped an infinitesimally different way—a difference impossible to see except with a microscope—pulls hard. Study carefully the knife. No matter how carefully the machine is built, an imperfect knife cannot cut right. Most knives are imperfect in spite of the rigorous specifications given

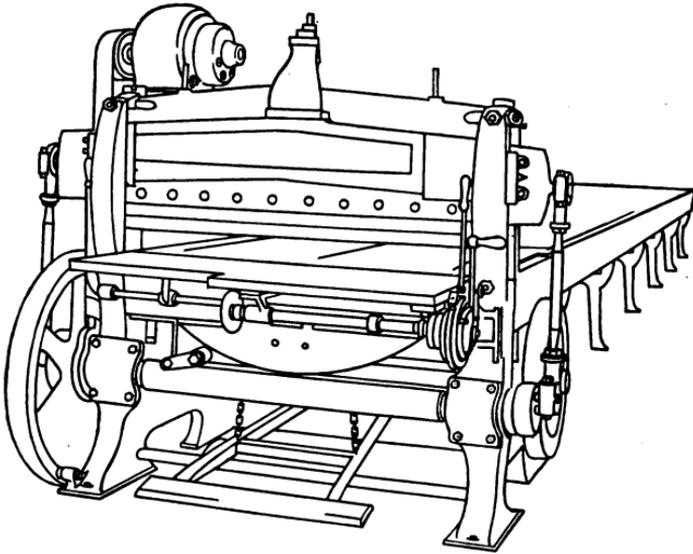


Fig. 9

VERTICAL-STROKE POWER MACHINE

Changeable to Double Shear

them by makers. They vary in thickness, straightness, concave, bevel, flatness, temper, and quality of steel; and also in the character of their sharpening and honing, which varies with the fineness or coarseness of the grinding wheel and stone. These variations need only be a few thousandths of an inch to cause trouble.

A blue wave mark indicates where the temper is drawn, and a file which "drags" when pushed fairly hard across the flat of the bevel indicates the soft spots, where the temper is imperfect.

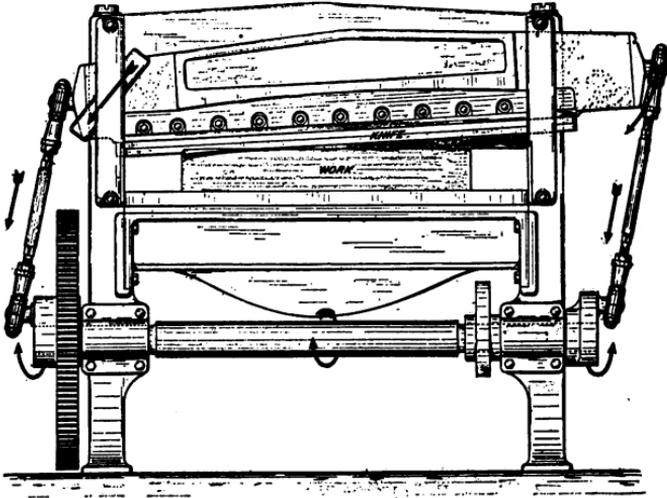


Fig. 10

DIAGRAM SHOWING DOUBLE SHEAR STROKE OF THE
KNIFE PASSING OBLIQUELY THROUGH THE PILE

At the beginning of the stroke the knife is higher at the right-hand side; when finishing the cut the knife is parallel to the table

To ascertain if a knife has a correct face, hold it flat, face up, with one end on a window ledge, and look along the face for variations. This is a simple matter which any one can do. Use a perfectly straight and clean-edged steel rule and pass it along from one end to the other as shown in Figs. 11 and 12. A dark spot shows the point of contact of the rule with the knife. These dark spots should show only exactly at the cutting edge and at the

back edge. If a dark spot shows away from the cutting edge, it indicates that the knife is imperfect there and will not make a true cut. Re-grinding the face by the makers can correct this fault, except where it is the fault of the one who hones the knife after it is sharpened.

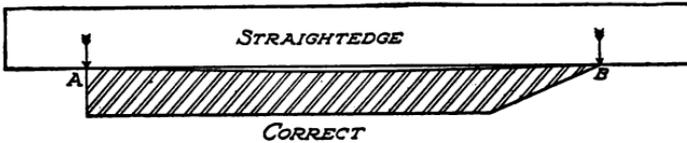


Fig. 11

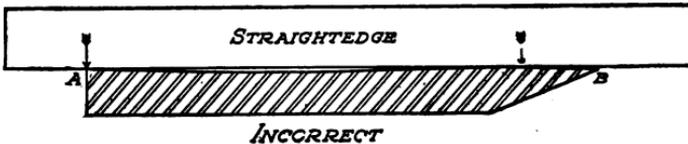


Fig. 12

Hone the knife only on the bevel. To remove the wire edge burrs along the edge lay the hone flat on the face and rub gently so as not to round over the edge.

A knife will sometimes cut better after it has been ground the first time. A polished knife will give a better surface to the cut. The cutting of the same kind of stock will often vary with different makes of knives. An oily rag tied to a stick kept handy and passed along the bevel of the knife before cutting hard stock will improve the cut. A blunt bevel is preferred for hard stock; a long, thin bevel for soft stock.

A general rule for the length of bevel on knives is two and one-half times the thickness of the knife. This may be varied to suit the different materials to be cut, but must

be held within reasonable limits to preserve the strength of the cutting edge of the knife and also to secure accurate, clean cutting.

The face of a knife should be as nearly flat as possible and must not be convex. It is better to have it concave than convex, but not over two or three thousandths of an inch concave. A knife that is too concave or convex will tend to dig in or out of the work.

For safe clearance the knife should be a few thousandths of an inch thinner at the top than the distance from its back to the line of its cutting edge.

The knife bolts should always be screwed up snug, so that the cutting edge of the knife will have the correct pitch in relation to the pile. The top or back edge of a knife should be held absolutely straight to get a firm thrust—bearing all along the knife-bar. Knives abutting against adjusting screws for this reason are not apt to give so good results as knives that abut against a solid shoulder all across the knife-bar.

Dirt, oil, grease, paper, chips, etc., in the knife-slot or bar, or a bruise or nick on the back edge of the knife, or a defective knife bolt, may prevent the knife seating firm and true in its proper place and may cause poor cutting.

Knives bought from the maker of paper-cutting machines are apt to give the best results because they receive two inspections: one by the knife maker, and another by the machine maker, who is careful to see that only perfect knives are supplied.

In order to understand how important it is to use a sharp knife on a power cutter, throw off the belt and pull the machine around by hand through a high cut with a dull knife. Then put in a sharp knife and make the same cut. Where there is much cutting to be done and the

machine is in constant use, it is well to keep extra knives on hand to allow one to be sharpened while the other is being used.

A specially tempered knife is best for boards or varnished paper. Gummed and varnished stock are likely to break small pieces off the knife edge. The double shear motion for the knife now furnished on the new automatic rapid production cutting machines practically eliminates this trouble.

The first place to look when work is not cut true, after making sure there is correct clamping pressure, is the knife. See if it is sharp. See if it has been honed properly. See if it has the proper length of bevel.

Grinding Paper-Cutter Knives

It is best to grind with a soft sandstone; but if an emery wheel is used, it should be about 46-60 grain, 5½ grade, or soft enough so that a light feed can be taken without burning or glazing the bevel of the knife.

The operator of the grinding machine should be in constant attendance while the knife is being ground, and should have a liberal supply of water feeding on the wheel where it comes in contact with the bevel of the knife, *not* at the top of the wheel. If this supply of water is cut off and the wheel continues to grind without water, this will create friction, heat up, and draw the temper in the knife or crack it.

Extra precaution should be taken to grind the cutting edge of the knife parallel with the back of the knife, and not have one end of the knife wider than the other. When this occurs the cutting edge of the knife does not hit the cutting stick squarely, and not only has a tendency to

snip out at the wide end, but also to destroy the cutting stick quickly.

The bevel should be ground flat or a shade concave, and must not exceed twice the thickness of the knife, plus one-quarter inch, or twenty-four degrees. If this rule is not adhered to and a longer bevel than this is ground on the knife, the flat side or face of the knife will become rounded about one-half inch back from the cutting edge, thereby taking the slight concave out of the knife and causing the machine to cut tapering; *i. e.*, the top of the cut, say four or five inches high, will be narrower than the bottom of the cut.

If a knife is ground on the rim of an ordinary emery wheel worn to a small diameter, the smallness of the emery wheel will tend to make the bevel concave. This weakens the edge of the knife. A knife grinder with a cup-shape emery wheel makes it easier to grind the bevel straight.

Honing Paper-Cutter Knives

Every knife, when coming direct from the grinding machine, has a wire edge which should be honed off before the knife is adjusted to the knife-bar. Excellent results in honing are obtained from No. 1 Washita oilstone (Pike Mfg. Co., N. H., U. S. A.), or an india oilstone made by W. H. Price, Hartford, Conn.

The knife should be laid on a bench or table, flat side down, with the edge of the knife protruding about one-eighth of an inch beyond the edge of the table. The hone should be held flat on the bevel, and the motion should be a circular or rotary movement as well as up and down, and the honing should be done from one end to the other without lifting the hone from the knife.

When a fine wire edge appears on the flat side, lay the hone on lightly with no pressure and absolutely flat, and draw from one end to the other. After honing the knife for a short time (four or five minutes) the wire edge will disappear or get so thin that a small piece of white pine or other soft wood, if drawn along the cutting edge, will eliminate this thin wire edge. Never hone the flat side of the knife. Never hone a knife while in the machine.

A wooden holder for the oilstone will protect the fingers.

For smooth "glass edge" cutting, the bevel of the knife may be ground slightly concave. Then hone thoroughly with an extra fine hone slightly convex in shape.

No method of grinding has yet been devised which will leave a perfectly smooth surface, because no matter how fine the stone or material that is used for grinding it will leave marks on the edge of the knife, and these marks cause roughness in the cut. The reason the above method gives almost a perfectly smooth cut is because a thorough honing removes most of the marks.

The Clamping Pressure

The clamping of the stock in the machine while the cut is being made is an important feature of a modern paper cutter. This is done by means of a horizontal bar placed behind the knife and parallel with it. This clamping bar is moved up out of the way while the stock is being placed in position and is then brought down with the desired pressure to hold the pile of sheets firmly until the cut is made, and is again lifted up out of the way.

In the simpler machines the clamping pressure is obtained by means of a stout vertical threaded rod to which

the clamp bar is attached at the lower end. The rod is operated by a hand wheel at the top and turns in a threaded opening in the cross-head of the frame.

Clamping pressures vary greatly under different conditions, from a light pressure to several tons. The ratio of the power applied in hand clamping to the pressure secured on the clamp is, in ordinary commercial machines, about 1 to 150 for small machines up to 32 inches wide, using a 2-foot-diameter clamp wheel and overhead screw. The ratio of power in cutting machines 34 inches and wider, having a 1½-foot-diameter clamp wheel, and worm of ¾-inch pitch at the side engaging a worm gear keyed to the clamp shaft, is about 1 to 180. That is, a pull by the hand of 1 pound on the overhead clamp wheel will produce about 150 pounds pressure of the clamp on the stock to be cut; and a pull by the hand of 1 pound on the side clamping wheel will produce about 180 pounds pressure of the clamp, less friction. Operators will pull ordinarily from 10 to 100 pounds; *i. e.*, producing a pressure of from one to nine tons.

The first type of automatic-clamp cutting machines produced always the same arbitrary pressure on the clamp, with consequent waste of power, crushing and indenting the work, offsetting the ink unless it was absolutely dry, and requiring adjusting with a wrench, which was slow, dirty, and indefinite.

All modern automatic-clamp cutting machines have independent automatic-clamp pressure, and these apply the pressure at both ends of the clamp. The earliest power clamps were called "self-clamp." In these the knife and clamp were connected together (*i. e.*, dependent). The modern automatic-clamp mechanism is not only independent of the knife, but in addition practically all the

power of the belt goes first to clamp the work and then afterwards to drive the knife through the cut. This separation of the clamping effort from the cutting effort increases efficiency and economy.

By a modern device on some machines this clamping pressure is instantly variable to suit different kinds of stock and other conditions.

Cutting Sticks

The cutting stick, into which the knife passes after cutting through the bottom sheet, saves the edge from cutting on the iron table.

Correctly designed cutting machines have knife-bar motions that permit no "chug" of the knife into the stick and thus conserve its sharp edge. Many designs, however, are faulty in this respect and the unrecorded expense of their operation is a serious leak.

The cutting stick is set in a slot in the table. The most common and perhaps best form, everything considered, is a $\frac{3}{4}$ -inch square hard maple stick, set so that the knife strikes it $\frac{1}{4}$ inch from the edge. All four faces of such a stick may be used.

A metal frame for holding a $\frac{1}{4}$ -inch square hardwood stick, or a soft metal (so-called) cutting stick, is made. A round wood cutting stick connected to a timing mechanism which rotates it automatically for every cut, or for a certain number of cuts, is valuable for hard stock requiring microscopical perfection.

The Back Gage

The back gage is moved and controlled on the machine table in several ways. In the simpler machines the gage

is attached to a rod under the table, a long slot in the center of the table allowing the connection of the gage with the rod below. The rod is attached to the gage with a worm gear and is operated by a small hand wheel at the front of the table. In other machines the gage is attached to a steel cable, or a metal tape, or a chain which passes over wheels at the back and front below the table.

The one-piece back gage was improved by cutting it into two or three sections so that the first and final cuts of two or three piles may be made at every stroke of the knife. Adjusting screws are provided for tilting the back gage forward or backward to compensate for the variation in the width of the top and the bottom sheets which occurs in the same machine and with the same knife when cutting hard or soft papers. A swinging adjustment is also provided to "square" the back gage parallel with the knife edge.

Various devices for taking up the slack caused by wear in the table slot guiding the back gage are furnished, but probably the simplest and best method is the replacement and refitting of the inexpensive sliding part.

INDICATOR ATTACHMENT FOR BACK GAGE

The distance the back gage is moved is read in different ways. The movement of a gage operated by a screw and wheel is indicated by a pointer on the front edge of the table overlapping the rim of the long screw wheel. If the rim of the screw wheel is lined off in sixteenths of its circumference, the pitch of the screw being one inch, each complete turn of the screw wheel means that the back gage is advanced one inch, and each one-sixteenth turn means that it is advanced one-sixteenth of an inch. It is

important always to keep turning the screw and wheel the same way when so measuring, because otherwise the "back lash" (looseness of the screw and its nut to permit easy working) will cause variation.

For a back gage moved by a chain or a wire cable or a metal tape, a graduated dial is attached to the top of the cable hand wheel which reads from a pointer attached to the front edge of the table.

Both these ways of reading require the operator to look down.

For a back gage moved by power, a steel indicator ribbon passing around a wheel overhead in the frame cap and attached to a standard on top of the back gage (see Fig. 7) enables the operator to read the position of the back gage without looking down, and a second wheel indicator and pointer permits reading to less than one-thousandth of an inch. Similar indicator ribbons are attachable to the back gage for screw, cable, chain, and metal tape movements.

These indicator ribbons are usually graduated and marked for inches, halves, quarters, eighths, and sixteenths. They are also furnished with metric system measurements, graduated and marked for centimeters and millimeters. They are also furnished extra wide so that both the English inch measurements as well as the metric system measurements may be put upon the same ribbon. When graduated to thirty-seconds of an inch and millimeters a good magnifying glass of about three inches diameter, adjusted in front of the pointer, enables easier and more accurate reading. An easily operated lock for holding the back gage fast to the table at any exact mark prevents variation in the width of cutting.

Fixed distance gage rods and suitable engagements with the back gage are provided for cutting at any time dupli-

cates of exactly the same width, especially valuable for loose-leaf ledger work. Pins and holes drilled in the back gage and table also secure uniform locations impossible to get solely from reading the overhead ribbon or an indicator dial, which latter may be read incorrectly because of poor light or variation in the operator's position or eye.

Locking devices for the back gage ordinarily consist of (a) a friction grip around the moving screw, or (b) about the cable hand wheel, or (c) a clamping device which holds the back gage, or (d), best of all, a fixed grip rod-holding device operated from the front of the table, thus eliminating any possible lost motion through connecting parts from the jogging or chucking of work.

A back gage is split so that different width piles may be cut at the same time, such as trimming the heads, tails, and fronts of books. The fingers at the splits are placed smooth, so that they may be used as side gages to enable the wear of the knife to be taken its full width, instead of just at the usual left-hand end.

Power Back Gage Movement

The larger sizes of cutting machines are equipped with a labor-saving power connection to the main driving shaft which may be thrown in by the operator at will to move the back gage forward or backward by power, a micrometer reading the position to thousandths of an inch.

Special Devices

Special spacing devices for the back gage are revolutionizing many branches of work. The usual screw or cable is relatively slow and undependable and requires care and time to move the work the exact distance required.

The new way is to equip the cutting machine with a back gage operating mechanism having stops which can be set for any width to be cut. The operator simply pulls a lever between the stops, which instantly moves the pile and measures it exactly. Production has been increased six hundred per cent. with such spacing devices.

Gages for measuring the width of the cut may be simply a sample cut the desired width laid upon the pile, or an exact size wood or metal pattern, or the width may be determined by reading on a steel indicator-ribbon attached to the back gage the distance its face is back from the knife edge.

These methods are only approximately accurate, however; for exact cutting, steel distance-pieces of correct lengths to give the different widths of cut required are set against a fixed stop in the back table and the back gage run back until it grips the steel distance-piece. This brings the face of the back gage the desired distance from the knife.

Modern patented spacing devices for the rapid duplication of exact widths in succession, while the machine runs continuously without stopping between cuts, have been perfected so as to enable, on some classes of work, one cutting machine to do the work of six and still obtain accuracy. These spacing devices operate the back gage through a chain or a screw or a gear by means of a lever driven by hand or by power between accurately set stops fixed for any desired width, and thus eliminate the time ordinarily lost measuring the width for each cut.

Among other conveniences on the large modern cutters two starting levers, one at each side of the machine, or a starting bar extending across the front, save several motions at each cut.

A flat piece of metal, called a clamp face, which may be quickly attached to the under side of the fingered clamp, is used to prevent these fingers marking soft or delicate finished stock.

A snake gage is a folding lattice used in front of the back gage of a solid wide face clamp machine to enable the back gage to push the pile up nearer the knife.

For large pamphlets or magazines an extra clamp attached behind the regular clamp to hold the back of the pile down gently by spring pressure will prevent the sheets springing up and away from the back gage, caused by the folds and air between the sheets.

A plate attached to the machine with hooks upon which to hang the wrenches is provided upon the most modern machines and this helps the operator to keep them together and in order.

Guards covering the gearing, knife edge, pulleys, fly-wheel and other moving parts are required by many state laws, and power cutting machines are, therefore, so designed and furnished complete.

Application of Power

There are five methods of applying power necessary to operate paper cutters: by hand lever, by belt, by direct gearing, by chain and sprocket, and by direct connection of electric motor.

Figure 13 shows an electric motor on a bracket, adjustable vertically, attached to the frame of the cutting machine, driving by a belt from the motor pulley to the machine pulley. The belt cushions the heavy repeated thrusts of the clamp and knife in cutting upon the motor. The electric motor may be set on the floor or on a bracket on the wall.

Figure 14 shows a direct-gearred connection of the electric motor through its noiseless rawhide pinion engaging an iron gear on the machine driving shaft.

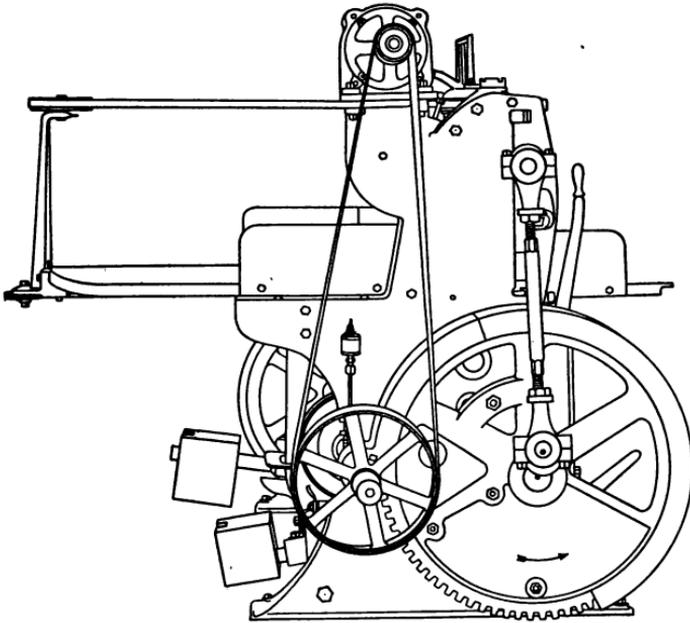


Fig. 13

ELECTRIC MOTOR OVERHEAD, BELT DRIVE

An adjustment is provided for taking up the wear in the gears, in order to maintain the noiseless running of the machine.

The chain drive is like the direct-gearred except that it substitutes a chain and two sprockets for two gears.

It is not generally understood what a large amount of power is required to drive a paper-cutting machine, and how important it is that the number of working parts connecting the belt pulley to the knife be as simple and

few as possible in order to eliminate friction and lost motion, and to secure efficiency. Every cut costs money for the power consumed.

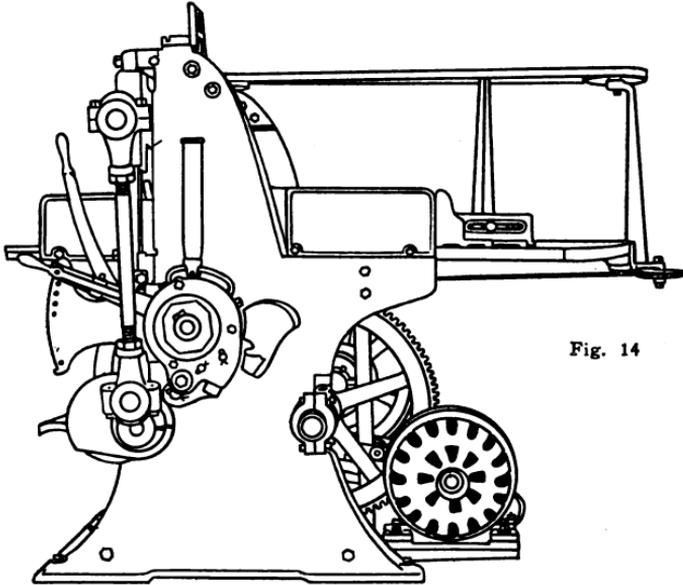


Fig. 14

ELECTRIC MOTOR UNDERNEATH, GEARED DRIVE

An inch-high pile of writing paper with a sharp knife may take one thousand pounds for each foot of length of the knife to drive it through. A higher pile on a fifty-inch power cutter may take three tons pressure, plus the automatic clamping effort and plus frictional losses, and (more important) plus a tremendous increase in case the knife is dull.

Care of the Machine

A man is known by the condition of the machine he keeps. Keep the knife sharp. That is the first rule to repeat

every day and every hour of the day. The second rule is to oil every hole and place required on the machine. The third rule is to keep the machine and its neighborhood scrupulously clean. The fourth rule is to learn by heart and follow the printed directions attached to the machine by the maker. If you do not understand or if you cannot follow correctly every instruction on the printed instructions attached to the machine by the maker, first ask your foreman or superintendent. If the directions are not clear, write, or ask the office to write, to the maker for a detailed explanation or to have his traveling representative come and explain them. Any operator who does not understand the adjustments of the machine he operates has but partly learned his trade. Be particular to see that the driving pulley on your machine runs at the speed given for it on the manufacturer's directions.

Keep the machine always in adjustment. See that the brake band is adjusted so that when the starting lever is thrown in to start, the friction is entirely released and there is no drag on machine.

Do not allow the knife to sink any deeper into the cutting stick than to sever the last sheet of the pile.

Never use more pressure on the clamp than is necessary to hold the pile without drawing or slipping; any additional pressure is only an added strain on the machine.

Jog your stock before putting it in the machine and do not use the back gage for that purpose. Continual hard jogging with heavy lifts of stock against first one end of gage and then the other will quickly knock it out of square or loosen it.

A little talcum powder, French chalk, or powdered boracic acid dusted on the table makes the stock handle easier.

A slip-sheet of paper or thin pulp board placed on top or on the bottom of the pile, and cut up with it, protects delicate surfaces from finger marks or soiling. Keep your hands and apron clean. Keep the machine clean in every part.

Use only wrenches furnished with the machine, because they fit the bolt heads properly and because they are the correct lengths to put on the proper tension.

Do not use a monkey wrench, because, unless the jaws are carefully adjusted, it will destroy the bolt heads and if used on small bolts, on account of its length and power, is apt to strip the threads or break the bolt or part.

Occasionally go over every part of machine and see that all taper pins, bolts, nuts, etc., are snug in place.

A locked cupboard or box at the cutting machine is useful to keep the full set of wrenches provided, clean waste, colored crayons, a good magnifying glass, powdered pumice stone, French chalk, talcum powder, boracic acid, special cutting pads, and boards for making them, size strips, dimension records, etc. The oil can should stand always filled and ready on its bracket.

If a belt is put on too tight, it may pull so hard on the bearings as to heat and cause them to cut. It is easier not to put the belt on too tight at first and to relace it several times while it is stretching, than it is to repair a rough bearing.

Keep clean waste in a box. Destroy dirty, oily waste instantly after use, or place it carefully inside a fireproof oily waste can if provided. Do not put dirty, oily waste away or leave it around. It is most dangerous and many plants have been burned by its spontaneous combustion.

Have a definite fixed time to oil, and to clean the machine. Mark the hours when to oil every day, and the

day and hour when to clean and polish the machine every week, on the maker's direction sheet attached to the machine.

Oil with intelligence, not just with an oil can and oil. Oil freely, but not sloppily. Oil should not drip upon the floor. Oil should not flow over parts not requiring it. An excess of oil on a brake band will prevent its acting and stopping the machine promptly. Wipe out the excess oil in this case by passing a rag under and around the bands. Oil that runs or drops or is wiped off is wasted.

Oil the parts above the table carefully and thoroughly. A few drops of oil on the palm of the hand and applied to the four front and back faces of the knife-bar prevents dripping on the table from the oil can. Run the machine through a few strokes after oiling and then wipe off clean with a cloth or piece of waste the surfaces against which the stock to be cut is placed.

When oiling, remember it is only the oil that reaches the bearing that does any good. Any surplus that runs over and defaces the machine is waste.

The best kind of oil to use is a free-running, light-colored petroleum machine oil. Cheap oils cost more in the end.

Operating the Machine

The character of the cutting depends upon, first, the machine, second, the knife, and third, the man.

Successful cutting is a fine manual art. The finest razor improperly stropped and used in unskilled hands does poor work. The finest cutting machine unintelligently operated will stultify the best efforts of the printing plant.

The machine that has the simplest mechanism evolved

by long experience and study ensures the first safeguard of accuracy. The knife that fulfils the specifications given elsewhere furnishes the second. And third, the man whose standard of work is high, who is conscientious in following his instructions, who is big enough and broad enough to understand how important his position is, and how necessary, therefore, it is for him to coöperate with every other department in a friendly and intelligent manner, completes the tripod that can stand up successfully under any job.

A cutting machine is a sharp-edged tool and, therefore, dangerous when run by a careless or unskilled operator. "Look before you leap" applies especially to the cutting machine. Its action is powerful and quick. Accidents occur through failure of the operator to watch his own motions and because of the improper operation of the machine through failure of some of its parts. Sufficient safety devices to make all accidents impossible would render the cutting machine as useless as an axe in a velvet case. Accidents which occur from undue wear or neglect to oil are apt to happen. Two preventives are available: *first*, to train the operator to care; *second*, to provide as many safeguards as can be utilized and still permit commercially successful operation.

With the modern high-speed machine operating at from twenty-five to forty cuts a minute, the time consumed in the cutting room is not the time taken by the knife to pass through the stock, but rather the time getting the stock laid up and measured ready to cut. Consequently, these latter operations are the ones to study for savings.

The time and labor required to cut a job depends upon the number and kind of motions of the hands and body and feet that are made to get the stock ready and to take it away. The fewer motions necessary to do this and to

operate the machine, the easier and pleasanter it is to work at a cutting machine.

Powdered chalk and naphtha put on the bright parts and nickel and allowed to stay over night will polish off in the morning and leave the machine appearing clean and free from rust.

The clamp strap ways should be kept clean and free from the fuzz from the cuttings and thick oil. This can be done by occasionally cleaning them out with kerosene.

If the oil gets in the friction brake band the machine may not stop promptly at the proper point. Throw off the driving belt, and throw on the starting lever to loosen the brake band; then pass a rag around under the band, between it and the clutch rings, so as to remove the oil, then throw off the starting lever. If a piece of waste is laid on the lower part of the friction brake band just next to the ring, it will keep it free from oil for some time.

Rub the knife and other bright parts of the machine with an oily rag every night. This will prevent the rust forming with the variation of temperature between day and night.

When using the graduations on its rim to measure by, always keep turning the gage screw wheel in one direction, without reversing it, when pulling the back gage forward for successive cuts. This will keep up all the slack and lost motion of the screw and its nut. If the screw wheel is moved first one way and then another, little dependence can be placed upon the graduated reading of the scale.

Safety of the Knife

The best automatic rapid-production cutting machines are provided with four safety devices to prevent the knife making an unexpected stroke.

First—A solid knocker throws out the clutch positively. Neither gravity nor a spring for a trip is depended upon to move an intercepting part, but the certain fact that two solid bodies cannot occupy the same space at the same time.

Second—An automatic friction brake grips firmly and stops all motion silently.

Third—An automatic counterbalance is used for both the knife-bar and the clamp, and retains them at the top position.

Fourth—An automatic steel safety bolt engages a solid lug on the large gear, so that the gear cannot revolve further until the operator deliberately pulls the starting lever for another cut.

These four safety devices are designed so as to act positively and simultaneously on the completion of each cut. To start requires a deliberate action of the starting lever by the operator.

Handling Paper

Paper is made principally in long webs, or continuous strips, and is rolled up as it comes from the paper-making machine. It is then cut into sheets by a revolving fly cutter or a shear knife, cutting one sheet at a time off the roll. These sheets are furnished by the mills in bundles or cases, which are trimmed to certain sizes on a paper-cutting machine.

The best method of handling and cutting stock, the proper quantity to take on at each lift, the height of the pile to cut, and the routine of passing each cut section along in orderly fashion, should be given careful study.

Convenient tables of the right height and of ample sur-

face are essential if the work is to be carried on satisfactorily, without backtracking or unnecessary motions and lifting.

Large stock should be piled on movable wooden platforms which can be moved quickly from place to place.

A primary difficulty in cutting-machine work is due to the great variety of papers and sizes required to be handled on the machine. This varies from little narrow slips to piles the full width of the table, from a few sheets to a pile the full height allowed by the clamp, and from soft book paper to stock nearly as tough as tin. All these varying conditions cannot be met with equal success in one automatic machine. Therefore, superior intelligence rather than unusual muscle should be required of the operator.

Good judgment is required to determine the proper height of a pile to cut. This will often depend upon how much can be grasped each time with the hands and put into place in good order. Time may be lost and sheets wasted trying to fill up to the capacity of the machine; smaller piles and more of them may sometimes be a more economical method. The time taken for the knife stroke is only a second, while the time necessary to jog up several lifts may be minutes more than to put one lift into place. The convenient lift, as large as possible, and uniform in size if there are several of them, is the advisable practise.

Inaccurate cutting may be the result of several causes:

- (a) Not jogging the pile thoroughly against the back gage; this should be done by pressing the ball of the thumbs against the front of the pile from top to bottom.
- (b) By disturbing the pile when turning it for the next cut.
- (c) By lifting out the pile and failing to jog it care-

fully when flat against the back gage again. (d) Work that is fed to points on the printing press may not be square and true and consequently cannot be jogged against a straightedge gage and cut accurately. This condition should be watched for in such cases. Find out, if possible, which is the feed edge in the printing and jog up to that. Pressmen are often careless about this necessary instruction in sending printed sheets to the cutter.

Inaccurate cutting is also due to insufficient clamping pressure, allowing the pile to slip out of place slightly; or to excessive clamping pressure, compressing the pile more than necessary just at the line behind the knife cut.

The above causes may result in imperfect cutting when the machine is in good order. When the machine is not in the proper condition, and the knife is dull, or of a shape not adapted to the work, accurate cutting cannot be expected.

When piling up sheets see that each sheet is laid in exact register with all the others, that is, that the printed pages, guide marks, and edges are all in the same position throughout the pile. One sheet on top laid the wrong way may be the cause of cutting every other sheet of the pile wrong unless (and this is very important) the operator looks at the under sheets to make sure that they are all laid alike.

When cutting or trimming printed sheets it is necessary that the operator should jog the sheets to the pressman's feed edges. These should be marked plainly, without chance of misunderstanding. If they are not, he should ask for directions. One wrong cut will spoil the whole pile.

When a sheet is taken off a pile for examination or for any other purpose, care should be observed that it is laid back again uniform with the other sheets. A pile is easily

disturbed in this manner either when swinging it over, turning it around, or rejogging, if the utmost care and orderliness are not observed.

Papers received from the mills or from dealers are not always trimmed squarely, but have what is called a mill edge. This edge is only approximately straight and the corners only apparently square. For accurate work, either in printing or in cutting, one or two edges may need to be retrimmed on a paper cutter to get them straight and have a true corner. The ultimate accuracy of the finished work will depend upon this proper trimming before the sheets are printed.

Exact register and accurate trimming can be secured only by working from the same edges of the paper at every operation and the edges must be straight and squarely cut. When the edges are thus trimmed they should be marked with a red crayon, or in some similar manner, in order to be readily identified at each handling.

A pile may be tested for squareness by jogging it in the cutter table against both the back gage and the side gage, if the machine gages are themselves in perfect adjustment. If it is difficult to see whether the sides of the pile are close against the gages at all points, narrow strips of paper put between the pile and gages will show whether the pile touches the gages uniformly.

When cutting lithographed work or similar close-register printing, where large sheets are apt to come with an irregular edge, a small wooden block against the back gage or the side gage at points on the sheet where the original register guides of the press were placed, will usually insure cutting on an accurate line with the printing. In this manner the same points of contact as were used in the press feeding may be secured.

To cut a pile of paper in half, fold over the top sheet and fold at the middle, carefully matching the edges. Crease this fold distinctly and use the crease as a guide when the sheet is opened out and laid on the pile. To cut into thirds or fifths it is better to measure the sheet exactly with a rule and make clear pencil marks at the points of cutting.

Hand-made papers have rough, uneven edges which are thicker than the rest of the sheet and, therefore, require particular care in jogging and clamping. They should be handled in small piles.

Gummed and varnished papers require special care even when perfectly dry, but more so in a moist atmosphere. Varnished stock if it is very dry may nick the knife, and a clean oily (but not too oily) swab run over the bevel of the knife before the cut will make a smoother, safer cut. It is not well to use soap on the knife, especially on lithographic work.

Freshly printed work which tends to offset on the next sheet may be cut where necessary by placing strips of reglet or thick card around the margin close to the line of the proposed cut, so as to keep the pressure of the clamp off the printed matter.

Tissue paper requires to be firmly clamped to cut accurately. A clamping motion that will first exert a gentle pressure to squeeze the air out between the sheets and pack the pile down evenly all over and then apply a powerful pressure before the knife strikes the pile, gives the best results.

Accuracy is required in manifold duplicate work, where absolute register must be made, to secure the proper location of dollars in dollars columns and cents in cents columns. The ruling and printing both depend entirely on

the square and accurate cutting of the stock to secure proper register.

The cutting of waxed and oiled manifold stock, if carefully jogged up, is not difficult with the newer types of clamping mechanism, especially on that type of cutting machine where the pressure of the automatic clamp is applied at first gently and then with maximum pressure, similar to the hand-clamp.

To Cut a Pile into Strips of Equal Width

This is sometimes required to be done for a large quantity of stock and it is desirable to do it with economy of time and labor. The obvious method is to first trim one edge of the stock, then set the back gage to the required width and jog the pile up to it for each cut. This method is usually accurate but requires a great deal of handling of the stock—almost three times as much as is necessary by some other methods.

The following methods require the pile of paper to be first trimmed with a true edge in order to jog it against the back gage, and also with a true edge on the opposite or front side.

1. Make a mark or place a thin paper sticker on the top surface of the front table the exact distance in front of the cutting edge of the knife to correspond with the required width of the strip. Place the pile of paper on the back table with a trimmed edge against the back gage. Move the gage forward so that the front edge of the pile comes to the mark on the front table. Make the cut. Repeat this until the pile is cut up. This requires only one jogging of the pile into place.

2. Same as the method just described, except that a

small hinged metal gage is used instead of a mark on the table. This requires a special device. The front flange of this device or gage may be slotted and fastened to the table by a thumbscrew. The vertical angle part must be hinged to the part fixed to the table so that it can be swung upward and back far enough to leave the cut pile room to move forward on the table when the knife passes down through the pile.

3. Use a hand automatic spacing device, gage screw movement.

4. Use a template placed on top of the pile. Run the clamp down to the pile, place a card or fiber template on top of the pile in front of the clamp. Draw the pile forward until this front edge coincides with the front edge of the template. Make the cut and repeat the operation until the pile is cut up.

5. Draw the front edge of the pile forward to dimension on the regular graduated rule set in the front table.

6. Draw the pile forward the distance desired by reading the steel tape scale overhead, or the dial, or the graduation on the gage movement wheel.

7. Use a hand automatic spacing device, chain movement.

To Cut a Pile Rectangular

To trim a pile with perfectly true corners first jog its straightest edge against the back gage, and make the first trim. Then jog this cut edge against the back gage and make the second trim, keeping the pile away from the side gage. This trimmed edge should be exactly parallel with the edge trimmed first. Then jog either of these cut edges against the side gage, and push gently (but do not jog) to the back gage, for distance. This cut will

be at exact right angles to the first and second. Turn the pile and make the last cut with the trimmed edge against the back gage keeping the pile away from the side gage.

Do not try to jog a pile against both side gage and back gage at the same time, for, although these are at right angles, the attempt to force a pile against both will slue the pile.

Turn the pile on the table with the greatest care; do not lift it between cuts or jog it vertically. To test a pile for rectangularity, turn part of it one-half way around and match the edges.

To Square a Pile

First—Set the back gage about one-eighth inch further from the cutting edge of the knife than the desired dimension of the square. The extra distance the back gage is set beyond the dimension of the square will depend upon the amount necessary to trim it to a true, clean edge.

Second—Jog an uncut edge of the pile against the back gage and make a clean trim.

Third—Jog this clean trim against the side gage and just “feel” the back gage for distance. This trim is at right angles to the first.

Fourth—Now draw the back gage up to the exact dimension of the square desired.

Fifth—Jog either of the clean trimmed edges against the back gage (keep the pile away from the side gage). This trims three sides.

Sixth—Jog the pile against the back gage and trim the remaining uncut edge, keeping the pile away from the side gage. This completes the square.

To test a pile for squareness, turn part of the pile one quarter way around and match the edges.

To Cut Unusual Shapes

Any odd shapes having straight lines may be cut by the following method: Make a sample of the shape and size required; then take a piece of No. 70 strawboard a little larger than the pattern. The board must be squared up, and the odd-shaped card laid on it; then put the two pieces under the clamp and adjust the strawboard against the back gage and the sample card even with the clamp in front; then run the clamp down and draw a pencil line around the sample card on the strawboard. A piece of wood can then be glued on to the strawboard along the pencil line at the back and another at the end. If a bunch of cards is laid into this box gage and the board pushed up against the back gage of the machine, a narrow strip of wood or board must be glued on the clamp right over the card, so that a pressure may be secured on the stock. This clamp-stick must, of course, fit into the box gage, so that it will take up the difference in thickness between the pile of stock and the height of the box gage. These gages may be made by means of a square and a pair of dividers, as well as in the machine.

Celluloid may be cut into narrow strips by using the method described above. A sharp knife and rubber bands are all that are necessary.

Trimming Books

A common error made by printers is to make up forms nearly the full measurement of the leaf, thereby leaving

the binder very little trim margin. A standing rule of every printing and binding establishment should be to allow one-eighth of an inch trim margin for the fore-edge, head, and tail of all stitched tablets and quarter-bound cut-flush books. All sewed books should have three-sixteenths of an inch for the fore-edge, and one-eighth of an inch for the head and tail trim margins. The trimming of letter-press work should be standardized, so that paper-covered books are trimmed a trifle larger to permit a re-trim when books are returned for a substantial cover. To illustrate this, a sheet 24 x 38 inches made up into thirty-two-page signatures, when folded, is 6 x 9½ inches. The paper covered books should be trimmed 5⅞ x 9⅛ inches; one-eighth of an inch is trimmed off the head, the balance off the tail, while the fore-edge has one-eighth of an inch trim. These books, when returned for permanent covers, as they frequently are, have one-sixteenth of an inch trimmed off the head and tail; and one-eighth of an inch off the fore-edge. This gives the standard book size, 5¾ x 9 inches for the bound volume.

When the entire edition is to be bound with a permanent cover, provision is made for three-sixteenths of an inch trim at the head. This enables the printer to standardize forms without varying the head margins, and gives the binder sufficient margin to trim inaccurately folded sheets.

To trim books on a cutting machine, take as many as will make a pile about three inches high, and jog at the head and back. Set the back gage the exact size to which the book is to be trimmed; put the books in the machine with the head against the side and the back against the back gage. Run down the clamp, provided the machine has a hand clamp; an automatic or self-clamp requires

nothing more than to pull the lever. When the cut has been made and the machine stops, remove the books and put to one side. Repeat this operation until all books are trimmed on the fore-edge and lay aside in piles with the backs out.

To trim the heads and tails, fillers must be made to take up the thickness of the back. Cut strips of straw or binders' board about four inches wide; glue them together; fan out and press. Put the books in the machine with the heads against the back gage and the trimmed fore-edges against the side; then lay the board filler on top in such a way that the fanned-out ends are sufficiently away from the back to permit an even pressure of the clamp on the books. Pull the lever, and repeat the operation for subsequent books. The filler can be glued to the clamp and the books put directly under it.

For the head, the gage is set forward and the trimmed tail is placed against the back and side gage. The board filler is placed on top in the same manner as above described and the operation continued. On thin books the board filler may be dispensed with by reversing the backs of the books alternately, so as to distribute the thickness of the back on both sides of the pile.

If there are two splits in the back gage, *i. e.*, if it is a three-part back gage, set the center for trimming the fore-edge, the left for trimming the tail, and the right end for the head. This, however, should be done only when the quantity to be trimmed justifies it. When the back gage is set, tighten the thumbscrew with the hand. To guard against the marking of the book by the pressure of the clamp, cut a piece of binders' board somewhat larger than the width of the clamp face and glue it on the clamp.

Waste leaves should be placed on the top and bottom of enameled or glazed stock to keep it clean.

To trim quarter-bound cut-flush tablets or pads which are bound two or more on a sheet, as in the case of receipts, trim the fore-edges, cut all the tails alike, then the heads. The knife should cut against the back. In making up books to be bound two or more on, one-fourth of an inch trim must be provided for, to clear the bevel caused by the knife. This is provided for if books are made up with one-eighth of an inch trim for the head and tail. Thick books can be bound two or more on until the stitching is completed. Then cut apart and proceed with the rest of the binding in the regular way.

Blank books are trimmed so that the standard sizes are reduced one-fourth of an inch for the length and three-sixteenths of an inch for the width. The paper for a medium book is 18 x 23 inches; when folded, 11½ x 18 inches. If such standard sizes are adopted the work of forwarding is greatly facilitated, as cases and boards can be made in advance without fear of the books being trimmed too large.

In trimming spring-back account-books, sewed straight or on guards, the fore-ends are trimmed, then forwarded until the books are in straps. Sharp knives are indispensable in trimming books which are concave on the fore-edge. Deep rounds should be filled in with waste paper to prevent the top sections and the back from breaking. Board fillers are always laid on top and the book placed so that the knife will cut against the back.

Brochures with extended cover should have the stock first cut to size of cover before printing, and sufficient extra stock allowed for an all-round trim of the inset after, especially at the fore-edge where after folding in

sections the inner sheets are apt to bulge forward. The printer should know how much will be taken off in the after trim to enable him to allow uniform widths of margin. After a job is bound, the cutting machine cannot remedy any defect of edges.

Paper Cuttings and Waste

Cuttings and waste may be disposed of by throwing them into a large bag attached to or placed near the machine. When filled, this can be taken away and another substituted. Throwing waste on the floor should not be tolerated. It is untidy, costs time and labor to gather up, and is dangerous.

A light box on wheels is also a good plan for caring for waste of this kind. In some places where there is a great deal of trimming, a chute in the floor next to the machine provides a convenient method of disposing of waste from a number of machines. This chute leads into a large bin or baling machine below, from which the material is carted away.

The worth of a paper-cutter operator can be measured by an examination of the waste cuttings. A careless operator can waste a large sum of money in a year. Many persons make a good living from the waste paper of large printing and binding plants by buying it at a nominal price and selling it again at a considerable advance.

There is unavoidable waste, of course, but there is often a great deal of unnecessary trimming. When the necessary trimming runs up into hundreds and thousands of pounds, as it does in all large plants, it is worthy of notice, especially when it is realized that this waste has been paid for at the same rate per pound as the stock that is

actually used. Some printers and binders sort and bale their waste and dispose of it so as to make a considerable saving, but few understand how a little care and system can be made to return a good profit.

There is another waste, sometimes far greater in amount, caused by the careless cutting of stock. A thoughtless operator will often try to save ten minutes by hasty calculation and then waste stock through inaccurate cutting that costs several dollars.

In some binderies the operator is instructed to sort his trimmings according to the kind of stock; that is, clean white edge trimmings kept by themselves are worth more than when mixed with miscellaneous colored trimmings. By having two or more bins at hand into which these different kinds can be thrown as they come from the knife the sorting can be done without extra handling.

An intelligent inspection, segregation and saving of the waste cuttings will well repay the effort. The larger pieces of waste can be kept for pads or other use. White stock should be kept separate from colored and where the quantity will warrant the cost, all waste should be baled in a baling press.

Depreciation of a Paper-Cutting Machine

Deterioration takes place in a paper-cutting machine chiefly in the knife, friction clutch, driving-shaft bearings, knife-bar guide ways, and knife pull-down connection. Depreciation in the entire machine occurs rapidly when it is not kept oiled, adjusted, and clean. Neglected bearings which run dry are ruined in a short time. The times for the daily oilings and weekly cleaning and polishing should be fixed and faithfully attended to.

On modern machines the worn knife and the friction-clutch bearings may be easily replaced or repaired. Knife-bar guide ways and the guide slot for the back gage are made with adjustments for taking up wear, for which the maker will give correct instructions on request. The knife-bar pull-down connections are not so easily corrected for wear, and the simpler and more direct these connections are, and the fewer slots and rolls, pins, etc., the better. The general design of the machine also affects its value, especially if it is not adapted for the addition of improvements or attachments for increasing its production.

The depreciation that comes from natural evolution due to the constant effort by machine makers to render their product more efficient, and the impossibility of attaching to the older machines new and improved devices, is more serious for two reasons: *first*, that it is apt to be overlooked by the owner; *second*, because of the greater cost of operating the machine, as compared to one of a later and improved design with attachments especially adapted to the particular work in each case, which in some cases permit three, four, five, and six times as much work being produced as can be obtained on a machine not so equipped.

A well designed and built paper-cutting machine will last with care nearly half a century. The prudent manager, however, will find he is obliged to discard most of the machines of various kinds in his plant in much less than twenty years in order to keep pace with the newer shops starting with the advantage of later-designed machines.

SUGGESTIONS TO STUDENTS AND INSTRUCTORS

THE following questions, based on the contents of this pamphlet, are intended to serve (1) as a guide to the study of the text, (2) as an aid to the student in putting the information contained into definite statements without actually memorizing the text, (3) as a means of securing from the student a reproduction of the information in his own words.

A careful following of the questions by the reader will insure full acquaintance with every part of the text, avoiding the accidental omission of what might be of value. These primers are so condensed that nothing should be omitted.

In teaching from these books it is very important that these questions and such others as may occur to the teacher should be made the basis of frequent written work, and of final examinations.

The importance of written work cannot be overstated. It not only assures knowledge of material but the power to express that knowledge correctly and in good form.

If this written work can be submitted to the teacher in printed form it will be doubly useful.

REVIEW QUESTIONS

1. For what is a paper cutting machine used?
2. How does it increase printing output?
3. What is its great importance?
4. What were the first methods of cutting paper, or its earlier substitutes?
5. How were piles of paper first cut?
6. How was the process improved?
7. Describe the development of cutting machines down to Samuel R. Brown's invention.
8. Describe that invention.
9. Give the lines of evolution of the cutting machine.
10. What are the characteristics of the best paper-cutting machines?
11. Describe a plough and press cutter.
12. Describe a card cutter.
13. Describe a hand lever cutter.
14. What are the differences between hand and power cutters, and what the advantages of the latter?
15. Describe two forms of hand-clamp power cutters.

16. What do automatic clamp machines do?
17. How is an automatic power cutter operated?
18. How is continuous running effected?
19. For what are vertical stroke machines used?
20. What results from the great power needed to operate cutting machines?
21. Give some idea of the amount of power needed for these machines.
22. What is the most important part of the machine and why?
23. How do these parts vary?
24. How can you judge the temper of a knife?
25. How can you tell whether a knife has a correct face?
26. How should you hone a knife?
27. What is the rule for the length of the bevel on knives?
28. How is this rule modified by stock?
29. What can you say of the face of the knife?
30. What is desirable in the thickness of the knife?
31. What precaution should be taken as to the setting of the knife?
32. What should you look at if the work is not cut true?
33. Tell all you can about grinding knives.
34. Tell all you can about the use of the hone.
35. What causes are liable to prevent the proper seating of the knife, and what is the result of improper seating?
36. How can the best knives be obtained, and why?
37. How is the paper held in place?
38. Describe the mechanism used.
39. What is the relation of the power exerted by the operator to the power obtained at the clamp?
40. What was the characteristic of the first automatic clamp cutting machines, and how have they been improved?
41. Describe the cutting stick and its substitutes.
42. What is the back gage, and how does it work?

43. Mention some improvements which have been made on the back gage.
44. How is the distance of the back gage read in hand-operated gages?
45. Describe an appliance for reading the movement of a back gage operated by power.
46. What contrivances are in use for cutting at any time duplicates of a given job?
47. How is the back gage locked?
48. How may piles of different widths be cut at the same time?
49. What device is used on the larger sizes of cutting machines?
50. What special devices have been applied to the back gage to increase production?
51. How is the width of the cut measured?
52. Describe some modern patented spacing devices, and tell what they accomplish.
53. What is a clamp face?
54. What is a snake gage?
55. What special contrivance is used for large pamphlets, etc., and for what purpose?
56. What safety devices are required by some states?
57. What five methods of applying power are in use?
58. Give the four great rules for the care of the machines.
59. What advice is given about adjustment, stroke of the knife, pressure of the clamp, use of oil?
60. What is the right time to jog stock, and why?
61. How should you oil the parts above the table?
62. How can you make the stock handle easier?
63. How can you keep stock clean?
64. What wrenches should be used and why?
65. What things should be done periodically?
66. What does a cutter operator need to work with, and how should he care for them?
67. What can you say about belts?
68. How should you care for waste, especially when oily?
69. How should you use oil?

70. What is the best sort of oil?
71. Upon what three things does the character of the cutting depend, and why?
72. How may accidents be prevented?
73. How is time consumed in cutting stock?
74. How can labor saving be accomplished?
75. What safety rule applies to cutting?
76. Why is a sharp knife an economy?
77. How can you keep the machine clean and bright?
78. How should you care for the clamp strap ways?
79. What care should be taken of the friction brake band?
80. How can you prevent rust?
81. How can you keep the gage screw wheel graduation true?
82. Give the four devices which safeguard the knife.
83. What are the things to study in handling stock?
84. What can you say about each of these things?
85. What are the causes of inaccurate cutting when the machine is in good order?
86. What care should be taken in piling sheets?
87. What precaution is necessary in cutting printed sheets?
88. What is a mill edge and what does it require?
89. How can exact register and accurate trimming be secured?
90. How may a pile be tested for squareness?
91. What device is used in cutting lithographed work and the like?
92. How can you cut stock in certain fixed portions?
93. What peculiarity have hand-made papers?
94. What precautions are needed with gummed and varnished stock?
95. What precaution is desirable in the cutting of freshly printed stock?
96. Give several methods of cutting a pile into strips of equal width.
97. How can you cut a pile rectangular?
98. What are the processes for squaring a pile?
99. How can you test a pile for squareness?

100. What care has to be used in cutting tissue paper?
101. How can waxed and oiled manifold stock be managed?
102. What additional margins should be left on book pages for trimming after they are bound?
103. Describe the operation of trimming books on a cutting machine.
104. How are quarter bound cut-flush pads or tablets trimmed?
105. How are blank books trimmed?
106. How are spring-back account books trimmed?
107. How are brochures with extended covers trimmed?
108. What should be done with cuttings and waste?
109. By what can you measure the worth of a paper-cutter operator?
110. How would you apply the test?
111. How can waste be prevented, or waste paper utilized?
112. Where does a paper-cutting machine naturally show special wear?
113. What other consideration affects the value of a machine?
114. How does the invention of improved machines affect the value of old-style machines?
115. How long should a good paper cutter last?

- AUTOMATIC CLAMPING**—Means that the clamp descends upon any height pile and produces approximately the same clamping pressure for all heights and all kinds of material. Among the methods for producing this pressure for automatic clamping are devices which employ friction discs turned only one way by ratchets which produce the maximum pressure with the least expenditure of power; friction discs or friction plungers worked forward and reverse; surfaces sometimes combined with wedge-shaped ways for producing a resultant pressure from the knife; weights, oil and hydraulic and air plungers; springs, climbing gears and weights, etc.
- BACK GAGE**—A movable device against which the paper is placed for measuring the size of the sheet to be cut.
- BRAKE, AUTOMATIC FRICTION**—Generally a band with a lining which grips automatically the outside of a wheel fastened to the driving gear and stops it promptly after every cut when the knife rises to the top.
- CHUG**—The action of the knife that results from lost motion in the parts connecting the knife-bar to the parts that operate it. "Chug" is caused, first, by the looseness of fitting necessary to permit the parts to operate without heating, and second, by wear of these parts. "Chug" dulls knives and spoils stock and makes expense for grinding, sharpening, and knife replacement.
- CLAMP**—The part that presses the work firmly on the table to hold it while being cut.
- CLAMP, ONE PIECE**—Means a single casting used both for marking (or gaging) the stock where the knife is going to cut and also for pressing the pile to hold it.
- CLAMP DWELL, LONG**—Means that the clamp is held down a little longer upon the pile after the knife has cut, so as to allow the knife to rise to a safe height before the clamp is released. This prevents the knife rippling up the sheets on the return motion and disturbing the pile.
- CLAMP FACE**—A removable flat steel plate fastened underneath across the clamp fingers to prevent the indenting of soft stock.
- CLAMPING, AUTOMATIC PRESSURE ADJUSTMENT**—A device for varying the holding pressure easily and instantly for different kinds of work.
- CLUTCH, FRICTION DRIVING**—An improvement over the jaw clutch, because instead of starting the machine with a jar, it permits gradual engagement of the power.
- COUNTERBALANCE WEIGHT FOR KNIFE-BAR**—A safety device which, through constant and dependable action of gravity, always tends to keep the knife from dropping.

CUTTING STICKS—A wood or soft metal piece inserted in the table, on which the knife edge strikes; in shape usually square, but sometimes round and rotatable by hand or power to present fresh surfaces after a number of cuts.

DOUBLE-SHEAR STROKE—Means there are three motions taking place at the same time; first, the downward motion through the pile; second, the single "shear" motion across the face of the pile; and third, the double-shear motion which means that the cutting edge starts to cut higher at one side than the other and by rocking approximates parallel when it reaches the bottom of the cut at the table. The double-shear cuts more like a pair of scissors, the knife edge entering each sheet at its side and gradually cutting across it. Its advantages are less power required to cut, less strain on the machine and the knife, a more perfectly cut edge and a smoother face to the pile. See Fig. 10, Page 18.

DUPLICATING DEVICES, AUTOMATIC—See "Spacing Devices."

GAGE MOVEMENT, CABLE—A steel wire cable wound around a drum which when revolved pulls the back gage forward or backward.

GAGE MOVEMENT, CHAIN—A connection for operating the back gage to and fro; principally used with automatic spacing devices.

GAGE MOVEMENT, POWER—A friction drive variable speed connection from the main driving shaft to move the back gage forward and backward.

GAGE MOVEMENT, SCREW AND HAND WHEEL—This is used on the simpler, cheaper styles of cutting machine devices. It is slower than the cable device, but more reliable.

GAGE MOVEMENT, AUTOMATIC SPACING DEVICE—This quickly moves the back gage and the pile forward a given distance without measuring for each cut, thus largely increasing production.

GREASE CUPS—Receptacles with a screw top containing lubricating grease, which is forced a little at a time upon the bearing when the screw top is turned, or which starts to melt and flow if the bearing warms.

GROOVED TABLE—Means slight rounded depressions lengthwise in the back table in which the back gage fingers travel, extending slightly below the table surface to catch the lowest sheets and prevent them from wedging under the back gage.

HAND CLAMPING WHEEL—Is generally connected to the clamp by a worm and gears (or directly by a screw). A force of one pound exerted on its rim holds the work with about one hundred and fifty pounds pressure and correspondingly more for each additional pound.

- INDICATOR**—Generally a steel ribbon ruled to sixteenths of an inch, reading the distance from the front face of the back gage to the cutting edge of the knife.
- INTERLOCKING CLAMP AND BACK GAGE** (also called fingered clamp and fingered back gage)—Recesses in the clamp permit projections on the back gage to push the work farther forward than if both clamp and back gage were solid and the clamp of sufficient width to hold the stock firmly.
- JOG**—To jog a pile against the gage is to strike it with a blow just sufficient to bring every sheet in the pile so that it touches the gage and in the same relative location with each other if all the margins are uniform.
- KNIFE**—A piece of tempered tool steel about one-half the width and thickness of the whole blade, forged into a piece of less expensive soft steel, in which holes can be drilled more easily for the bolts that hold it to the knife bar.
- KNIFE ADJUSTMENT**—Devices for lowering the knife-bar to compensate for the wear of the knife and for tilting it in case the knife edge is ground out of level.
- KNIFE-BAR**—A rigid carrier for the knife. The best style takes the down thrust and side thrust of the knife directly upon a solid shoulder planed in it, instead of the knife back abutting against the points of adjusting screws.
- KNIFE-BAR MOTION**—A mechanical way of imitating the action of a draw shave in pulling down the knife. The nearer it is to the hand method, the more simple and successful it is. Rods connected to each end of the knife-bar and pulled down by simple cranks at each end approach nearest to the method of human hands.
- LIFT**—The pile of paper or other stock cut and handled at one time.
- MARKER**—A part of the clamp on some machines, separate from the pressing part, that may be pulled down by a treadle to show where the knife is going to cut.
- MOTOR BRACKET**—A support attached to one side or top of the cutter to which the electric driving motor is firmly bolted.
- OIL BOXES**—Channels containing oily waste which allows the oil to seep slowly upon the bearing.
- OIL CUPS**—An oil feeding device requiring careful attention.
- PLAIN CLAMP AND BACK GAGE**—The under face of the clamp is a solid broad surface without any recesses; consequently the back gage has no projections but is simply a solid smooth front.
- PILOT CLAMPING WHEEL**—A wheel with handles projecting from the rim to give a firmer grasp.
- POWER ATTACHMENTS**—For hand-power cutters. These may be put only on machines designed and built originally for them.

- SAFETY BOLT (LOCK STOP)**—A steel bar which must be unlocked each time before the machine can make a cut.
- SIDE GAGES**—Flat guides bolted to each side of the table, front and back, accurately set at right angles to the knife and the table, against which the stock may be set to cut square.
- SINGLE-SHEAR STROKE**—The stroke of a knife which has a side-wise motion at the same time that it descends, with its edge always parallel with the table top. The single-shear cuts the entire width of each sheet at the same time all through the pile.
- SOLID KNOCKER FOR THROW-OUT**—This is a part solidly fastened to the shaft (or gear) making one revolution for each cut of the knife and that throws the clutch out positively and puts on the brake throwing in the safety bolt after every stroke of the knife.
- SPACING DEVICES, AUTOMATIC**—See "Gage Movement, Automatic Spacing Device."
- STARTING BAR**—A rod extending clear across the front of the larger size of the machines to start and stop the machines.
- STARTING LEVERS**—Preferably two, one at each side, on medium size machines, to start and stop the machines.
- TABLE**—A slab of metal upon which the stock is laid and handled for cutting.
- TABLE, FRONT SIDE EXTENSIONS**—Wings bolted on the front table upon which work may be handled before and after cut without having to turn around.
- TOGGLING CRANK**—A device on hand-lever cutters that increases the power as knife goes down and eliminates jumping on the lever to get the knife down through the lower part of the cut.
- TREADLE, FOOT (for clamping)**—A convenience which leaves the operator's two hands free to handle the work while locating the line of the cut by pulling down the clamp with foot treadle.
- VERTICAL STROKE**—An attachment for shear or double-shear stroke cutting machines which brings the knife down vertically, instead of side-ways. It is used with knives of a special shape to cut irregular or fancy edges or to pink cloth samples. See Fig. 9, page 17.

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THE following list of publications, comprising the **TYPOGRAPHIC TECHNICAL SERIES FOR APPRENTICES**, has been prepared under the supervision of the Committee on Education of the United Typothetae of America for use in trade classes, in course of printing instruction, and by individuals.

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