July 25, 1939. F. L. MANNY 2,167,279

ROTARY PUNCHIHG AND NOTCH CUTTING MACHINE

Filed July 14, 1938 4 Sheets-Sheet 1

Fig. 9

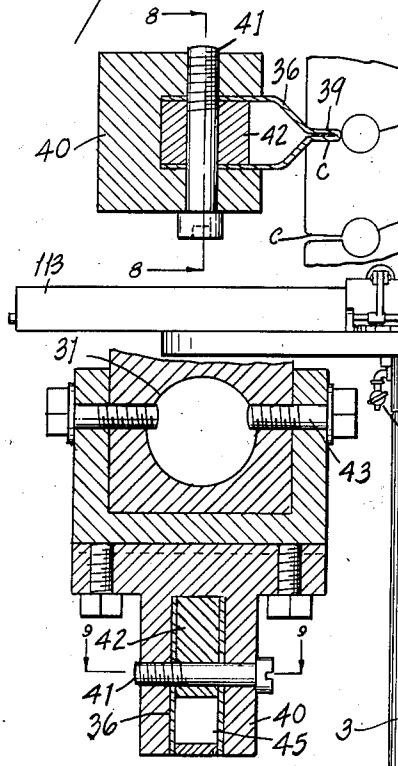


Fig. 10

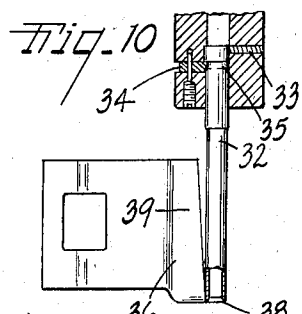


Fig. 8

Fig. 1

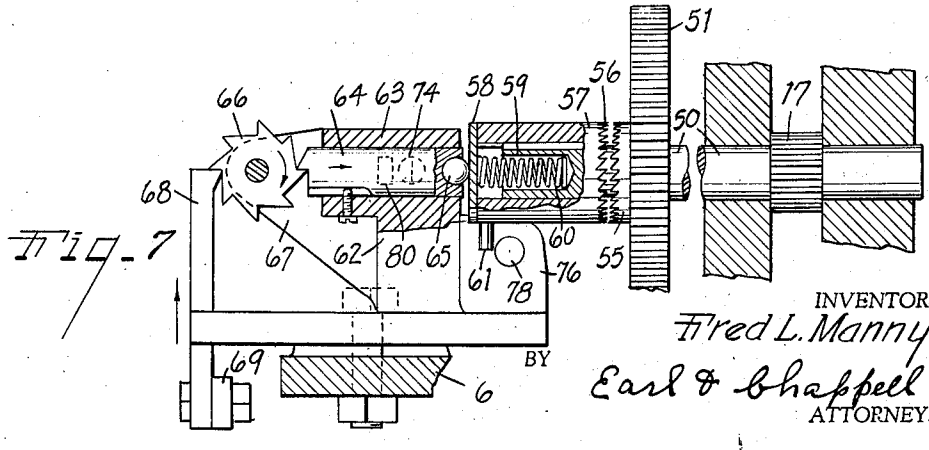


Fig. 7

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ROTARY PUNCHIHG AND NOTCH CUTTING MACHINE

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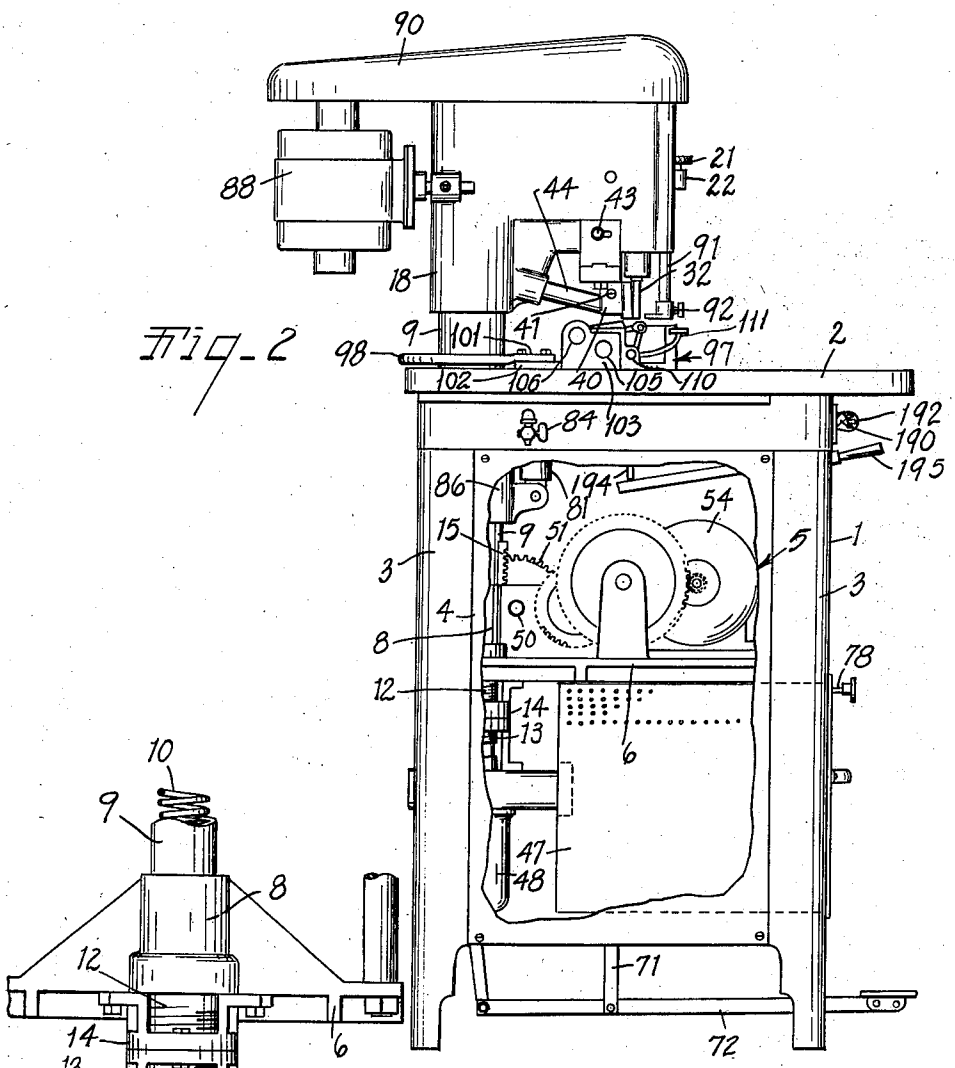


Fig. 2

Fig. 4

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ROTARY PUNCHIHG AND NOTCH CUTTING MACHINE

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Fig. 3

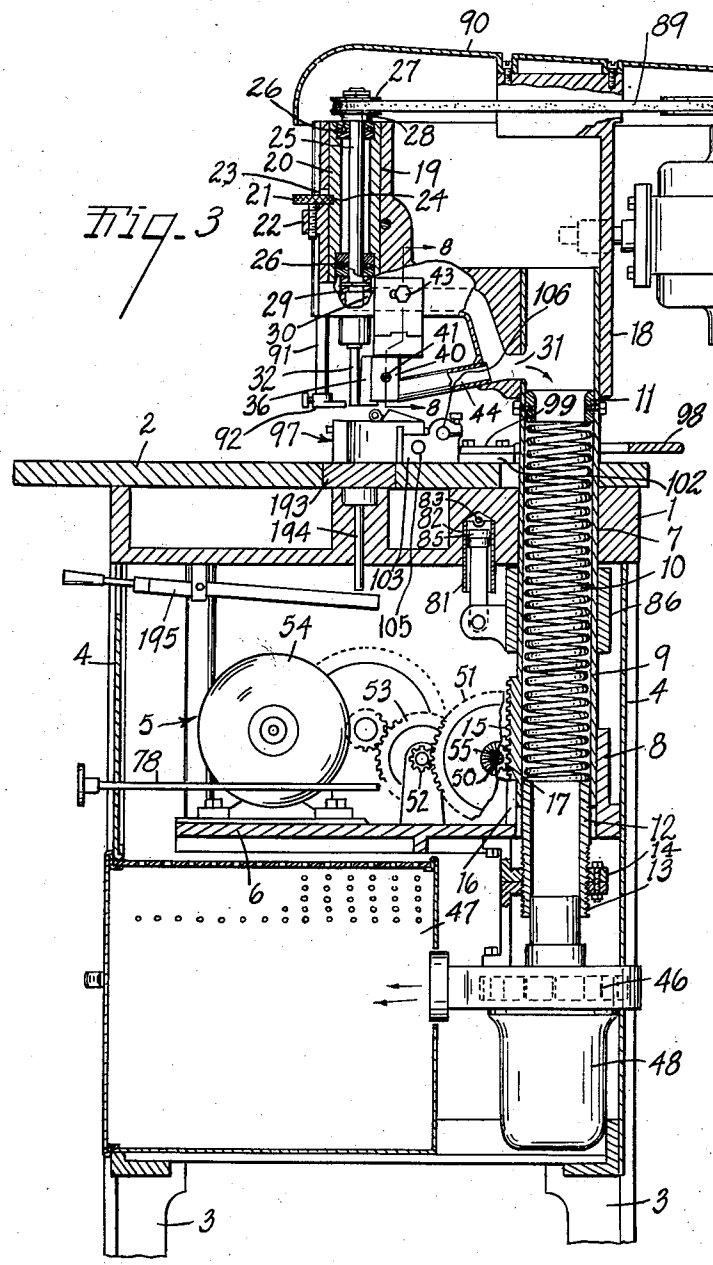
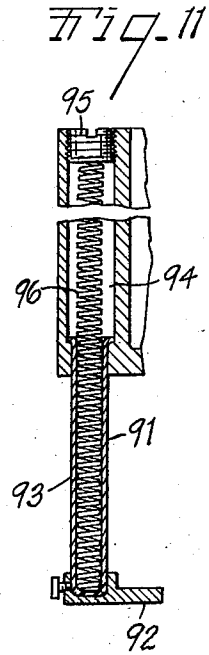


Fig. 11



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ROTARY PUNCHIHG AND NOTCH CUTTING MACHINE

Filed July 14, 1938 4 Sheets-Sheet 4

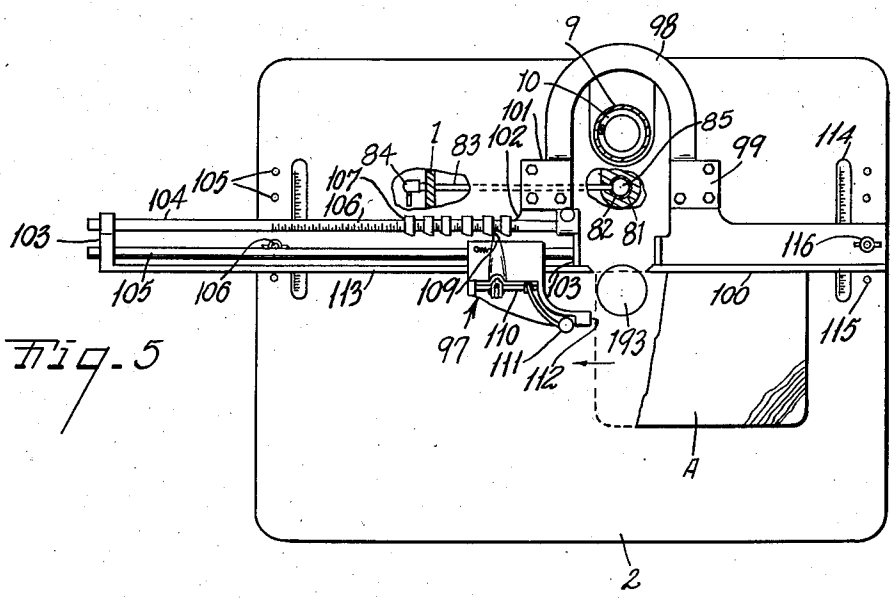


Fig. 5

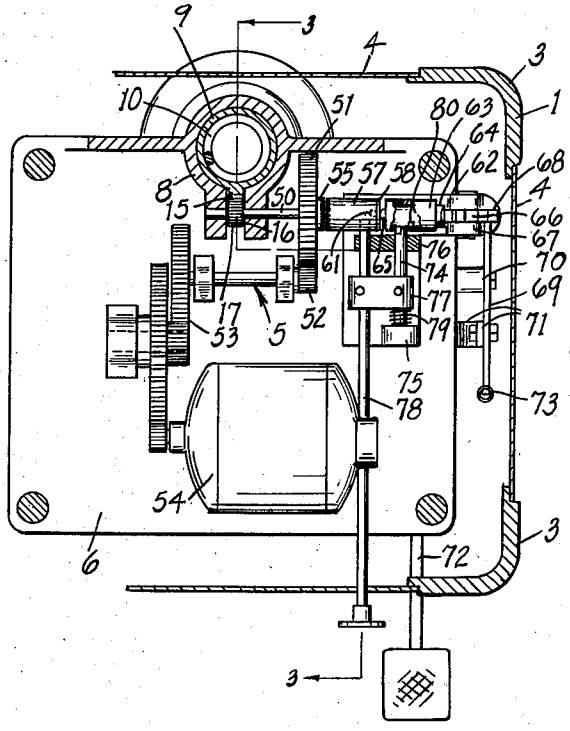


Fig. 6

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Patented July 25, 1939 2,167,279

UNITED STATES PATENT OFFICE

2,167,279

ROTARY PUNCHING AND NOTCH CUTTING MACHINE

Fred L. Manny, Benton Harbor, Mich., assignor to F. P. Rosback Company, Benton Harbor, Mich.

Application July 14, 1938, Serial No. 219,113

33 Claims. (Cl. 164—87)

This invention relates to improvements in rotary punching and notch cutting machines.

The main objects of my invention are:

First, to provide a novel machine for forming slotted holes in ledger sheets, notebook sheets and the like.

Second, to provide a machine of the type described having boring and cutting tools acting simultaneously on the edge of a stack of sheets to be provided with slotted holes.

Third, to provide a boring and cutting machine for a stack of ledger sheets and the like provided with a rotary punching or boring tool and an improved slotting or cutting tool, the tools being associated in a novel relation whereby to form slotted holes in a single stroke or actuation of the machine.

Fourth, to provide a machine characterized by a rotatable boring tool and a slotting cutter and improved means for actuating and retracting the same in unison.

Fifth, to provide a machine adapted to form slotted openings in the side of a stack of sheets and the like in a single operation, the said machine having novel actuating and clutch instrumentalities for performing a single operative stroke, returning to initial position, and coming to rest.

Sixth, to provide a machine of the type described having novel chip or waste removing provisions.

Further objects relating to details and economies of my invention will definitely appear from the description to follow. The invention is defined in the claims.

A structure embodying the features of my invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a view in front elevation of the machine of my invention.

Fig. 2 is a view in side elevation of my machine partially broken away to illustrate the actuating mechanism therefor.

Fig. 3 is a view in vertical section on line 3—3 of Fig. 6, illustrating more clearly details of construction of the machine.

Fig. 4 is an enlarged fragmentary view illustrating a portion of the novel chip removing mechanism of my invention.

Fig. 5 is a top plan view of my machine partially broken away and in section to illustrate certain details of the construction.

Fig. 6 is a fragmentary view in horizontal section illustrating the actuating and clutch instrumentalities of the machine.

Fig. 7 is an enlarged fragmentary view partially broken away and in vertical section, illustrating details of the clutch mechanism.

Fig. 8 is an enlarged fragmentary view in horizontal section on line 8—8 of Figs. 3 and 9.

Fig. 9 is a detail view in section on line 9—9 of Fig. 8, illustrating the manner of attaching the notching cutter constituting one of the tools of my machine, and also illustrating the type of work performed by the machine.

Fig. 10 is a fragmentary view partially broken away and in vertical section illustrating the rotary punching or boring and cutting or notching tools of my machine in operative relation to one another.

Fig. 11 is a fragmentary view in vertical section illustrating the construction of the work stripper mechanism employed on the machine.

The present invention relates to machines of the type employed in forming notched or slotted openings along the edges of sheets, such as ledger sheets, notebook sheets and the like, adapted to receive binder elements. The type of openings referred to is illustrated in Fig. 9, wherein a stack of sheets is designated by the reference character A, the openings B, and the slots connecting the openings with the edge of the sheets C. In hitherto known machines it has been proposed to form the said openings and slots by a plurality of successive operations and in my co-pending application, Serial No. 171,323, filed October 27, 1937, I describe and claim a machine which is well adapted for that purpose. Although particularly designed for the notching and aperturing of paper sheets for ledgers, notebooks, and the like, it will be apparent to those skilled in the art that the machine of my invention is well adapted for forming notched openings in the edges of other types of laminated or stacked sheets, such as, for example, thin, soft metal sheets, or wood veneers, or other analogous sheet material wherein it is desired to provide notched edges for an ornamental or functional purpose.

The advantages of simultaneously performing a boring or rotary punching operation whereby the openings B are formed and a notching or slotting operation whereby slots C are formed are obvious, however this has not heretofore been accomplished with commercial success in my own experience, due mainly to the difficulty of designing a slotting cutter adapted to be associated in suitable relation to the boring tool to operate without excessive power requirement or without deflection from the desired relation

under pressure or in a manner to permit proper removal of chips. The present machine eliminates all of these difficulties.

Referring to the drawings, the reference numeral 1 in general indicates the machine of my invention, which includes a work table 2 supported by suitable legs 3 or other standards. In the actual machine constructed in accordance with my invention, I enclose the space beneath the table and within the area between the legs by a suitable sheet metal shield or skirt 4 providing room to accommodate the actuating and clutch instrumentality, which is designated generally 5 and which rests on a sub-table or ledge 6 suitably supported in the space thus provided (see Fig. 3). The table 2 is provided with a vertically disposed cylindrical guide 7 and the subtable 6 has a cylindrical guide 8 in vertical alinement with guide 7 to slidingly receive a vertically reciprocable tubular actuator member 9. This member is hollow throughout its length to receive a strong coil return spring 10 whose ends abut respectively a thrust ring 11 secured interiorly of tubular member 9 adjacent the upper end thereof and a fixed abutment or sleeve 12 telescoping within tubular member 9 at the lower end thereof. The said abutment sleeve 12 is preferably made axially adjustable relative to the frame of the machine in any suitable manner, but, reference being had to Figs. 3 and 4, I indicate a readily feasible manner of securing this adjustable mounting by screw threading sleeve 12 on the lower end thereof, as indicated by the reference numeral 13, and threadedly engaging the same with a bracket 14 supported on the frame or sub-table in any suitable manner, whereby the said abutment sleeve may be lowered and elevated by simply rotating the same. By the foregoing provisions, it will be appreciated that the thrust effort which coil spring 10 exerts on ring 11 may be readily adjusted.

One side of the tubular drive member 9 is provided with a suitable actuating rack 15 which extends through a longitudinal opening 16 provided in guide 8 to accommodate the same, the said opening also accommodating a drive pinion 17 suitably journaled in the guide, as illustrated in Fig. 6. This pinion serves to shift member 9 downwardly on an operative or boring and cutting stroke against the force of spring 10 in the manner which will be more particularly described, the upward or return motion of the member being effected through the agency of the thrust spring, as will be apparent.

Tubular drive member 9 at its upper end above table 2 carries a housing-like carriage 18 (see Fig. 3) which is secured to the drive member in any suitable manner to partake of its vertical reciprocating movement. Carriage 18 carries the boring and cutting instrumentalities effective to form the slotted openings in the work A and it also carries other instrumentalities which will be more particularly described.

Referring to Fig. 3, it will be seen that the carriage 18 is cored out at 19 to provide a cylindrical chamber receiving a cylindrical boring tool carrying sleeve 20 for vertical adjustment in the chamber. This adjustment is effected by means of a knurled screw 21 threadedly carried on an ear 22 integral with carriage 18 and extending through an aperture 23 in the carriage into a suitable recess 24 formed in sleeve 20, whereby rotation of the screw effects a slight vertical adjustment of the sleeve. Suitable means not shown in detail are provided to lock the sleeve in adjusted position. It is thus possible to adjust a boring tool carried by the sleeve vertically so as to space the same properly from table 2 for best operation.

The sleeve 20 rotatably journals a boring tool spindle 25 by means of end thrust bearings designated 26. At one end, spindle 25 is secured to a pulley 27 above the sleeve which is maintained in spaced relation to the uppermost bearing 26 by a boss 28 formed on the pulley. At its other end, spindle 25 extends through the lowermost bearing and is pinned to a hollow boring tool chuck 29.

This boring tool chuck has a side opening 30 formed therein adapted to register once each rotation of the same with one arm of a suction passage 31 formed in carriage 18, whereby to effect removal of chips passing upwardly through the hollow rotatable boring tool 32 which is locked in chuck 29. In Fig. 10, I illustrate suitable means for securing the boring tool 24 to the chuck, the boring tool 24 being held from rotation in the chuck by engagement of a recess or notch at the upper end thereof with an inwardly projecting lug or pin 33 carried by the chuck and being restrained from axial movement by means of a suitable pivoted latch or detent 34 on the chuck engaging an annular recess 35 in the tool.

A cutting or slotting tool, indicated by the reference numeral 36, is disposed adjacent boring tool 32 (see Fig. 10). This cutting tool is formed of hardened sheet metal bent in suitable form or outline to cut the desired shape of slot C. The sharpened lowermost edge 37 of tool 36 is disposed in the same horizontal plane with the cutting edge 38 of boring tool 32 and the boring tool and forward cutting edge or nose 39 of cutter 36 are almost though not quite in contact, it being preferable to allow a very small clearance, say of approximately .001 inch, between the said rotary and fixed tools. From its point of adjacency to the boring tool cutting edge, 38, the forward edge or nose 39 of notching tool 36 is inclined rearwardly and upwardly, as illustrated in Fig. 10, whereby to effect a clean slicing action through the stack of sheets.

The blade of tool 36 is secured to a cutter head 40 by means of a suitable bolt 41 (see Fig. 9) with a spacer piece 42 disposed between the sides of the blade to rigidify the same. Cutter head 40 is supported on carriage 18 for adjustment laterally relative to the boring tool 32 by means of the slot and bolt arrangement 43 illustrated in Fig. 3, whereby the clearance of the two tools may be altered as desired. As stated, I prefer to employ a small clearance between tools 32 and 36 since this permits virtual severance of the paper between the notch C and opening B, the severance being rendered complete by tearing of the negligible paper fragment remaining between tools 32 and 36 under the influence of the chip removing suction to be described. In this manner, friction caused by contact of the rotatable and angularly fixed tool is avoided.

In order to remove chips excised by cutter 36, I provide a hollow tube 44 connecting an opening 45 in cutter head 40 and the vacuum passage 31. This passage communicates with the interior of hollow actuator member 9 as illustrated in Fig. 3, whereby chips removed by cutters 32 and 36 will be drawn rearwardly and downwardly when a state of suction or partial vacuum is created within the said hollow member and passage.

To create such suction, I employ a suitable blower 46 whose intake is connected with tubular member 9 as illustrated in Figs. 3 and 4 and which discharges into a foraminated waste receiving box 47 carried beneath sub-table 6. Blower 46 is driven by a suitable motor in a motor housing 48 supported on bracket 14, the lead wires for the motor being designated by the reference numeral 49 in Fig. 4.

The instrumentalities for reciprocating tubular actuator members 9 and the boring and cutting instrumentalities carried thereby will now be described. Referring to Figs. 3, 6, and 7, the shaft 50 whereon the pinion 17 is mounted has a large gear 51 loosely mounted for free rotation thereon. This gear is in mesh with a pinion 52 driven from a train of gears, generally designated 53, actuated by a motor 54 on sub-table 6, the said motor, gears, and pinions constituting a part of the actuating and clutching instrumentality 5 referred to above. Gear 51 is connected to one toothed member 55 of a clutch 56, the other tooth member 57 of which is splined on the end of shaft 50. As illustrated in Fig. 7, the clutch member 57 is in the form of an elongated sleeve and has the end thereof closed by a suitable disk or plate 58. The extreme end of shaft 50 is drilled axially to provide a space 59 wherein I dispose a coil compression spring 60 normally tending to separate the clutch members 57 and 55 and to maintain them in the separated relation illustrated in Figs. 6 and 7. Clutch member 57 also carries a radially projecting pin 61 for a purpose to be described.

The sub-table 6 is provided wtih a bracket 62 which is drilled coaxially with shaft 50 to provide a horizontal cylindrical guide 63 for an axially sliding, angularly restrained tappet 64. This tappet has on its forward end an anti-friction ball 65 engaging thrust disk 58 of the clutch member 57, the said tappet when actuated serving to urge the clutch members into engagement in opposition to the force of coil spring 60. For the purpose of actuating tappet 64, I provide a ratchet member 66 journaled in arms 67 of bracket 62. This ratchet is engaged by a vertically acting pawl 68 on an arm 69 pivoted to a suitable part of the frame at 70 and oscillated by a link 71 actuated by a treadle 72, a coil spring 73 being utilized to return the pawl upon release of the treadle. These parts are illustrated somewhat conventionally in Figs. 2 and 6 and it is felt that their construction and arrangement will be understood without further description or illustration.

From the foregoing, it is apparent that when ratchet 66 is indexed by pawl 68 one step in the direction illustrated by the arrow in Fig. 7, the tappet 64 will be shifted to the right, engaging clutch members 55 and 57 and thereby drivingly connecting pinion 17 with rotating gear 51. My invention contemplates means for holding the clutch members in engaging position during the resultant downward stroke of actuator member 9 and the tools carried thereby. Referring to Figs. 6 and 7, this means consists of a slidable latch member or pin 74 slidably mounted in brackets 75, 76 carried on sub-table 6, which latch member or pin is coupled by means of a cross head 77 for axial sliding movement with rod 78. A coil spring 79 surrounding pin 74 between cross head 77 and bracket 75 urges the said pin transversely of and into engagement with the side of tappet 64, the bracket 62 which guides the tappet being provided with a transverse opening for this purpose. Tappet 64 has a recess 80 formed in the side thereof and the end of pin 74 is shaped so as to enter recess 80 when the latter is axially alined with the pin. In this manner, once the tappet 64 is advanced to the right as illustrated in Fig. 7, into alinement with pin 74, the latter drops into engagement with the recess under the influence of spring 79, thus latching the tappet in operative position and holding clutch members 55, 57 in engagement. This results in transmission of power from the continually rotating gear 51 to shaft 50 through the clutch 56 and the resultant actuation of member 9 on a boring and cutting stroke by means of rack 15 and pinion 17 meshing therewith. Thus, the tools 32, 36 pass into and through the stack of sheets or work A forming the slotted openings B, C in the edge thereof.

When the operative stroke has been completed, it is of course necessary to declutch gear 51 from shaft 50 and thereby disconnect pinion 17 from its source of power. This is effected automatically by the engagement of radial pin 61 on the clutch member 57 with rod 78 to shift the same rearwardly and thus withdraw latch member 74 from recess 80 in the tappet. The clutch member 57 and tappet 64 are urged by coil spring 60 rearwardly or to the left as viewed in Fig. 7 to disconnect clutch 56. It will be appreciated that upon engagement of the clutch at the beginning of the stroke the radial pin 61 is brought into alinement with rod 78 to position the parts for displacement of the rod and disengagement of the clutch at the end of an operative or down stroke. In practice, radial pin 61, rod 78, transverse pin 74 and recess 80 are designed and located so as to permit pin 61 to clear rod 78 at the beginning of the rotation of clutch member 57 and before the latch members take effect.

When the clutch is disconnected as described, the actuator member 9 and tools actuated thereby are returned vertically by means of the strong coil spring 10 enclosed in the said drive member. Obviously, were no provisions made to brake the return of the member under the influence of the spring, it would be attended by an excessive impact. To overcome this difficulty, I provide the pneumatic brake or dashpot type of shock absorber illustrated in Figs. 2, 3, and 5 and designated by the reference numeral 81. This brake consists of the dashpot cylinder 82 suitably mounted in the work supporting table, one end of which communicates with the atmosphere through a passage or tube 83 and adjustable regulating valve 84 (see Figs. 3 and 5). A plunger 85 works in cylinder 82 and is pivotally connected to a collar 86 rigidly carried on actuator member 9. Accordingly, the upward or return movement of the drive member is a controlled one due to the pneumatic braking or dashpot action of the device 81 which entirely eliminates shocks and resultant likelihood of breakage.

In order to rotate boring tool spindle 25, I utilize the pulley 27 referred to above and a further driving pulley 87 on the vertically disposed shaft of a suitable motor 88. This motor is supported on carriage 18 in any desired manner. The drive belt 89 is trained around pulleys 27, 87 to effect continuous rotation of boring tool spindle 25. A suitable hood or shield 90 is secured to carriage 18 to enclose and protect the pulleys and belt.

The various actuating motors described above are under the control of switches 190, 191 conveniently mounted on the front of the machine. One of these switches governs the boring tool ro-

tating motor 88 and the actuating motor 54 for plunger rod 9, while the other switch controls the blower drive motor in housing 48. The connections to the motors are conventional and have not been illustrated. If desired, a jeweled warning light 192 may be employed to indicate when the actuating circuits are energized.

My machine also includes an improved type of stripper device for engaging the work and permitting withdrawal of the tools 32, 36 at the end of the boring and slotting stroke. This stripper is illustrated in Figs. 1, 3, and 11 and is designated generally by the reference numeral 91. It consists of a presser foot 92 secured to hollow tubes 93 adapted to telescope within coréd-out recesses 94 on the forward part of carriage 18. The recesses are closed at their upper ends by threaded plugs 95 which serve as abutments for compression springs 96 extending to the lowermost ends of the tubes. Accordingly, upon lowering of carriage 18 during the working stroke, the presser foot 92 engages the work, the coil springs 96 yielding as the tools pass through the work and serving to maintain the presser foot against the work to strip the same from the tools as they are retracted on the return stroke.

Table 2 includes an anvil 193 of wood or other material against which the sharpened edges of tools 32, 36 may impinge without damage, see Fig. 3. This anvil is removable for replacement by means of a knockout plunger 194 shiftable vertically by manipulation of a lever 195 pivoted beneath the table.

The reference numeral 97 indicates in general a work positioning and gauging instrumentality or device which is disposed on table 2 as illustrated in Figs. 2, 3, and 5. The said device is one which allows manual indexing of the work A transversely of the tools 32, 36 and also permits lateral adjustment as desired to permit a number of notched openings to be formed at spaced intervals along the edge of the stack of sheets or to position said openings as desired relative to the edge. The gauge consists of a U-shaped yoke 98 embracing the vertical actuator member 9 and disposed parallel to table 2. One leg of this yoke has bolted thereto at 99 a casting presenting a side edge guide or gauge surface 100 for the stack of sheets A and the other leg has bolted thereto at 101 a suitable cast frame 102 for supporting certain edge and end gauge and indexing instrumentalities to be described.

Frame 102 is generally similar in form to the casting constituting edge guide 100, but it is more elongated, and provided with end members 103 carrying the rods 104, 105, which extend longitudinally of the frame, and of which the former is provided with a suitable calibration or scale 106 and is adapted to receive and have suitably clamped thereto the indexing stops 107. The latter rod 105 has slidably mounted thereon an indexing carriage 108 provided with a bore disposed radially of rod 104, in which bore a stop engaging finger or pin 109 is slidably mounted. This pin is connected by a suitable small crank or by other eccentric connection to a rockshaft 110 journaled in the carriage and controlled by a finger piece 111 whereby actuation of the finger piece causes the pin 109 to be projected or retracted radially with reference to the calibrated rod 106 to thereby position the pin to either engage or clear the adjustable stops on said rod. The carriage 108 has a laterally projecting end gauge finger 112 thereon and the frame 102 carries a side gauge surface 113 in line with side gauge surface 100, whereby a stack of sheets positioned against gauge finger 112 and the side guides 100, 113 may be successively indexed desired distances lengthwise of the said guides by manipulation of control lever 111 and manually shifting the stack in a manner which will be apparent.

The gauge device is shiftable as a unit in a direction from front to back of the work table 2, the guide elements moving as a unit because of their yoke connector 38. The table is provided with scales 114 coacting with the side guides 100, 113, and the gauge is adapted to be held in desired adjusted position by means of screws extending through the guide member castings and through spaced locating holes 115 in the table, being clamped in adjusted position by wing nuts 116.

The aforesaid gauging device permits quick and accurate positioning of a stack of sheets or other elements to be provided with notched edge apertures and the successive indexing of the same laterally whereby to space the said apertures as desired along the edges of the work. It adds greatly to the ease and expedition with which my machine operates as a whole by supplementing the simultaneously acting rotary punch and slotter operating instrumentalities by a gauge in which little time and effort are wasted in accurately locating the stack following each operation of the said instrumentalities.

In its preferred embodiment, the machine of my invention is characterized essentially by the fact that it permits the boring and cutting of a stack of sheets to be effected in a single reciprocatory working stroke without shifting of tools relative to the work or work relative to the tools, such as is usually necessary in a multiple-stroke operation. This is made possible in large part by the improved hardened sheet metal cutting knife 36. The sheet metal conformed construction thereof permits ready disposition of chips, produces a clean cut without requiring the expenditure of a great amount of power, and may be readily and inexpensively conformed into any desired outline to suit the needs of the particular job being done. A similar knife is described and claimed in my copending application, Serial No. 171,323 referred to above, wherein the same is embodied in a machine for performing slotted apertures by a two-stroke operation, however I desire it to be understood that the said knife has equally important advantages in its embodiment in, and was intended equally for, a one-stroke machine such as I have described.

In addition to the foregoing features of advantage, the present machine is simple in its parts and rapid in action due to the use of spring power to effect the return half of the stroke cycle thereof. The clutch instrumentalities which I have described are simple in nature yet foolproof and unfailing in operation and the provisions for removal of chips excised by the boring and cutting tools have been found to be extremely effective in actual operation.

I have illustrated and described my improvements in an embodiment which is very practical. I have not attempted to illustrate or describe other embodiments or adaptations as it is believed this disclosure will enable those skilled in the art to embody or adapt my improvements as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A boring and cutting machine for stacks of paper sheets and like work, comprising a hollow slotting tool of hardened sheet metal bent to provide a forward nose, rearwardly extending sides, and a sharpened cutting edge, a hollow rotary boring tool having a sharpened edge in horizontal alinement with the cutting edge of said slotting tool, said cutting edges being closely associated for reciprocation in a direction axially of the boring tool, means for mounting said tools for vertical reciprocation together toward and away from the work, means for reciprocating said means comprising a rack on said mounting means, a pinion meshing with said rack, and means for rotating said pinion, single revolution clutch means controlling the rotating means for said pinion, and a spring operatively engaged with said mounting means to return the same to initial position following a boring and cutting stroke, and means for withdrawing chips resulting from the boring and cutting operation through said tools by suction.

2. A boring and cutting machine for stacks of paper sheets and like work, comprising a hollow slotting tool of hardened sheet metal bent to provide a forward nose, rearwardly extending sides, and a sharpened cutting edge, a hollow rotary boring tool having a sharpened edge, said cutting edges being closely associated for reciprocation together toward and away from the work, means for reciprocating said means, and means for withdrawing chips resulting from the boring and cutting operation through said tools by suction.

3. An aperturing and cutting machine for stacks of paper sheets and the like, comprising a slotting tool, a rotary aperturing tool, means for mounting said tools for reciprocation together axially of the aperturing tool, and means for reciprocating said means, comprising a rack on said mounting means and a pinion meshing with said rack, means for rotating said pinion, single revolution clutch means controlling the rotation of said pinion, and spring means operatively engaged with said mounting means to return the same to initial position following an aperturing and slotting stroke.

4. In a machine for forming notched holes in a stack of sheets or the like, a cutting tool comprising a hardened sheet metal member bent to provide a hollow cutting blade, said blade having a sharpened edge for engagement with the stack to cut a notch therein, a rotary punch associated with said cutting tool and having a cutting edge in alinement with the cutting edge of the blade, whereby to form an opening through the stack adjacent the notch, the cutting edges of said rotary punch and blade being positioned closely adjacent one another whereby to substantially sever the material between said notch and opening, said blade extending upwardly and away from said punch to facilitate passage of the blade through the stack, means for positively actuating said punch and blade together through the stack, and spring means for returning the blade and punch to initial position.

5. In a machine for forming notched holes in a stack of sheets or like work, a cutting tool comprising a hardened sheet metal member bent angularly to provide a hollow cutting blade, said blade having a sharpened edge for engagement with the stack to cut a notch therein, and a rotary punch associated with said cutting tool and having a cutting edge to form an opening through the work, the cutting edges of said punch and blade being positioned closely adjacent one another whereby to substantially sever the material between said notch and opening, said blade being disposed at an angle to the axis of said punch to facilitate passage of the blade through the work.

6. In a machine for forming notched holes in a stack of sheets or like work, a cutting tool comprising a hardened sheet metal member bent angularly to provide a hollow cutting blade, said blade having a sharpened edge for engagement with the stack to cut a notch therein, and a rotary punch associated with said cutting tool, said punch and blade being positioned closely adjacent one another whereby to substantially sever the material between said notch and opening.

7. In a machine of the type described, a hollow notching tool comprising a blade of hardened sheet metal bent to angular form and having a sharpened advance cutting edge, a hollow rotary boring tool having a cutting edge disposed closely adjacent to and in the same plane as the cutting edge of the blade, means for reciprocating said tools as a unit relative to and through work to be operated on, and means for creating suction communicating with the interior of said hollow tools to withdraw chips therefrom.

8. In a machine of the type described, a hollow notching tool having a sharpened advance cutting edge, a hollow aperturing tool having a cutting edge disposed closely adjacent to and in the same plane as the cutting edge of the blade, means for reciprocating said tools relative to and through work to be operated on, and means for creating suction communicating with the interior of said hollow tools to withdraw chips therefrom.

9. In a machine for forming notched openings in a stack of sheets and like work, a rotary boring tool, and a slotting tool located closely adjacent said boring tool, said slotting tool comprising a hardened sheet metal blade bent to angular form and having the work engaging edge thereof sharpened, said sharpened edge being substantially coplanar with the cutting edge of the boring tool, and means for reciprocating said tools together relative to the work.

10. In a machine for forming notched openings in a stack of sheets and the like, a boring tool, and a slotting tool located closely adjacent said boring tool, said slotting tool comprising a blade angular in cross section and having the work engaging edge thereof sharpened, said sharpened edge being substantially coplanar with the cutting edge of the boring tool, and means for reciprocating said tools together relative to the work.

11. In a machine for operating on work to form notched openings therein, a rotary boring tool, a slotting or cutting tool comprising a knife of hardened sheet metal bent to angular cross section and having an edge thereof provided with a cutting edge, and means for reciprocating said tools together toward and from the work.

12. In a machine of the type described for forming openings a hollow aperturing tool and a hollow cutting tool, means for reciprocating said tools relative to work to be operated on, said means comprising a hollow actuator member, and means for actuating said actuator member, and means for creating a partial vacuum in said hollow actuator member and at least one of said tools whereby to withdraw from the latter chips incident to the opening forming operation.

13. In a machine of the type described, a hollow rotary boring tool and a hollow cutting tool,

means for mounting said tools in operative relation to one another and for reciprocating the same as a unit relative to work to be operated on, comprising a hollow actuator member, and means for actuating said actuator member, and means for creating a partial vacuum in said hollow actuator member and tools whereby to withdraw from the latter chips incident to the boring and cutting operation.

14. In a machine of the type described, a hollow rotary punch, a hollow slotting tool closely adjacent the punch, means for reciprocating said punch and tool as a unit relative to work to be operated on, and means for creating a partial vacuum within said hollow punch and tool to withdraw chips therefrom.

15. A machine for forming notched apertures in a stack of sheets or like work, comprising a frame, a hollow rotary punch, a hollow slotting tool, means mounting said punch and tool for reciprocation together relative to the frame, means on said mounting means for rotating the punch, means for reciprocating said mounting means comprising a hollow actuator member mounted for reciprocation in said frame, means for positively moving said actuator member to and through the work, resilient means for returning said actuator member to initial position comprising a coil compression spring within said actuator member, and means for engaging the spring with the actuator member and an abutment fixed relative to the frame, means for cushioning the return stroke of the member comprising an air cylinder on the frame having a valved bleeding port, a plunger operating in said cylinder, and means connecting said plunger to the actuator member, and means for creating a partial vacuum within said hollow actuator member and for communicating said partial vacuum with said hollow punch and tool whereby to withdraw from the latter chips incident to the notching and punching operation.

16. A machine for forming notched apertures in a stack of sheets or like work, comprising a frame, a hollow rotary punch, a hollow slotting tool, means mounting said punch and tool for reciprocation together relative to the frame, means on said mounting means for rotating the punch, means for reciprocating said mounting means comprising a hollow actuator member mounted for reciprocation in said frame, means for positively moving said actuator member to and through the work, resilient means for returning said actuator member to initial position, means for cushioning the return stroke of the member, and means for creating a partial vacuum within said hollow actuator member and for communicating said partial vacuum with said hollow punch and tool whereby to withdraw from the latter chips incident to the notching and punching operation.

17. A machine for forming notched apertures in a stack of sheets or like work, comprising a frame, a hollow rotary punch, a hollow slotting tool, means mounting said punch and tool for reciprocation together relative to the frame, means on said mounting means for rotating the punch, means for reciprocating said mounting means comprising a hollow actuator member mounted for reciprocation in said frame, means for reciprocating said actuator member, and means for creating a partial vacuum within said hollow actuator member and for communicating said partial vacuum with said hollow punch and tool whereby to withdraw from the latter chips incident to the notching and punching operation.

18. A machine for forming notched apertures in a stack of sheets or like work, comprising a frame, a hollow aperturing tool, a hollow slotting tool, means mounting said tools for reciprocation together normal to the work, means for reciprocating said mounting means comprising a hollow actuator member mounted for reciprocation in said frame, means for positively moving said actuator member to and through the work, and resilient means for returning said actuator member to initial position comprising a coil compression spring within said actuator member, the spring engaging the actuator member and an abutment fixed relative to the frame, and means for creating a partial vacuum within said hollow actuator member and for communicating said partial vacuum with said hollow tools whereby to withdraw from the latter chips incident to the slotting and aperturing operation.

19. A machine for forming notched apertures in a stack of sheets or like work, comprising a frame, a hollow aperturing tool, a hollow slotting tool, means mounting said tools for reciprocation together normal to the work, means for reciprocating said mounting means comprising a hollow actuator member mounted for reciprocation in said frame, means for positively moving said actuator member to and through the work, and resilient means for returning said actuator member to initial position comprising a coil compression spring within said actuator member, the spring engaging the actuator member and an abutment fixed relative to the frame.

20. In a machine for forming notched apertures in a stack of sheets or like work, an aperturing tool, a slotting tool, means for actuating said tools as a unit on an operating stroke to and through the work, comprising an actuator member for said tools, a rack on said actuator member, a pinion meshing with the rack, and means for driving the pinion on the operating stroke of the tools and for thereafter releasing the same, spring means for returning the actuator member to initial position upon release of the pinion, and pneumatic brake means to cushion the actuator member at the end of the return stroke thereof.

21. In a machine for forming notched apertures in a stack of sheets or like work, a frame, a tool, means for positively actuating said tool on an operating stroke to and through work supported on the frame, including a reciprocating actuator member, spring means for returning the actuator member to initial position upon completion of the operating stroke, and means to cushion the actuator member at the end of the return stroke thereof, comprising a cylinder on the frame having a valved exit port and a plunger carried by the actuator member slidable in said cylinder.

22. In a machine of the class described, the combination with a work table, of a tool carriage, a rotatable boring tool on said carriage, a slotting cutter mounted on said carriage radially of said boring tool with the tip of its cutting edge closely adjacent but spaced from said boring tool so that the periphery of the boring tool is not in rotating contact with the cutter, and means for actuating said carriage including a manually engaged and automatically disengaging clutch.

23. In a machine of the class described, the combination with a work table, of a tool carriage, a hollow rotatable punch on said carriage having

a circular inwardly beveled cutting edge, and a slotting cutter having spaced cutting edges joined at the tip of the cutter mounted on said carriage radially of said drill and with its cutting edges in the plane of the cutting edge of the punch and its tip closely adjacent to but spaced from said punch so that the periphery of the punch is not in rotating contact with the tip of the cutter.

24. In a machine of the class described, the combination of a hollow rotatable punch, a slotting cutter having spaced cutting edges disposed radially of said punch and with its tip closely adjacent to but spaced from said punch so that the periphery of the punch is not in rotating contact with the cutter, and means for simultaneously feeding said punch and cutter to the work.

25. In a machine of the class described, the combination with a work table, of a tool carriage, a hollow rotatable punch on said carriage having a circular inwardly beveled cutting edge, and a slotting cutter on said carriage disposed radially of said punch with the tip of its cutting edge spaced from said punch a distance of the order of .001 inch.

26. In a machine of the class described, the combination with a work table and a carriage associated for relative reciprocating movement, of a tubular boring tool on said carriage and a slotting cutter mounted on said carriage in radial relation to said boring tool with its tip closely adjacent to the boring tool and having a cutting edge in approximately the plane of the cutting edge of the boring tool.

27. In a machine for forming notched apertures in a stack of paper sheets, the combination with a work table and a carriage associated for relative reciprocating movement, of a rotary tubular boring tool on said carriage and adapted to form an aperture through the stack, and a slotting cutter adapted to form a notch in the edge of the stack and mounted on said carriage in radial relation to said boring tool with its tip spaced from the boring tool a distance sufficiently small to permit ready tearing of the material of the stack between the aperture and notch.

28. In a machine of the class described, the combination of a rotary tubular boring tool adapted to form an aperture through the stack, a slotting cutter adapted to form a notch in the stack and mounted in radial relation to said boring tool and with its tip spaced from the boring tool a distance sufficiently small to permit ready tearing of the material of the stack between the aperture and notch, and means for simultaneously actuating said boring tool and cutter.

29. In a machine for forming notched apertures in a stack of sheets and including a work support, a rotatable aperturing tool and a notching tool and means for simultaneously reciprocating said tools through said stack, said tools being located sufficiently close to one another to permit ready tearing of the material of the stack between the aperture and notch formed thereby, means for adjustably positioning the stack beneath said tools and for enabling the stack to be successively indexed laterally relative to the tools following the operations thereof, whereby to space a plurality of said notched apertures accurately along the edge of the stack, comprising a pair of alined edge guides on said work support adapted to engage and position said stack, a yoke embracing the path of reciprocation of said tools and having the arms thereof secured to said edge guides to hold the same in spaced alined relation on opposite sides of the path of travel of the tools, one of said edge guides having an elongated rod disposed thereon and extending parallel to said guides, an indexing carriage slidably mounted on said rod for movement parallel to said edge guides, said carriage having an end gauge member thereon adapted to engage and position the end of the stack, a further elongated rod on said one of said guides, said last named rod being calibrated and having a plurality of stops adjustably secured thereto, said carriage having a pin slidably mounted thereon and projectable and retractable radially of said last named rod for engagement and disengagement with said stops in the adjusted position thereof, means for actuating said pin radially to engage and disengage the same with said stops, said carriage and stack being shiftable laterally when the pin is disengaged, and means for adjusting said guides at right angles to the lateral path of movement of said carriage.

30. In a machine for forming notched apertures in a stack of sheets and including a work support, a rotatable aperturing tool and a notching tool and means for simultaneously reciprocating said tools through said stack, said tools being located sufficiently close to one another to permit ready tearing of the material of the stack between the aperture and notch formed thereby, means for adjustably positioning the stack beneath said tools and for enabling the stack to be successively indexed laterally relative to the tools following the operations thereof, whereby to space a plurality of said notched apertures accurately along the edge of the stack, comprising a pair of alined edge guides on said work support adapted to engage and position said stack, a yoke embracing the path of reciprocation of said tools and having the arms thereof secured to said edge guides to hold the same in spaced alined relation on opposite sides of the path of travel of the tools, one of said edge guides having an indexing carriage slidably mounted thereon for movement parallel to said edge guides, said carriage having an end gauge member thereon adapted to engage and position the end of the stack, an elongated rod on said one of said guides having a plurality of stops adjustably secured thereto, said carriage having an element thereon projectable and retractable radially of said rod for engagement and disengagement with said stops in the adjusted position thereof, means for actuating said element to engage and disengage the same with said stops, said carriage and stack being shiftable laterally when the element is disengaged, and means for adjusting said guides at right angles to the lateral path of movement of said carriage.

31. In a machine for forming notched apertures in a stack of sheets and including a work support, an operating tool, and a notching tool and means for reciprocating said tools through said stack, means for positioning the stack on said work support relative to said tools and for enabling the stack to be successively indexed laterally relative to the tools whereby to space said notched apertures along the edge of the stack, comprising a gauge frame including a pair of edge engaging guides for the stack, and means secured to said edge guides and holding the same in spaced relation to one another on opposite sides of the path of travel of the tools, one of said edge guides having an elongated rod thereon and an indexing carriage slidably mounted on said rod for movement parallel to said edge

guides, said carriage having an end gauge member thereon adapted to engage and position the stack, a further elongated rod on said one of said guides, said last named rod being calibrated and having a plurality of stops adjustably secured thereto, said carriage having a latching element mounted thereon and projectable and retractable radially of said last named rod for engagement and disengagement with said stops in the adjusted position thereof, means for actuating said element radially to engage and disengage the same with said stops, said carriage being shiftable laterally relative to the tools when the element is disengaged, and means for adjusting said gauge frame at right angles to the lateral path of movement of said carriage.

32. In a machine for forming notched apertures in a stack of sheets and including a work support, an aperturing tool, and a notching tool and means for reciprocating said tools through said stack, means for positioning the stack on said work support relative to said tools and for enabling the stack to be successively indexed laterally relative to the tools whereby to space said notched apertures along the edge of the stack, comprising a gauge frame including a pair of edge engaging guides for the stack, and means secured to said edge guides and holding the same in spaced relation to one another on opposite sides of the path of travel of the tools, one of said edge guides having an indexing carriage mounted thereon for movement parallel to said edge guides, said carriage having an end gauge member thereon adapted to engage and position the stack, an elongated rod on said one of said guides, said rod being calibrated and having a plurality of stops adjustably secured thereto, said carriage having a latching element mounted thereon and projectable and retractable for engagement and disengagement with said stops in the adjusted position thereof, means for actuating said element to engage and disengage the same with said stops, said carriage being shiftable laterally relative to the tools when the element is disengaged, and means for adjusting said gauge frame at right angles to the lateral path of movement of said carriage.

33. In a machine of the type described including a work support, a cutting tool, and means for reciprocating said tool through work supported by said support, means for positioning the work on said work support relative to said tool and for enabling the work to be successively indexed laterally relative to the tool, comprising a gauge frame including a pair of edge engaging guides for the work and means secured to said edge guides and holding the same in spaced relation to one another on opposite sides of the path of travel of the tool, one of said edge guides having an elongated rod thereon and an indexing carriage slidably mounted on said rod for movement parallel to said edge guides, said carriage having an end gauge member thereon adapted to engage and position the work, a further elongated rod on said one of said guides, said last named rod being calibrated and having a plurality of stops adjustably secured thereto, said carriage having a latching element mounted thereon and projectable and retractable radially of said last named rod for engagement and disengagement with said stops in the adjusted position thereof, means for actuating said element radially to engage and disengage the same with said stops, said carriage being shiftable laterally relative to the tool when the element is disengaged, and means for adjusting said gauge frame at right angles to the lateral path of movement of said carriage.

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